IADIS MULTI CONFERENCE ON COMPUTER SCIENCE AND INFORMATION SYSTEMS

Prague, Czech Republic
22-26 July, 2013

Proceedings of the
IADIS International conference
e-Learning 2013

EDITED BY
Miguel Baptista Nunes
and Maggie McPherson

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INTERNATIONAL CONFERENCE

E-LEARNING 2013

part of the

MULTI CONFERENCE ON COMPUTER SCIENCE AND

INFORMATION SYSTEMS 2013

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE

E-LEARNING 2013

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FOREWORD

These proceedings contain the papers of the International Conference e-Learning 2013, which was organised by the International Association for Development of the Information Society and co-organised by The University of Economics in Prague (VŠE), Czech Republic, 23 – 26 July, 2013. This conference is part of the Multi Conference on Computer Science and Information Systems, 22 - 26 July 2013, which had a total of 948 submissions.

The e-Learning 2013 conference aims to address the main issues of concern within e-Learning. This conference covers both technical as well as the non-technical aspects of e-Learning.

The conference accepts submissions in the following seven main areas: Organisational Strategy and Management Issues; Technological Issues; e-Learning Curriculum Development Issues; Instructional Design Issues; e-Learning Delivery Issues; e-Learning Research Methods and Approaches; e-Skills and Information Literacy for Learning.

The above referred main submission areas are detailed:

→ Organisational Strategy and Management Issues

- Higher and Further Education
- Primary and Secondary Education
- Workplace Learning
- Vocational Training
- Home Schooling
- Distance Learning
- Blended Learning
- Change Management
- Educational Management
- Continuous Professional Development (CPD) for Educational and Training Staff
- Return on e-Learning Investments (ROI)

→ Technological Issues

- Learning Management Systems (LMS)
- Managed Learning Environments (MLEs)
- Virtual Learning Environments (VLEs)
- Computer-Mediated Communication (CMC) Tools
- Social Support Software
- Architecture of Educational Information Systems Infrastructure
- Security and Data Protection
- Learning Objects
- XML Schemas and the Semantic Web
- Web 2.0 Applications

→ e-Learning Curriculum Development Issues
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- Innovations in e-Assessment
- e-Moderating
- e-Tutoring
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- Participation and Motivation in e-Learning

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- Design Research
- Course and Programme Evaluations
- Systematic Literature Reviews

- Historical Analysis
- Case Studies
- Meta-analysis of Case Studies
- Effectiveness and Impact Studies
- Evaluation of e-Learning Technologies
- Evaluation of Student and Tutor Satisfaction
- Learning and cognitive styles
- Ethical Issues in e-learning

→ e-Skills and Information Literacy for Learning
- Teaching information literacy
- Electronic library and information search skills
- ICT skills education
  - in schools and colleges
  - for business, industry and the public sector
  - in adult, community, home and prison education
  - informal methods (peer groups, family)
- Education for computer-mediated communication skills
  - Netiquette
  - Online safety for children and vulnerable users
  - Cybercrime awareness and personal prevention
- Student production of online media
  - Web design
  - Digital storytelling
  - Web 2.0 tools
  - etc.
- Digital media studies

The e-Learning 2013 conference received 231 submissions from more than 36 countries. Each submission has been anonymously reviewed by an average of four independent reviewers, to ensure that accepted submissions were of a high standard. Consequently only 36 full papers were approved which means an acceptance rate of 16 %. A few more papers were accepted as short papers, reflection papers and posters. An extended version of the best papers will be selected for publishing as extended versions in the Interactive Technology and Smart Education (ITSE) journal (ISSN:1741-5659) and also in the IADIS International Journal on WWW/Internet (ISSN: 1645-7641). Other outlets may also receive extended versions of the best papers, including journals from Inderscience

Besides the presentation of full papers, short papers, reflection papers and posters, the conference also included two keynote presentations from internationally distinguished researchers. We would therefore like to express our gratitude to Thomas C. Reeves, Professor Emeritus of Learning, Design, and Technology, College of Education, The University of Georgia, USA, and also to Doc. Ing Jan Lojda, President of the Czech Association of Distance Teaching Universities, Czech Republic, for accepting our invitation as keynote speakers. Also a special thanks to Peter L. Stanchev, Kettering University, USA and Institute of Mathematics and Computer Science, Bulgarian Academy of Sciences, Bulgaria, for presenting a tutorial.

A successful conference requires the effort of many individuals. We would like to thank the members of the Program Committee for their hard work in reviewing and selecting the papers that appear in this book. We are especially grateful to the authors who submitted their papers to this conference and to the presenters who provided the substance of the meeting. We wish to thank all members of our organizing committee.

Last but not the least, we hope that everybody will have a good time in Prague, and we invite all participants for the next edition that will be held in Lisbon, Portugal.

Miguel Baptista Nunes, University of Sheffield, United Kingdom
Maggie McPherson, University of Leeds, United Kingdom
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Prague, Czech Republic
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Yannis Psaromiligkos, Technological Education Institute Of Piraeus, Greece
Zinayida Petrushyna, Rwth Aachen, Germany

KEYNOTE LECTURES

THOUGHTS ON THE QUALITY OF LEARNING IN MOOCS

Thomas C. Reeves, Ph.D.
Professor Emeritus of Learning, Design, and Technology
College of Education
The University of Georgia

ABSTRACT

Massive Open Online Courses (MOOCs) and other forms of open education are viewed as positive disruptive innovations by some and as threats to traditional education by others. The discord over MOOCs is especially vociferous in the higher education sector. This paper examines the evidence for and against MOOCs, especially with respect to the quality of the learning accomplished by participants. The paper also discusses inconsistencies in assessment in MOOCs, and suggests appropriate assessment strategies based on more authentic approaches. At the conclusion of this paper, recommendations are made for advancing the efficacy and impact of MOOCs through educational design research.

SOCIAL NETWORKS AS THE SUPPORT OF THE E-LEARNING

Jan Lojda, associate Prof., MSc. PhD. MBA
vicerector
College of Banking
Czech Republic

ABSTRACT

The paper deals with the new and actual approaches in E-learning. It seems, that the period of sophisticated Learning Management System (LMS) is over and the potential customers = e-students prefer new environment for their learning activities. Interactivity and communication tools are considered as the crucial point how to make the individual e-study more open and users friendly. Sharing learning experience, external study materials and study problems facilitates the study processes and is helping to manage the stress in the learning of lonely student.

Keywords: social networks, independent study, Learning Management Systems, learning and teaching processes, e-learning environment.

CONFERENCE TUTORIAL

CONVERTING A REGULAR LEARNING COURSE INTO DISTANCE COURSE

By Peter L. Stanchev,
Kettering University, USA and Institute of Mathematics and Computer Science,
Bulgarian Academy of Sciences, Bulgaria

ABSTRACT

The beginnings of distance education date back over one hundred years ago to the age of correspondence education when Frederick Turner ran the correspondence history program at the University of Wisconsin. Resent research clearly shows that students who learn at a distance do not learn any better or any worse than the traditional students.

Web 2.0 and social software tools have tremendous potential to remove the barriers of distance education. The social dimension of Web 2.0 tools has already begun to change the traditional paradigm of distance education. The challenges that social software addresses (meeting, building community, providing mentoring and personal learning assistance, working collaboratively on projects or problems, reducing communication errors, and supporting complex group functions) have application to educational use.

In the tutorial, we identify the milestones of techniques that were developed to meet the needs of a new type of learning that beneficially exploits the domain of distance-learning courses. A methodology for converting a regular course into a distance course is presented. For the conversion process we use the ADDIE technology. The ADDIE (Analysis, Design, Development, Implement, and Evaluate) model is the generic process traditionally used by instructional designers and training developers. The five phases represent a dynamic and flexible guideline for building effective training and performance support tools. Topics such as: develop instructional strategy, develop and select instructional materials; design and conduct formative evaluation, revise instruction; design and conduct summative evaluations are also presented. Some of the education theories such as: theories of independence and autonomy, theories of industrialization of teaching, theories of interaction and communication are discussed. The conversion process, the technique issues, requirements and conversion steps are outlined. Different distance learning technologies are given.

The conversion of the regular course “Web technology” into distance course is presented. “Web technology” is a regular course that was converted into a distances course, which we designed and implement in the frame of the “Master of Science in Information Technology program” in the Kettering University. The course is based on video, textbooks, “Blackboard” system based information and e-mail communications. The course is accompanied by a list of books, which are required to be used by the learner to prepare for each session as well as a list of recommended books and papers, which discuss various issues and elaborate on the topics.

As is the case in writing a textbook, the development of a good distance education course is a long-term process of trials and errors.

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Keynote Papers

THOUGHTS ON THE QUALITY OF LEARNING IN MOOCS

Thomas C. Reeves, Ph.D.
The University of Georgia, 325C Aderhold Hall, Athens, GA 30602 USA

ABSTRACT

Massive Open Online Courses (MOOCs) and other forms of open education are viewed as positive disruptive innovations by some and as threats to traditional education by others. The discord over MOOCs is especially vociferous in the higher education sector. This paper examines the evidence for and against MOOCs, especially with respect to the quality of the learning accomplished by participants. The paper also discusses inconsistencies in assessment in MOOCs, and suggests appropriate assessment strategies based on more authentic approaches. At the conclusion of this paper, recommendations are made for advancing the efficacy and impact of MOOCs through educational design research.

KEYWORDS

MOOC, Quality, Assessment, Accreditation, Educational Design Research.

1. INTRODUCTION

> *Quality tends to fan out like waves. The Quality job he didn't think anyone was going to see is seen, and the person who sees it feels a little better because of it, and is likely to pass that feeling on to others, and in that way the Quality tends to keep on going.* – Pirsig (1974), p. 357

Since late 2011, MOOCs (Massive Open Online Courses) have been the subject of global attention among educators and the public at large as well as the target of large financial and intellectual property investments by some of the most prestigious institutions of higher education around the world (Daniel, 2012). This brief paper is intended to address the quality of MOOCs, especially with respect to the learning accomplished by those who "enroll" in them.

The concept of a MOOC first emerged from Canada in 2008 when George Siemens and Stephen Downes offered a free online course focused on "Connectivism and Connective Knowledge" to a few fee-paying students at the University of Manitoba and more than 2,000 interested learners from around the world who "enrolled" for free. The MOOCs offered by Siemens and Downes and others have been referred to as cMOOCs to reflect their connectivist and constructivist pedagogical origins whereas the MOOCs offered by people and entities associated with certain elite U.S. universities (such as Stanford, MIT, and Harvard) have been referred to as xMOOCs to reflect what some see as their roots in behaviorist or "transmissionist" (teaching by telling) pedagogy and/or their stated goals of making profits (Siemens, 2012).

Sources of information related to MOOCs have expanded rapidly over the past two years, encompassing blogs (such as http://www.downes.ca/news/index.html and http://www.elearnspace.org/blog/), press reports, and a few academic journals. The *Chronicle of Higher Education*, the weekly newspaper of record for higher education in the U.S., published a special Online Learning supplement focused on MOOCs in October 2012. In May 2013, the *New Yorker* magazine published a lengthy examination of MOOCs titled "Laptop U: Has the Future of College Moved Online?" (Heller, 2013). In addition, several refereed journals have issued or will soon publish special issues focused on MOOCs (cf. *Research and Practice in Assessment*, *Journal of Online Learning and Teaching* (JOLT) and *Distance Education*).

Three major MOOC providers emerged in 2012:

- Coursera (https://www.coursera.org/) is a for-profit venture founded by Andrew Ng and Daphne Koller, two computer science professors from Stanford University.
- edX (https://www.edx.org/) was established by the Massachusetts Institute of Technology and Harvard University as a non-profit venture. The University of California-Berkeley, the University of Texas System, and other highly rated universities are also involved in this MOOC collaboration.
- Udacity (http://www.udacity.com/) was founded as a for-profit corporation by Sebastian Thrun, David Stavens, and Mike Sokolsky, three entrepreneurs connected to Stanford University.

In addition to the well publicized and for now well-funded enterprises of Udacity, Coursera, and edX, there have been many other MOOC offerings. For example, with backing from BlackBoard, an international course management system company, Curt Bonk from Indiana University, author of *The World Is Open: How Web Technology Is Revolutionizing Education* (2009), offered a MOOC titled "Instructional Ideas and Technology Tools for Online Success" (http://events.blackboard.com/open) to more than 4,000 learners in April/May 2012. Professor Paul Kim, Chief Technology Officer and Assistant Dean for the Stanford University School of Education, has offered a MOOC titled "Designing a New Learning Environment" (http://venture-lab.org/education) in which small teams of participating learners collaborate to create designs for innovative learning environments.

MOOCs are not just a North American innovation. A project-based learning approach was employed in a MOOC titled "Learning Design for a 21st Century Curriculum" that originated from the Open University of the United Kingdom (http://www.olds.ac.uk/) from January-March 2013. In March 2013, Open Universities Australia released its Open2Learn platform (https://www.open2study.com/) offering MOOCs in topics ranging from anthropology to writing. In April 2013, eleven European universities launched OpenUpEd (http://www.openuped.eu/), a MOOC platform that already offers more than 40 courses in 12 languages. Moessinger (2013) wrote a three-part article surveying MOOCs around the world that includes additional information about MOOCs being developed in other parts of the world, including Asia and South America.

Clearly there has been an enormous growth of the MOOC phenomenon. MOOCs are "massive;" tens of thousands of people have signed up for selected MOOCs. Most MOOCs are "open" in the sense that fees are not required, although costs may be involved for specific "premium" services (e.g., Coursera's "Signature Track Verified Certificate" of course completion). So-called xMOOCs are not open in the same sense that cMOOCs are in that in the former the creators of the content retain the copyright for most of what is included in the learning environment whereas in the connectivist MOOCs, content is freely created and shared by everyone involved. MOOCs are almost completely "online," although in some cases, learners wishing to earn transferrable credits must take final exams and other assessments at proctored physical sites. Whether they are "courses" in the traditional sense of this hallowed academic construct gets to the crux of the matter. After all, amidst all this creative effort and investment, one question remains inadequately addressed: "What is the evidence that high quality learning is taking place on the part of those who enroll in MOOCs?"

2. ASSESSMENT, CERTIFICATION, AND ACCREDITATION

Before directly addressing the evidence of high quality learning question, three important issues must first be considered: 1) assessment, 2) certification, and 3) accreditation. Assessment is the process of determining what people are learning in any type of learning environment as well as the extent to which they are learning. Traditional assessments including tests and essays whereas alternative assessments include portfolios of cumulative products and completion of authentic tasks (Oosterhof, Conrad, & Ely, 2008).

Certification refers to the process whereby an institution of higher education warrants that someone has learned and issues a credential (e.g., a Bachelor of Arts) as evidence of that learning (Astin & Antonio, 2012). For most people formally enrolled as students in courses at a traditional university or college, a transcript of courses completed and the grades or marks achieved in those courses usually represents certification. When enough courses have been completed under the organizing scheme of a program of study, a student is awarded a degree that further certifies a given level of achievement (e.g., a Masters of Science in Biology degree). Several interesting developments related to certification and MOOCs have occurred in the last twelve months. For example, Antioch University, a U.S. institution with five campuses in four states and a reputation for innovation, announced in October 2012 that it has reached an agreement to offer official college credits for completion of MOOCs offered by Coursera (DeSantis, 2012). In February 2013, the influential American Council on Education announced that it had determined that five of the MOOCs offered by Coursera were worthy of transferrable university credit (Kolowich, 2013). Since then, many individual universities as well as various academic consortia have announced plans to accept MOOC-based credits. Legislators in two U.S. states, California and Florida, have been especially proactive in promoting the wider acceptance of MOOC credits by their state university systems (Ebersole, 2013a).

Accreditation is the process whereby an external agency warrants that an institution is worthy of offering and awarding degrees at various levels (Jung & Latchem, 2012). Accreditation is an important process in that it provides evidence that a higher education institution is maintaining sufficient quality with respect to its various missions such as teaching, research, and service. In light of criticism that accreditation agencies have focused too much on "inputs" to institutions (physical plant, degrees held by faculty, books in libraries, etc.), these agencies are currently being pressed to base their judgments on outcomes such as graduation rates, career success of graduates, and other indicators (LaCelle-Peterson & Rigden, 2012).

Although certification and accreditation are important factors that require more refinement as they relate to MOOCs, assessment is the issue most closely linked to the question of evidence of learning. Ebersole (2013b) highlighted the problem: "At a time when evidence of learning is increasingly demanded by accreditors and the federal government, a determination of equivalency in instruction alone is no longer sufficient. Valid, secure learning outcome assessment must now be part of the equation as well."

Although it may sound cynical to some, unless something has been assessed within the context of a formal learning environment (regardless of whether it is online or not), there is no acceptable foundation for warranting that learning has occurred (Reeves & Okey, 1996). A corollary to this conjecture is that for the most part, people engaged in formal learning fail to put sufficient effort into learning something unless they know that it is going to be assessed. So how is learning currently assessed within MOOCs? More importantly, how can assessment of learning within MOOCs be improved to the point that a clear answer to the question of learning in MOOCs can be provided?

3. ASSESSMENT PRACTICES IN MOOCS

The providers of and participants in some MOOCs, especially those employing the cMOOC model based on constructivist learning principles, are not usually concerned with assessing participant learning. For example, Kop, Fournier, and Mak (2011) described two connectivist MOOCs originating in Canada in which neither course included "formal assessments of learning outcomes as the learning objectives for each learner on the MOOCs was different, dependent on his or her context" (p. 74). The basic philosophy of these types of MOOCs is a focus on enabling opportunities to learn as well as to contribute to the learning of others.

For the providers and sponsors of other MOOCS, including many of the xMOOC variety, who are more concerned with assessing participant learning, the options for assessing student learning within a MOOC are not unlike the methods used in traditional face-to-face courses as well as online and blended courses (Rovai, 2000), although there are arguably more complex challenges involving closely related issues such as cheating and plagiarism (Oliver, 2012; Young, 2012). The type of assessment methods used within any type of learning environment should be aligned with other important components of the learning environment, especially the learning objectives and the learning activities that purport to enable students to accomplish the objectives (Reeves, 2006). As an example of the alignment between objectives and assessment strategies, Table 1 lists various assessment strategies that could be used in a MOOC to assess different levels of cognitive learning represented in Bloom's updated taxonomy (Anderson & Krathwohl, 2001).

Table 1. Assessment Strategies for MOOCs Aligned with Objectives.

Cognitive Process	Objective	Assessment Strategy
1. Remembering *1.1 Recognizing* *1.2 Recalling*	List the terms represented by the acronym ADDIE.	Online quiz
2. Understanding *2.1 Interpreting* *2.2 Exemplifying* *2.3 Classifying* *2.4 Summarizing* *2.5 Inferring* *2.6 Comparing* *2.7 Explaining*	Classify objectives according to the revised version of Bloom's Taxonomy.	Online quiz
3. Applying *3.1 Executing* *3.2 Implementing*	Demonstrate the capacity to use linear equations, specifically finding solutions through graphing, elimination, or substitution, in solving word problems.	Peer assessment of problem solution guided by rubric

Cognitive Process	Objective	Assessment Strategy
4. Analyzing *4.1 Differentiating* *4.2 Organizing* *4.3 Attributing*	Analyze the probable causes of climate change.	Essay marked by instructors and other subject matter experts
5. Evaluating *5.1 Checking* *5.2 Critiquing*	Write a review of a film for submission to a scholarly journal.	Review refereed by journal editors
6. Creating *6.1 Generating* *6.2 Planning* *6.3 Producing*	Design and produce an open education resource (OER) for a specific learning objective.	OER tested with and evaluated by actual learners.

Roberts (2012) prepared one of the only available reports detailing assessment activities within a MOOC. In May and June 2012, the Oxford Centre for Staff and Learning Development (OCSLD) at Oxford Brookes University in the UK offered a MOOC titled "First Steps in Learning and Teaching." Targeted for novice lecturers, doctoral students with teaching roles, and people moving from industry or other sectors into higher education, the MOOC initially attracted 200 enrollees from 24 different countries. Of these, 60 participants remained in the MOOC for the entire six weeks, and 14 of these participants completed the assessment tasks and received a certificate in recognition of their achievement. According to Roberts (2012), there were three components in the assessment scheme applied in the "First Steps in Learning and Teaching" MOOC:

- **Activity 1** (10 days, individual/and public discussion) Brief public professional reflective profile statement shaped by Standard Descriptor One of the UK Professional Standards Framework for Teaching in Higher Education; to be posted by *Monday 28 May* for peer discussion by Wednesday 30 May [**NOTE** *extended deadline for submission* Friday 1 June for feedback by Friday 8 June]
- **Activity 2** (1 week, whole cohort) Collaborative annotated bibliography of works that have influenced you in respect of the scholarship and practice of teaching; to be done by *Wednesday 6 June.*
- **Activity 3** (2 weeks, individual/small group) Micro teaching session. To run from *Wednesday 6 June to Wednesday 20 June*. There will be four options for engaging in this activity.

Roberts (2012) reported that for the most part, this assessment scheme worked well, However, in future iterations of this MOOC, he suggested that the first two activities should be formative in nature and that only the third task (micro teaching session) would actually be marked. While it is easy to conceive how videos of the Micro teaching sessions of 14 participants could be marked by the MOOC leaders, if this assessment strategy was taken up by hundreds of learners, major difficulties would arise. Scaling up project-based assessments is a major challenge facing MOOC developers.

Another challenge rests with human foibles. Cheating and plagiarism are concerns within any assessment scheme, but especially for MOOCs. Oliver (2012) noted that Coursera is utilizing the crowd sourcing strategy of peer assessment to assess the learning that cannot be easily marked by a computer algorithm. She questioned this strategy and stated "crowd sourcing can't be relied upon when self-interest is at play." Oliver promoted "authentic assessment" strategies whereby the methods used to assess learning closely approximate the actual activities people face in the real world. Herrington, Reeves, and Oliver (2010) described examples of how online higher education courses have been designed around significant authentic tasks in which assessment is inherent in the tasks. This is essentially the strategy that was used in the aforementioned "Learning Design for a 21st Century Curriculum" MOOC organized by the Open University of the UK.

Another strategy to combat cheating in MOOCs is to employ external invigilation or proctored exams. According the Clayton (2012), Pearson Assessment Centers can now facilitate proctored tests and exams in MOOCs offered by Coursera, edX, and Udacity. Parry (2012) reported that an exam proctored by Pearson for Udacity MOOCs will cost the learner 89 U.S. dollars. Students passing exams at Pearson Assessment Centers will receive certificates indicating that their assessments were proctored. Learners armed with such certificates may be able to convince the universities in which they are enrolled to accept MOOC participation for credit towards a degree. Schemes for proctoring assessments within MOOCs are likely to proliferate if MOOCs continue to expand at their current rate.

4. IMPROVING LEARNING ASSESSMENT IN MOOCS

The current options for assessing learning in MOOCs are similar to those that can be found in other delivery systems for higher education such as face-to-face courses, blended courses, or totally online courses. Regardless of the type of delivery system, assessment strategies must be carefully aligned with other components of the learning environment, specifically, the objectives, content, learning design/learning activities, the roles of the instructor, the roles of the learners, and the technological affordances inherent in the delivery system (Reeves, 2006). Misalignment of these factors is a frequent criticism leveled at higher education because, although most programs and courses will state lofty goals and objectives, they rarely match these with relevant, reliable, and valid assessment strategies.

Universities offering MOOCs or accepting MOOC-based credits must confront issues related to cheating, plagiarism, and other human failures that threaten to undermine the assessment strategies and related issues such as certification and accreditation. The incorporation of authentic tasks (Herrington et al., 2010) into MOOCs addresses alignment issues as well as cheating and plagiarism. One of the inherent advantages of authentic tasks-based assessment is that real world tasks, especially when the products or services that learners produce or provide have real audiences such as consumers or clients, are difficult to plagiarize.

Authentic tasks-based assessment should be the hallmark of MOOCs that purport to certify that participants have really learned higher-order knowledge, skills, attitudes, and intentions. For example, imagine a MOOC for higher education instructors focused on alternative assessment methods. The goals of this MOOC would be to enable instructors to incorporate the most effective types of assessment methods within their courses. Such a MOOC could be designed to present a series of engaging video lectures about different assessment practices. Videos of these various methods actually being applied in different types of courses could be included as well as videos of instructors and students discussing the pros and cons of various assessment strategies. Opportunities to experience examples of different assessment strategies could also be incorporated into the MOOC, such as, stealth assessments embedded in serious games (Shute, 2011) or rigorous multiple-choice exams that have been carefully validated (Ebersole, 2013a).

However, the primary learning task in the proposed MOOC would be to work in a small team to develop an alternative assessment scheme for an instructor who desires to enhance the assessment of learning in one of his/her specific courses and therefore has signed up in the MOOC to serve as a real world client. Rubrics would be provided to allow the clients as well as the MOOC learners to judge the quality of the alternative assessments developed, and the MOOC providers would apply similar rubrics to the assessment of a random sample of the assessment schemes developed by the teams. Oh and Reeves (in press) describe how a similar authentic tasks design was applied to an online course focused on E-Learning Evaluation, and Herrington and Herrington (1998) described how authentic assessments have been applied in traditional and online courses.

Why aren't more MOOCs and other higher education courses designed around authentic tasks? It may well be that traditional instructional design approaches are not adequate for the development of the types of authentic tasks-based MOOCs recommended here (Oh & Reeves, 2010). Instead educational design research (McKenney & Reeves, 2012) should be applied to the development of MOOCs if they are to be designed and implemented in such a way that clear evidence of learning is demonstrated. Developing a MOOC that provides unambiguous evidence of participant learning is the kind of "wicked problem" that does not yield easily to the application of simple design heuristics used by most instructional designers (Krause, 2012). Wicked problems are the kinds of complex problems confronted in design fields such as architecture, engineering, public health, and education where human actions and interactions are often unpredictable (Margolis & Buchanan, 1995).

When it comes to innovative solutions to complex educational problems, researchers have primarily focused on the question "What works?" with respect to teaching and learning, with generally poor outcomes (Schoenfeld, 2006). Educational design research fundamentally changes the focus of research from "what works?" questions to "how can we make this work and why?" intentions. It can be safely predicted that if experiments are done at this time to compare MOOCs with traditional higher education courses the most common finding will be "no significant differences" (Reeves, 2011). The irony of these ill-fated comparisons is that neither the MOOCs nor the traditional courses have been optimized to support student learning.

The twofold goals of educational design research are first to solve real world problems through the development of effective interventions (e.g., a MOOC in which the evidence that participants have learned is unassailable) and second to reveal reusable design principles (e.g., how to design authentic tasks in which the

assessment of learning is inherent). MOOCs developed through educational design research protocols would be designed, tested, adopted, implemented, re-tested and refined in authentic settings iteratively over the lifespan of the learning environment. Large-scale MOOC providers such as Coursera, Udacity, and edX could be appropriate laboratories for conducting the kinds of educational design research recommended here. The establishment of the MOOC Research Initiative (http://www.moocresearch.com/) under the leadership of MOOC pioneer George Siemens at Athabasca University is a hopeful sign that a more effective research agenda may be emerging for the MOOC phenomenon.

As a still emerging research genre (McKenney & Reeves, 2013), educational design research applied to MOOCs and other types of open educational resources will demand long-term in-depth collaboration among researchers, instructors, and learners. It will require a strong commitment to creative design and rigorous evaluation work that will last many months, even years. However, this does not mean that any given MOOC must wait to be perfected before it is launched. Educational design research is driven by the best upfront analysis and design possible along with creative design, but further testing and revision of prototype interventions take place early and often.

McKenney and Reeves (2012) described educational design research as occurring across three iterative phases: 1) analysis and exploration, 2) design and construction, and 3) evaluation and reflection. Based on my personal experience as a guest instructor in three MOOCs and as a learner in three different MOOCs, it appears that most MOOCs are not being developed using educational design research methods, but rather by using some sort of rapid prototyping approach that emphasizes media production (especially for videos) over issues such as alignment across pedagogical dimensions and rigorous assessment. The mindset seems to be "build it and they will come," whereas what is really needed is "design it, build it, implement it, evaluate it, reflect on it, refine it, implement it again, evaluate it again, reflect on it again, refine it again, and so on"…continuing this process until optimal outcomes are realized or the audience for the MOOC is exhausted.

5. THE REALITY OF LEARNING AND TEACHING IN MOOCS

My own learning experiences in MOOCs have been disappointing thus far, partly the result of poorly designed learning interactions in two of the MOOCs and partly my own fault in the one well-designed MOOC in which I simply could not keep up with the workload during the last two weeks of the six-week course because of a heavy travel schedule. My "teaching" experiences in three MOOCs have also left me underwhelmed, primarily because I have failed to experience any real connection with the learners in these open environments. This again may be my fault because while some of the other learning facilitators in these MOOCs appear to utilize every social media tool on the planet to "connect" with the learners, I am still functioning with only email, discussion forums, Google docs, and the occasional teleconference via Skype or Google Hangout.

Setting aside my personal experience, I believe that it would be difficult for anyone to argue that substantive learning is occurring within most MOOCs or for most learners. The extremely high attrition rates in MOOCs attest to that (Daniel, 2012). But when learning occurs, it is because the MOOC is well designed <u>and</u> because the learner is willing to invest the necessary effort and time to engage in the learning activities fully. Both of these must occur. We cannot fool ourselves and imagine that we can design MOOCs wherein people can learn effortlessly. Learning is difficult, developmental, and requires time and commitment.

Carey (2013), an American expert on higher education policy from the New America Foundation, recently wrote one of the most useful and detailed descriptions of what it is really like to learn in a MOOC. Carey enrolled in MIT 7.00x, an introductory biology course, one of the first courses offered by the Harvard-MIT venture edX. Professor Eric Lander who was a leader of the Human Genome Project taught the course. Carey describes how he invested fifteen hours per week for fifteen straight weeks in intensive studying, managing to earn a respectable 87% score on the rigorous exams.

This level of effort is what undergraduate students should be investing in every one of their undergraduate courses. In the USA, a typical three-credit semester length course should involve three hours per week in class or labs, and another 9-12 hours per week in studying and relevant learning activities. But the reality is that university students are investing much less time in their academic studies than this. According to Babcock and Marks (2011), "Full-time students allocated 40 hours per week toward class and studying in 1961, whereas by 2003 they were investing about 27 hours per week" (p. 468). Ten years on, it is likely that

the number of hours spent studying has declined even more, and as Carey (2013) concluded, "For many students, full-time college has become a part-time job." What is especially ironic about this is that while the time invested in learning has steadily declined, the grades awarded to students have steadily increased (Rojstaczer & Healy, 2012). Clearly, the professoriate, at least in the USA, is expecting less effort and giving more rewards to students than ever before. This is not surprising given that, first, the reward systems for the professoriate generally value research and external grants above teaching, and, second curricular alignment is rarely scrutinized in any serious way. Developing rigorous, academically sound MOOCs through rigorous educational design research may provide a mechanism for turning these imbalances around.

6. CONCLUSION

Although the jury is still out whether MOOCs and other forms of open education will fundamentally transform higher education as we know it, the need to transform academe cannot be doubted. As the costs of higher education have far outpaced inflation in other sectors (Altbach, Reisberg & Rumbley, 2010) and student debt grows to unacceptable amounts, at least in the USA, something must fundamentally change. There is much weeping and gnashing of teeth among academics over what they see as the commercialization of higher education inherent in online learning. Rather than continuing to wail over our fare, we in the professorate need to seize the moment and engage in socially responsible research and development to improve the quality and impact of higher education. Instead of conducting any more studies to compare classroom learning with online learning, we need to focus on making online, blended, and traditional classroom education more effective through educational design research. We must strive to assess what is important to learn rather than what is easy to measure. Pirsig (1974) wrote, "Quality tends to fan out like waves." This is true, but the wave must start somewhere. It begins with us.

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SOCIAL NETWORKS AS THE SUPPORT OF THE E-LEARNING

Jan Lojda
Associate Prof., MSc. PhD. MBA, vicerector College of Banking, Nárožní 2600/9. 158 00 Prague 8
Mobile phone: +420 731 516 665

ABSTRACT

The paper deals with the new and actual approaches in E-learning. It seems, that the period of sophisticated Learning Management System (LMS) is over and the potential customers = e- students prefer new environment for their learning activities. Interactivity and communication tools are considered as the crucial point how to make the individual e-study more open and users friendly. Sharing learning experience, external study materials and study problems facilitates the study processes and is helping to manage the stress in the learning of lonely student.

KEYWORDS

Social networks, independent study, Learning Management Systems, learning and teaching processes, e-learning environment.

1. INTRODUCTION

Actual ways of E-learning applications are very different and many users of Learning Management Systems (LMS) and many course authors are working on the base of individual experience. Variety of LMS applications and lack of pedagogical qualification for management of training and course packages writing lead to the problematic results. Basic theoretical background for each author or provider of E-learning (having ambition to manage on-line events in E-learning) could be taken from the principles of distance education (DE). The core principle of DE is in the separation of the teaching and learning processes.

As the new trends in E-leaning environment are considered programmes recognised, like social networks. There are not accepted social nets like Facebook, LinkedIn or Yahoo tools (etc. of course). There is a lot of different tools at the market for networking and some of them were already tested for the purposes of E-learning. Some of universities in EU started already to test this new opportunities with the relative success. To sense of this contribution is in complex approach and discussion about the advantages and disadvantages of this new learning environment.

Before we start to comment this new environment is necessary to be sure and understand well the complexity and evolution from the simple E-course to the interactive game and it could be useful to describe categorisation of E-courses. Contemporary there is less attention done on the pedagogical components and measurable achievement and more attention is devoted to IT features, content and testing. Just wrong way of course objectives definition and blind using ways of testing (offered by LMS, mostly without any link to the measured real change of knowledge, skills and competences) brings a lot of problems and in fact decrease substantially the effectiveness of E-courses generally.

2. CLASSIFICATION OF E-LEARNING COURSES

2.1 Simple E-transfer of Information

This type of distribution of information is well known and used by many users. For application of such a type of sharing information and their distribution, there are often used conventional E-mails with the list of target group. There is not confirmation, that the receiver have read the text (confirmation of opening is not information about the reading!) and also there is no information about the understanding of the message.

2.2 E-transfer of Information with Confirmation of Acceptance

This is higher level of E-communication, because there is usually any legal measure how to ensure and confirm the acceptance. The signature or formal declaration of acceptance is requested. This type of E-transfer is used for purposes of responsibility or if there is expected transfer of this knowledge to the third person.

2.3 E-transfer of Information with Confirmation of Understanding

In certain cases the distributor of the information needs to be sure, that content of the message was fully understood and that the target receiver is able apply new information. Solution of this request could be for example in the simple and closed test. The risk, that test will be fulfilled by other person is low.

2.4 Knowledge Based (Informative) E-Course – Short

This is typical E-course with testing and assessment. This type of E-course is easy to prepare for potential authors and for potential receivers is easy to pass. There are a lot of good examples. The crucial condition is that author is able to define properly learning objective and learning outcomes. Also the appropriate way of assessment according to the right identification of the achieved learning change is necessary.

2.5 Knowledge Based (Informative) E-Course – Long

The students of long courses have the problem with the sustainable motivation. The solution is in the scheduling and separation of assessments in time. Usually is applied continuing and final assessment as the tool for keeping the student active during the whole E-course. The value of the marking from the continuing and final assessment depends on the type of course. Definition of learning outcomes, objective and expected change is requested as well. Both this type knowledge oriented courses could well follow Bologna process.

2.6 Competence Based (Formative) E-Course – Short

Formative training is more complicated and also more complex education. The final objective is to change attitude, development of the new skills or competences. In principle it needs more emotional involvement of student and more interactivity in the teaching/learning processes. The claims on the course scenario and selective ways of assessment are high. Still the development of such a course needs deep pedagogical knowledge and competences of its creator. Including of formative training into the E-courses needs professional approaches and psychological and educational advisory. Good examples from DE show, that there is necessary to apply less leadership and more independence in the learning process.

2.7 Competence Based (Formative) E-Course - Long

Competence based courses are usually made in the shape of intensive face to face training in smaller groups. Mostly is this type of courses targeted on the middle and top managers. The request of the big companies is to decrease the time consumption of participants and to facilitate the process of learning. Top managers are

special category of trainees because of their overloaded time schedule. This type of courses is usually prepared as tailored course and it means that it is expensive and it needs enough time for preparatory. As a part of competence based courses could be involved also managerial on-line games. As the special case, there is possible to engage role play game.

3. APPLICATION OF SOCIAL NETWORKING IT TOOLS IN E-LEARNING

Looking at the above mentioned classification we can clear see, that for more simple e-courses there is not necessary to have a special management tool and we can use any simple IT communication system (like i.e. Outlook) to realise it. On the other side namely the formative courses need more interactivity and student collaboration generally.

Actual experience with social network programmes in E-learning has faced some problems of this solution:

1. Students like it on the very beginning of the e-course, but later their enthusiasm is dropping down and together with the study problems, their interest to communicate with other students is not significantly higher.
2. Insertion of files into the social networking IT programmes is not so easy, like in the conventional LMS.
3. The management of e-course at the social network is highly demanding for the teacher or administrator
4. usually there is not administrative and assessment system included.
5. compatibility with the information systems of universities is low or missing

Speaking about these problems we could be confused if this is the right way of the new approaches to e-learning and if it could be useful to insert the implementation of such a system into the university strategy plans. The answer is not easy to be done, because there are a lot of conditions, which must be accepted before we start to teach at the social networks.

The application of social networks IT programmes for education is in the process of testing and looking for the right composition between the free and confidential communication, technical solutions related to the insertion of the different types of the study materials and compatibility of the system with existing information systems at the universities. We are now in the situation, that there is first necessary to answer some questions before we start to realise this type of innovative educational approach.

4. CONCLUSIONS

Despite of the fact, that former paragraph is slightly negative there is the big future in changing of the study environment generally. First of all the generation of the new learners is much more open and familiar in using virtual environment to fulfil their needs. Second the technical problems will be solved soon, in fact immediately after definition of the users needs. Social networking for education is very clear and visible challenge for all educational institutions and teacher, how to change steady approaches and frozen habits and meanings about the study way.

Lets have a positive look at this new emerging opportunities and lets open our minds to the new challenging solutions

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Full Papers

EVALUATION OF VISUAL COMPUTER SIMULATOR FOR COMPUTER ARCHITECTURE EDUCATION

Yoshiro Imai[1], Masatoshi Imai[2] and Yoshio Moritoh[2]
[1]*Graduate School of Engineering, Kagawa University, 2217-20 Hayashi-cho Takamatsu city 761-0396 Japan*
[2]*Department of Management Information, Kagawa Junior College, 1-10 Utazu-cho Ayautagun 769-0201 Japan*

ABSTRACT

This paper presents trial evaluation of a visual computer simulator in 2009-2011, which has been developed to play some roles of both instruction facility and learning tool simultaneously. And it illustrates an example of Computer Architecture education for University students and usage of e-Learning tool for Assembly Programming in order to realize effective and efficient ICT-based Practical Information Education. Evaluation for the visual simulator has been carried out not only as an instruction facility but also as a self-learning tool. The simulator can be used by teachers in their classroom lectures as well as by students for their making reports (essays). Such evaluated results are based on viewpoints from instruction of internal structure and behaviour in vonNeumann computer, Assembly Programming exercise, some essays by students with the simulator, and relationship between student's examination scores and usage of the simulator. Second half of the paper describes how to organize multiple server system for collaborative learning with the visual simulator.

KEYWORDS

Collaborative learning, multiple server, system, qualitative and quantitative evaluation.

1. INTRODUCTION

People of the world say, an ICT-based Education has become widely accepted from elementary schools to higher educational institutes. Even in Japan, Informatics Fundamentals has been included as one of the menus of University Entrance Examinations. It becomes more and more important for pupils and students to learn computer-related subjects even in not higher education.

Many instructors and researchers have designed and developed some kinds of computer simulators because they seem to be one of the effectively educational tools for the lecture of Computer Architecture and Information Processing. Some of the famous simulators are introduced in the fifth section (parts of Related Works). Such simulators can be used in the practical education. Several of their simulators have been able to illustrate how a computer works graphically and additionally provide some kinds of programming exercise environment. Some of them have been used as visual educational tools of instructors for their learners in classroom lectures. And others have been utilized as e-Learning tools for Programming Exercise through even after school.

It is clearly recognized to be useful and efficient that such simulators have been used in the actual and practical education for more than decade years and they have played ones of significant roles in Computer Architecture and its related lectures. Although such simulators have been providing good effects for Computer Architecture education, there are only a few reports to evaluate the simulators in the practical education and estimate their effects in qualitative and quantitative viewpoints. So we have described trial evaluation of the simulator in qualitative approach as well as quantitative one. The former is based on students' feedback and the later is performed by statistical analysis.

Collaboration and/or collaborative learning are important for users to work together in some kind of effective/efficient environment. We have tried to organize multiple server system for collaborative learning and have implemented collaborated learning environment with visual computer simulator. We will introduce how to organize multiple server system for collaborative learning.

This paper presents an example case of Computer Architecture including usage of our visual computer simulator in the next (second) section. It demonstrates the 2009-2011 evaluation of our simulator in the third section. The fourth section of the paper introduces organization and usage of multiple server system for collaborative learning. The fifth section mentions the related works about our research. And finally the paper summarizes its conclusion in the last (sixth) section.

2. A VISUAL COMPUTER SIMULATOR

A simulator called VisuSim is implemented as a pure Java program to provide two kinds of entries for both Java applet code and Java application one. Each can be selected automatically to invoke the suitable mode of Java program. Namely, for example, VisuSim recognizes its invoking environment and decide to execute as a Java applet in the environment of browser or to work as a Java application in the environment where the Java VM executes in the DOS prompt of Windows, in the command interpreter of Linux and so on. A necessary condition is only to equip the Java VM prepared to execute the simulator. So it is very useful because any executable environment will do, just like Windows, Linux and/or Macintosh.

There are both sides of views for the visual simulator as are summarized below. The first one is a tool to visualize an internal structure and behaviour of computer. It is useful for teachers to show students how a computer works graphically. The second is an e-Learning tool to provide an environment for Assembly Programming exercise.

2.1 Visualization Tool

VisuSim has 8 sets of general-purpose registers, including Stack Pointer, and 256/512 words of main memory. It can simulate computer internal behaviour in a register-transfer level. For example, a teacher of Computer Architecture can utilize it to demonstrate graphical view about von Neumann computer architecture by means of wall-hanging screen and PC projector. The teacher can explain step-by-step actions of internal register and memory with VisuSim. Fig.1 shows an overview of VisuSim which is downloaded from a server and executes on PC.

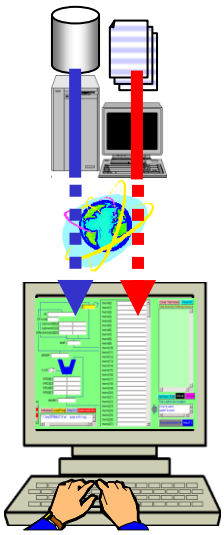

Figure 1. VisuSim on PC

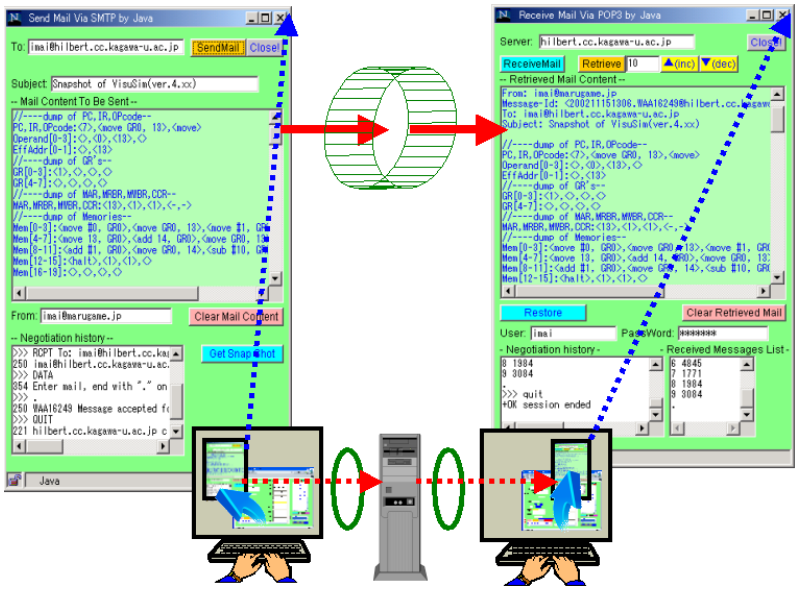

Figure 2. Communication between pair of VisuSim with buit-in e-mail functions

2.2 e-Learning Tool with Communication Facility

VisuSim is utilized for writing essays and answering problems of Assembly Programming exercise. Users (Students) of VisuSim can understand computer behaviour, program processing and well-defined algorithm through verification of assembly program execution. And moreover communication service can be provided between pair of VisuSim with its built-in e-mail function. So it supports effective information sharing between sender and receiver of VisuSim. It is very useful in an e-Learning tool among users in Fig.2.

3. EVALUATION OF VISUAL COMPUTER SIMULATOR

This section describes an evaluation of the visual computer simulator. It presents the detail of essay problems in the lecture, analyzes the scores of students' essays, short test and semester-end examination. And then it shows the relations of them as an evaluation of VisuSim in the relevant year. And it also explains qualitative and quantitative evaluation in the second half.

3.1 Essay Problems for Computer Architecture Education

It is important for students to learn vonNeumann computer architecture as efficiently as possible, because such a theme is positioned as an introductory talk of lecture and its perfect understanding makes more fruitful and expansible for the succeeding education in faculty or graduate school of university. Just like, for example, understanding Pipeline Processing as higher performance technology is a introductory talk for the advanced architecture themes such as Super-pipeline, Superscalar, VLIW and so on. In our university, a semester has only 15 weeks for every lecture and always suffers from lack of time enough to educate several items for students. This is one of reasons to develop our visual computer simulator described in the previous section. From such a viewpoint for lecture, it is necessary to utilize an educational tool for efficient lecture and provide an e-Learning tool for effective exercise environment. Essay problems of Computer Architecture are shown in the following style:

$$(1)\ \sum_{i=1}^{10}(2*i)+10 \quad , \quad (2)\ \sum_{i=0}^{3}A(i) \leftarrow A(0)=1000, A(1)=900, A(2)=50, A(3)=5$$

These are useful to understand Arithmetic Algorithm with iteration, register-register operation, and usage of index-register based indirect address modification. If a student writes such programs and investigate them using our visual simulator, he/she can recognize simple concept of vonNeumann computer architecture.

3.2 Relation between Essay and Two Kinds of Tests for Computer Architecture

In lecture of "Computer Architecture", students are requested to write assembly programs and verify their programs with our visual simulator. At the same time, they also ought to check by themselves whether they understand vonNeumann computer architecture or not. Contents of a short test include some items other than assembly programming or algorithm. So there is not always sure that the students, who used to operate our visual simulator very well, obtain excellent scores in such a test. It can be assumed that the contents of the test have very few factors to relate skill of visual simulator. Under these conditions, there is a result of comparison between Essay's Scores from students and Scores of Short Test by the same students shown in Fig. 3.

There is a certain correlation of Scores between Essay and Short Test. So we can confirm that understanding vonNeumann computer architecture is significantly affected by writing essays with usage of visual computer simulator, VisuSim.

It is also investigated whether there is any relation of Scores between Essay and semester-end Examination or not. It has been not yet a perfect investigation and confirmation to analyze any relation between Essay and Examination yet. We should not exactly mention about a kind of relation between Essay and Examination. So we only show some kind of good correlation of Scores between Essay and Examination as is shown in Fig. 4.

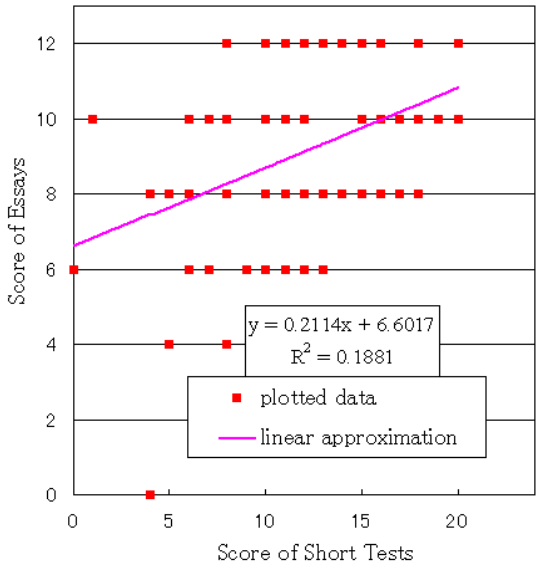

Figure 3. Relation of Scores between Essay and short Test of the same student.

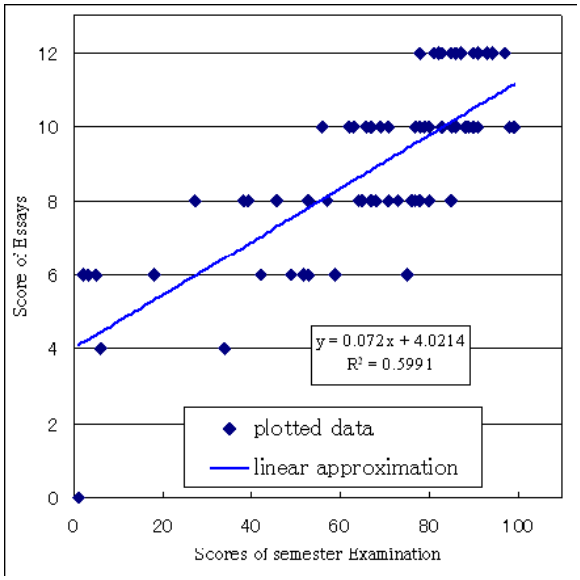

Figure 4. Relation of Scores between Essay and semester-end Examination.

3.3 Qualitative and Quantitative Evaluation of our Simulator

There are some comments and recommendation described in Essays from the students, who learned "Computer Architecture" in 2009. We think that these comments and others scripts are considered to be real and precious evaluation for our simulator. They must be subjective, of course. However, they can be also qualitative evaluation about our simulator VisuSim from the students who were real users of it. Some of positive comments are as follows:

1) It is easy to verify and point out mistakes through step-by-step execution and display the result by VisuSim.
2) I can check change for contents of registers and memory provided by VisuSim.
3) As I use sample programs through VisuSim, it is good enough for me to write new similar ones.
4) It is very important that I can easily understand how a computer works, because VisuSim visualizes interpretation and calculation of my programs graphically.
5) I can recognize characteristics of Stored Programming during writing programs and my essay.

The above positive comments may be considered as positive evaluations for our visual simulator. At the same time, however, there are some of negative comments in the relevant Essays, which are as follows:

6) It is difficult for me to operate VisuSim, so I must help my friends teach me to operate it. Finally I do write my essay only just until deadline.
7) When I modify my program, I have found mistake at the point where program jump from another routine. So I must adjust and shift the according routine.

These are not convenient so that I think it is necessary to be improved. These comments must be considered to be precious recommendations for improvement of VisuSim and teaching methods. We should have a plan to modify our visual simulator from these feedbacks

"Computer Literacy" is an introductory lecture for beginners of "Computer Architecture" at the first year of our university. Table 1 shows the relation of learners' scores between the reports using VisuSim for understanding computer and examinations for "Computer Literacy". The number of learners is 81. The ranks of the scores for reports are classified from A+ to D (ascending order), while the ranks of the scores for examination are "Superior", "Excellent", "Good", "Fair" and "No Good", respectively. Based on this table, we try to evaluate our visual simulator VisuSim by means of test of significance as follows.

Table 1. Distribution of Learners' Scores for Report and Examination

	Superior	Excellent	Good	Fair	NoGood	number
A+	8	13	3	2	1	27
A	2	15	10	4	0	31
B	0	0	3	2	0	5
C	0	0	1	2	5	8
D	0	0	0	2	8	10
total	10	26	17	12	14	81

H0 is a null hypothesis: "using VisuSim is independent from learners' scores of Computer Literacy." A chi-square test is used to decide whether the null hypothesis H0 holds or not. With data of Table 1, the chi-square statistic is

$$\chi^2 = \frac{(8-27\cdot 10/81)^2}{27\cdot 10/81} + \cdots + \frac{(8-10\cdot 14/81)^2}{10\cdot 14/81} = 87.5 \ .$$

By the way, the significance of the chi-square statistic is evaluated for (5-1)*(5-1) degrees of freedom. The chi-square percentile with (5-1)*(5-1) degrees of freedom at the 5% significance level is

$$\chi^2_{0.05}(16) = 26.3 \ .$$

From this result, the null hypothesis H0 is rejected and the alternative is accepted. An evidence of the above analysis indicates that a relation between using VisuSim to understand "Computer Literacy" and the learners' scores of "Computer Literacy" shows a statistically significant dependency. So it is said to be statistically significant that using of our visual simulator is effective to learn "Computer Literacy".

4. COLLABORATIVE LEARNING IN MULTIPLE SERVER SYSTEM ENVIRONMENT

This section explains two types of applications of distributed multiple server system, namely, implementation of collaborative learning environment and distributed surveillance system for emergency communication.

4.1 Collaborative Learning Environment

In order to manage our educational tool effectively, it is indispensable to design and implement a special-purpose information server, which can provide some kinds of information-exchanging environment for the tool and its users. With such a server, the tool can play the very important role to carry out communication among users. Built-in e-mail handlers of the tool realize such communication between users, i.e. a learner and an instructor. Learners using our tool, visual computer simulator, can obtain their necessary information from the special-purpose information server through its communication supporting functions according to their understanding levels. So the information server needs the following three basic functions.

4.1.1 Web Service Functions

They are very much essential to deliver the program (executable) code of Simulator and sample (source) programs for Simulator. They correspond to HTTP-based communication with 3-way hand-shaking procedure. Additionally, They support FTP-based data transferring service.

4.1.2 e-Mail Service Functions

Simulator can support the communication and information-sharing mechanism among users by means of SMTP-based and/or POP3-based facilities. It is necessary for the server to be implemented to provide SMTP-transferring server function and POP3-receiving server ones.

4.1.3 User Management Service Functions

There must be user management functions in the server, not only because of POP3-service but also because of user identification to recognize user's understanding level. The former is necessary to realize POP3-service, while the latter is essential to specify user's level to utilize simulator more effectively.

With these functions, the special-purpose information server prepares necessary and minimal conditions to realize communication supporting and information-exchanging environment for the educational tool and its users.

4.2 Cooperation among Multiple Servers System

The previous information server simply employed one server system for all the users' management, user identification with serial number, so that there were some regulations such as not so good two-way authentication among users, not so efficient information transmission and/or sharing between different level of users, etc.

Now we have employed a new resolution of Cloud Service to group all the users into cluster and assign such a cluster to one server as one of temporary expedients for management of users among multiple servers. Of course, the above palliative treatment is not effective for cooperation among multiple servers. Fig. 5 shows implementation of collaborative learning environment for our educational tool with a distributed multiple server system.

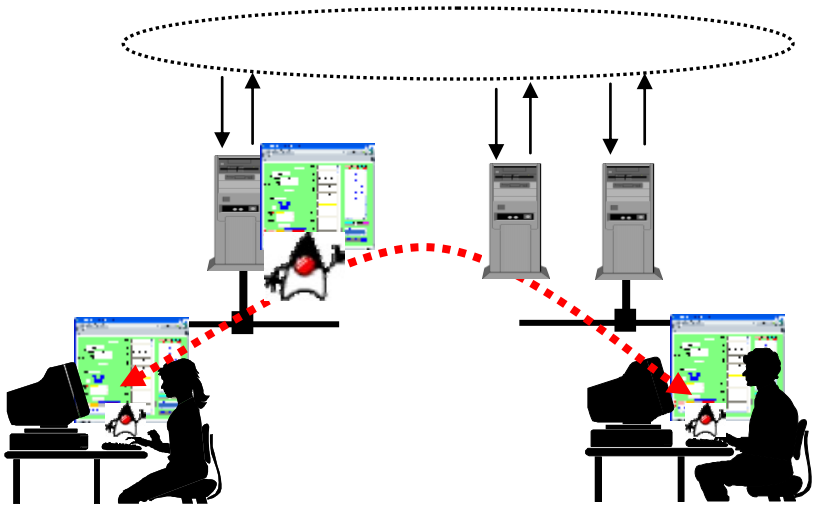

Figure 5. Collaborative learning environment on multiple server system for Visual Computer Simulator

It is necessary to establish more effective methods to organize and cooperate different servers. One of those is to utilize e-mail function of the educational tool and communication facilities between its users. An then all the users of the tool are registered on the shared user database and their mail spool area and users' home directories are created in the shared volume area by means of NIS/NFS or SAMBA (or Network-Attached Storage) facilities.

Flexible user identification is necessary to allow hierarchical user naming. With introduction of LDAP (Lightweight Directory Access Protocol) based authentication, it is very much smooth to manage the users among multiple servers and easy to implement flexible user authority for such servers. Although this is a useful method for user management, it will be suffering from some dangerous intrusion without closed network based characteristics and benefits. Security problems are very much heavily serious and expensive to protect correctly and urgently. Additional facilities such as NAT/NAPT (Network Address (& Port) Translation) mechanism will be implemented into a new information server simultaneously. So that will be one of future problems to be resolved for practical cooperation in a distributed environment.

4.3 Related Works

First of all, visualization is an absolutely necessary keyword and idea to improve the learner's understanding level. For example, when instructors educate their learners about computer, they want to use effective educational tools. These tools are expected to have some kind of function to visualize what is difficult to understand. With such tools, many learners will understand computer in a shorter period than other cases without using visualization tool.

4.3.1 Three Simulator Tools for Teaching Computer Architecture

Yehezkel et al. have pointed out that teaching computer architecture is not an easy task. So they provide three types of simulators with visualizations for different computer architectures. They are (a) EasyCPU for the Intel 80x86 families; (b) Little Man Computer for a general von Neumann computer architecture; and (c) RTLSim simulator for a MIPS-like CPU [1]. They are excellent works, but their GUIs are neither general nor common. It is difficult for beginners to use different GUIs of education tools in the related educational fields.

4.3.2 Simulators over the Network

Llamas-Nistal et al. have designed, implemented and tested a Web-based learning system in pure Java. They have attempted to stay within those standards what are suggested for distance learning, particularly Web-based collaborative distance learning [2]. From their paper, an architecture education of their system seems to be well conceived because of its visualization. Their academic results and opinions from their students who have utilized their system are generally. But the function of simulation is limited for a mid-level or lower computer course, so it seems to be not so useful enough to be applied to assembly programming exercise including recursion.

4.3.3 The MARIE Computer Simulator

Null et al. have prepared MarieSim (a computer architecture simulator based on the MARIE architecture) to teach beginners to study computer organization and architecture. It provides interactive tools and simulations to help them deepen their understanding. The graphical environment for MarieSim is written in Java Swing and seems to be useful in introductory computer architecture[3]. But MARIE employs accumulator-based simple architecture, so that it is not so suitable enough to execute recursive assembly program and moreover the MarieSim is not completely web-based but Java stand-alone application. It is not so convenient.

Secondarily, Web-based educational tools have realized powerful and fruitful results from scientific field to computing one. The second half of this section focuses the following two researches as the related works based on Web-based e-Learning system with effective GUIs.

4.3.4 Integrated Component Web-based Interactive Learning Systems for Engineering

Humar et al. have proposed a strategic approach to integrate already-developed components for development of a web-based learning environment. Although examples from their system only demonstrate how the system can be used with a course on electromagnetism, however, their basic approach must be applicable in other fields of engineering and natural science [4].

4.3.5 A Web-based Educational Environment for Teaching the Computer Cache Memory

Grigoriadou et al. have introduced a Web-based educational environment for teaching the computer cache memory and shown their aims to support and enhance the learning process for such a special and normally-invisible memory. The results obtained from the application/evaluation of such a Web-based environment are to indicate that the simulation and such an approach can effectively support and enhance the learning process [5].

Other related works are listed in the last references, as follows; Moure et al[6] have developed The KScalar simulator not only for ``Computer Architecture Education'' but also for normal professional usage. Dr. Chen [7] has designed and (maybe as his trial challenges) implemented an Automated Feedback System for Computer in order to utilize and improve his and other teachers' educational environments. Both of Huey-Ing Lui and Min-Num Yang [8] have originally designed and developed an excellent e-Learning system, which can provided QoL guaranteed adaptation and personalization in e-Learning systems. Djordjevic et al.

[9] have already developed and utilize Web-based Educational System for Computer Architecture Teaching in their university. And finally, we would like to introduce our related work about VisuSim in paper [10].

From the surveys of above described works, we have decided to design a Web-based educational tool with visualization and implement an effective GUI in order to support user-friendly learning process. The following three sections illustrate the detail of our Web-based educational tool for Computer Literacy and Architecture as focusing the characteristics of its GUI.

5. CONCLUSION

This paper describes summaries of a visual computer simulator, some trial evaluation of the simulator, and organization of multiple server system for collaborative learning with the simulator. And it introduces related works for computer simulators and Web-based e-Learning tools. Through the above explanation, our conclusion is summarized as follows:

1) The visual computer simulator has been evaluated in qualitative and quantitative approaches based on users' comments and statistical analysis for relation between essay and two kinds of tests of "Computer Architecture".
2) It is confirmed to be statistically significant that using of our visual computer simulator VisuSim can be effective to learn "Computer Literacy".
3) It shows an overview of distributed multiple server system for collaborative learning with the simulator. Such an environment will be useful and effective for practical education. But there are some problems to be resolved for practical education, just like security and external violation.

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UNDERSTANDING CHILDREN'S MUSEUM LEARNING FROM MULTIMEDIA INSTRUCTION

Asmidah Alwi[1,2] and Associate Professor Dr Elspeth McKay, FACS[1]
[1]*School of Business IT and Logistics, RMIT University, Melbourne,, Australia*
[2]*School of Multimedia Technology and Communication, Universiti Utara Malaysia, Malaysia*

ABSTRACT

The use of multimedia instructions for online learning has become very common particularly with the advances of the Internet technology. Consequently museums around the world utilize such information and communications technology (ICT) tools in order to provide richer learning experiences for their visitors. This paper discusses a study that investigated the relationship between multimedia instructional formats with individual cognitive learning preferences in a museum learning environment. A total of 91 school children age between 10 to 12 years old were randomly assigned into treatment groups based on their cognitive learning ratio. We employed a pre-test post-test quasi experimental design to reveal that general performance of the children exposed to the physical museum exhibits is better than the online museum environment. Although single cognitive learning preferences were evaluated, our findings suggest that analytics perform better than the wholists when exposed to the physical exhibits; whilst the result is reversed for the online exhibits environment. Verbalisers were found to be better than visualisers in the physical a museum context. Yet they were found to have slight differences when compared to visualisers in an online environment. Our findings on the combined cognitive styles (CCS) show that the analytics-visualisers' mean scores were different between physical and online exhibits, compared to the other three CCS.

KEYWORDS

Multimedia instructions, cognitive preferences, museum learning, web-based learning.

1. INTRODUCTION

Multimedia is simply defined as the use of text, graphics, animation, audio and video to present information. The revolution of the Internet and the communication technologies has foreseen the information to be delivered or made available in computer-based instruction utilizing multimedia. Combination of these media or better referred as multimedia instructions allows information to presented in a better way as compared to information dissemination in a single format. As suggested by Mayer (2009) and Schnotz and Lowe (2003), learning from multiple formats of instructions presumptively resulted in a better learning outcome as opposed to learning from a single format instruction. Nevertheless, there are research that proven otherwise (for example: Rasch & Schnotz 2009), hence the proposition remain inconclusive. Additionally, review of literature shows that in order to gain a more holistic understanding about how multimedia instruction could support learning, some other factors pertaining to the learning process such as the learning environment, learners' characteristics as well as institutional and administrative aspects should be considered when investigating the effectiveness of such learning instructions (Tallent-Runnels et al. 2006).

Web-based learning, which involves ICT multimedia tools, has emerged to overtake the more traditional forms of instructional environments. In doing so however, the increased adoption of this alternative pedagogical regimen may raise questions to doubt its effectiveness, such as: does the combination of different media really work in such learning environments?; which combination works and with whom?; and many other questions that will require answeres. Research has also shown that not every instructional format works for everyone. Schnotz (2008) and Kollöffel (2012) for example, suggest that effectiveness of animation when used as an instructional format depends on factors like: learners' preferences towards verbal or visual in format; prior domain knowledge; and other learners' personal learning characteristics. This dilemma suggests that other factors may be playing a part. Therefore learners' characteristics should be

closely taken into account when designing multimedia instruction strategies. Obviously, it requires concentrated attention that are caused by the human-computer interaction (HCI). The diversity of learner characteristics forces careful consideration to address an individual's specific learning requirements.

Children for example, have their own perceptions towards receiving their learning instruction given to them through multimedia. Previous research, which focused on children's performance when learning from multimedia instruction, indicated there were elevated promises afforded by such ICT tools. However, the findings remain inconclusive (for example see: Grimley 2007; Silverman & Hines 2009). This disparity is due to the other factors or other learner characteristics, which should be taken into consideration, when designing for multimedia learning environments. Herewith, we are suggesting that investigating the way people process their information may provide a deeper understanding of the effectiveness of ICT multimedia tools which adopt such instructional pedagogies in helping the instructional/learning process. Individual cognitive learning preferences, as such depict which is their preferred and habitual approach to organize and represent the instructional information they receive. This characteristic potentially provides *"an extensive and more functional characterization of students"* (Messick 1984). Cognitive style is a human psychological dimension that is integrally linked to a person's cognitive system (Peterson, Rayner & Armstrong 2009), whereby it is unique and likely to be a fixed aspect of a person cognitive functioning (Riding & Rayner 1998).

In the cognitive psychology field, several cognitive style models have been developed. However, it should be noted that they have been derived from researchers' perspectives and varied contexts. Hence in attempting to settle on one definition, it widens the scope and becomes very confusing. Riding and Cheema (1991) consolidated and categorized these various cognitive styles models into two dimensions: the wholist-analytic and verbalizer-visualizer dimensions. The wholist-analytic dimension describes the way an individual processes the information they receive, whilst the verbal-visual dimension explains the information representation strategy an individual adopts as they think about the information they receive (Riding & Sadler-Smith 1997).

The cognitive styles model suggested by Riding has given rise to a computerized testing tool called the Cognitive Styles Analysis (CSA) system. The CSA is used to assess a person's position on the continuum for both wholist-analytic and verbal-visual dimensions, based on the computer-generated ratio. Despite the critics on its reliability (Peterson, Deary & Austin 2003), the CSA remains to be one of the most systematic and useful tools to identify a person's cognitive (learning) preferences. The CSA has been used by researchers for many years. Based on the two (Riding) dimensions of cognitive style, a person's cognitive preference is anticipated to be one of four style groups: analytic-verbaliser; analytic-visualiser; wholist-verbaliser; or wholist-visualiser. Each of the four style groups may have different basic preferences towards mode of instruction. Based on this catagorization, a learner from the analytic-verbaliser category may prefer text in contrast to those analytic-visualisers, who may perform better given a captioned picture or diagram. Therefore, it is likely that different individuals with different cognitive learning preferences will perform an other way in another instructional context.

Based on the arguments discussed above, this research was conducted to investigate the interplay between multimedia instructions offered in a web-based museum learning environment and the learners' cognitive style preferences. This paper provides the context of investigation as well as explaining the experimental design. The findings will be discussed based on the results of the single cognitive preference dimension (CPD) and the combination of the full Riding cognitive style dimensions (CCS).

2. CONTEXT OF INVESTIGATION

Many museums around the world have now ventured into the web-based environment. Consequently, it is pertinent to investigate the effectiveness of multimedia ICT tools that are being used to provide richer museum learning experiences for their visitors. This investigation foreshadows an innovative transformation of the instructional/learning environment; in conjunction with the more traditional role a physical museum plays in facilitating a formal learning experience. Furthermore, acceptance of web-based museums as being a medium of communication and shared information is now seen more as contributing to acknowledgement that museum institution supports such transformation. To this end, museums are taking the advantages afforded by the web-mediated ICT tools to enhance their communication and educative interactions. These

digital pedagogies support the physical museum experience, thus creating a new dimension for their visitors' affective experiences. The museum's role as a communication medium has long been recognized (Lord 2007). Hence, the use of multimedia instructions in the web-based museum is intended to boost the information delivery whilst foster learning (Mayers 2009). However, many suggest that even professionally developed instructions have failed to achieve recognizable learning benefits (Spector and Davidsen 2000; Schnotz and Lowe 2003). This heightened museum's communication role cannot be seen only as the process of delivering information; it also delivers knowledge acquisition opportunities to suit the museum's educational aims and objectives. The opportunities offered by the web-based environment may provide a wider (cognitive) space for online visitors in their information processing (or meaning making).

As a result it is important to note here that it is the way information is represented influences how individuals attend to appropriate pieces of information (Kolloffel et al. 2009; Mendelson & Thorson 2004) that challenges both learners and designers. The fact that learning is highly influenced by the environment in which learning takes place (Gagne, (1985) has been reflected in the contextual model of museum learning (Falk & Dierking 1992; 2000), The situation in which the role of context is emphasized, contemplates that learning is a process occurring under certain instructional conditions, with the effects likely to vary among individuals (Gagne 1985). However, it is important to differentiate between learning and instruction, as learning theories explain what happens in the learner's head whilst instructional theories describe the conditions which facilitate learning (Reigeluth 1983). There are extensive changes in the supporting technologies available, whilst enriching the museum learning experience. It could be argued that the potential of such technologies may only be realized if the design and use of the ICT tools are designed and developed drawing upon our understandings of how the users learn Laurillard (2006).

It is with this background that this research project was conducted on an exploration of students' learning experiences in an online museum environment. The research aim was to investigate the relationship between the museum's ICT enhanced (multimedia) instructional strategies with students' cognitive learning preferences in their museum learning performance. There is still much to be discovered about how learners interact with multimedia enhanced instructional strategies online. Exploring the learners' individual cognitive preferences provides an insight of their working memory during the learning process hence afford a better understanding of the relationship between the two factors. This increased understanding will assist to identify the instructional conditions, which enable and facilitate, rather than hinder the learning process.

3. THE EXPERIMENTAL DESIGN

There were 91 schoolchildren age 10 to 12 years old chosen to participate in this research. They visited the museum (brought there on a special but, by their teachers as an educational field trip). They were to learn from a certain exhibit that related to what they would be expected to learn in their classroom setting. This group of children were recruited using a convenient sampling technique from three schools. Their prior knowledge was considered in the experiment's design. They were anticipated to share similar familial backgrounds and to have received the same level of educational experience as others of the same group.

The fieldwork-experiments employed a three-phase quasi-experimental design. The first phase involved a screening test to measure the participants' cognitive preferences, using the CSA (Riding 1991) screening test. The CSA and a pre-test were conducted prior to the children's museum visit. The purpose was to determine their prior domain knowledge as it related to the forthcoming museum exhibits. Based on the cognitive preferences identified from the CSA, the participants were assigned into the treatment groups; the children were given either the web-based museum instruction (T1) or the physical museum visit as their treatment (T2). Despite the distinctively different environments for T1 and T2, the multimedia instructions were the same (besides some other parts of the web-sites that offered instruction in other instructional formats such as video). Due to that disparity, for the purpose of this experiment, the T1 participants' access to the online exhibits was limited to the digital (computerized) instructional parts that replicated the instruction in the physical museum only treatment (see explanation in Figure 2).

In the second phase, each treatment group was given access to the online museum or the physical museum treatment respectively. For the online session, 30 minutes was allocated to the participants to browse the existing web pages of the Dinosaur Walk exhibition in the Melbourne Museum website (Figure 1). Meanwhile, participants of the physical visit treatment group were taken to physically explore the Dinosaur Walk exhibition (for example, see Figure 2 and Figure 3) in the Melbourne Museum within the same length of time. The experiment was concluded with a post-test given to the children immediately after receiving their T1 and T2, to measure any improvement in the cognitive performance (or learning outcomes) derived from their museum visit as learning experience.

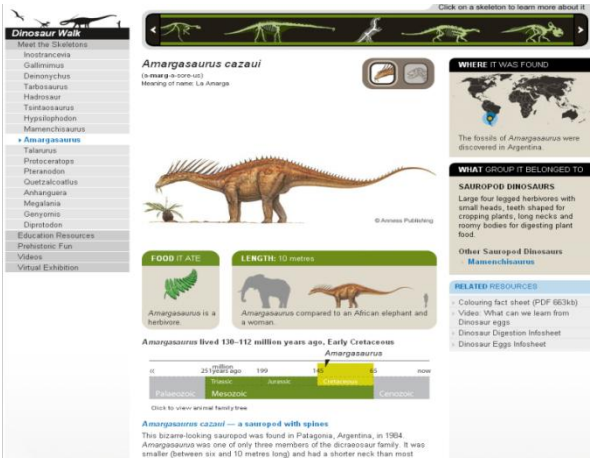
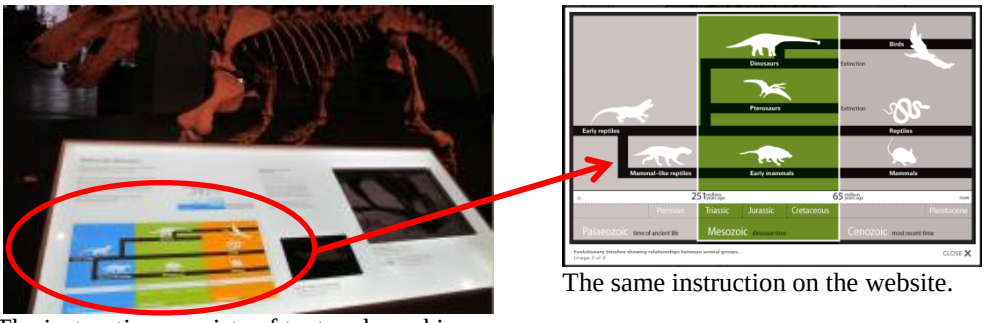


Figure 1. A page consists of the information of a dinosaur (courtesy of Melbourne Museum).



The instruction consists of text and graphics on display in the physical museum.

The same instruction on the website.

Figure 2. Example of exhibits display in the physical museum exhibition.

Figure 3. Dinosaurs' skeleton on display at the physical exhibition.

4. ANALYSIS AND RESULTS

The data gathered from the fieldwork experiment was then analysed using the Winstep Software that applies Rasch Measurement Model. The model is probabilistic and inferential therefore allows analysis of an individual performance relative to the instrumentation as "*the person ability and item difficulty are conjointly estimated and placed on a numerical scale*" (Sick 2008) called logit. A logit is a unit of measurement described as "interval scale in which the unit intervals between locations on person-item map have a consistent value or meaning" (Bond and Fox 2007) or referred as uni-dimensionality. This occurs when the data fit the model and reliability of item placement is established.

The data analysis discussed in this paper was conducted by looking at the single CPD values that differentiated between the wholist-analytic and verbaliser-imager dimensions; extending to the combination of the CCS described earlier as: wholist-verbaliser; wholist-visualiser; analytical-verbaliser and analytical-visualiser. The analysis of mean score intends to identify the relationship between the cognitive styles and the multimedia instructions with students' learning performances for each treatment respectively. To do this, the mean score for the specific CPD and CCS was compared within and between treatment groups in order to identify the relationship.

In general, the mean analysis indicated that the overall performance of participants in T2 were better, as compared to those in T1 for both CPD and CCS. For CPD, the result yields a mean score of 43.0 for T2 over T1 with mean score of 39.1. When comparing general performance of each CPD in between treatments, the result was consistent with the earlier analysis which indicated that each CPD (wholist, analytics, verbaliser and visualiser) demonstrated a better performance with the T2. Further analysis of CPD in T1 revealed that the verbalisers recorded the highest mean score of 39.9. Whilst the wholist mean score was slightly lower at 39.5. Analytics and visualisers were found to be at par in their performance with a mean score of 38.6 and 38.5 respectively. Analysing the result of CPD in T2 shows that all CPD had higher mean scores in T2. Nevertheless, the highest score was obtained by analytics with mean score of 44.8. Verbalisers that previously scored the highest in T1 were revealed to have the least mean score at 42.6. Overall analysis of CPD showed that analytics performed better than wholists in T2; yet the results was vice versa with T1. As for the verbaliser-visualiser dimension, the verbalisers achieved better scores with the T1, compared to the visualisers. However, both the verbalisers and visualisers' mean scores were found slightly differ with the T2. This analysis is simplified in Figure 4.

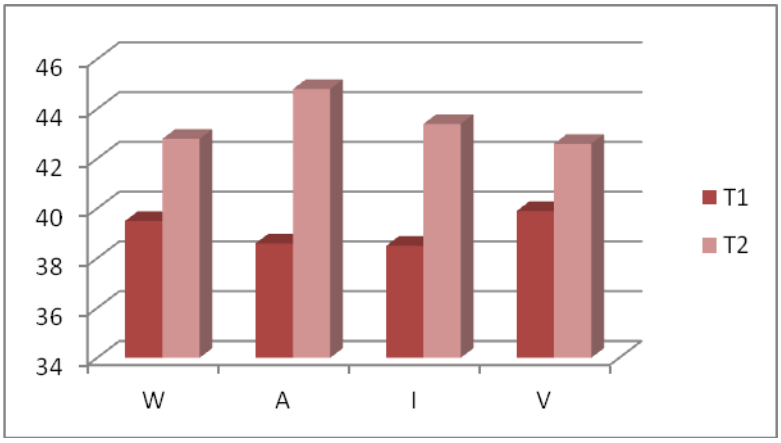


Figure 4. Mean score analysis of CSD according to treatment

Further analysis was conducted for CCS. In general it resulted showing that the analytic-verbalisers and wholist-visualiser achieved leveled performances with mean scores of 41.8 and 41.7 respectively. Whilst the wholist-verbaliser mean score was 40.9; the analytic-visualiser scored the least at 37.3. Analysis of CCS for each treatment provided further detail of their performances. For T1, the analytics-visualisers were found to score the least with a mean score of 35.7; whilst the analytics-verbalisers demonstrated that their highest ability was to score at the 40.4 level. The wholist-verbaliser and wholist-visualiser performed equally well with mean score differences of only 0.2. The mean scores analysis in T2 revealed that the analytics-

verbalisers group remained as the top scorers. On the other hand, wholist-visualisers performances were better compared to the wholist-verbalisers with mean score differences of 1.6. Interestingly, analytics-visualisers recorded a difference of 7.3 when compared with the mean scores in T1. The overall result for the CCS is depicted in Figure 5.

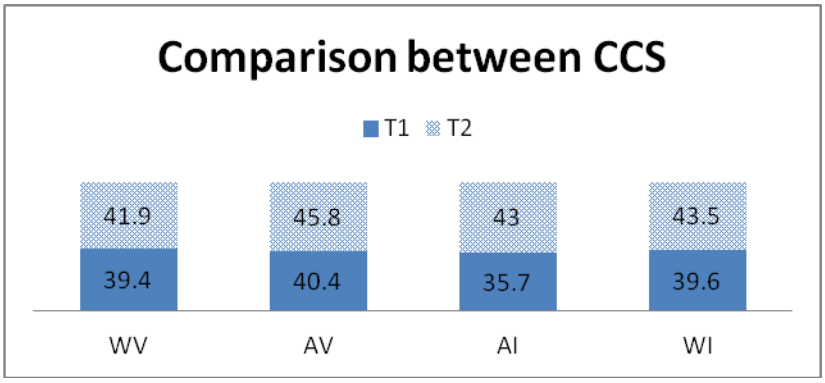


Figure 5. Mean score analysis between CCS according to treatment

5. FINDINGS AND DISCUSSION

The aim of this paper aims was to explore the effects of cognitive learning preferences; namely the verbaliser-visualiser and wholist-analytics dimensions on children's museum learning experiences. The research was conducted by focusing on the web-based museum exhibits whilst comparing them with the physical museum exhibit for the Dinosaur Walk exhibit. The data analysis was conducted in two stages. The first was by comparing between single CPD and within the CCS. For the analysis of CPD, the results demonstrate that wholists' performance was better than the analytics with T1 (the web-based museum exhibit environment). However, the results were vice versa with the T2; whereby the analytics achieved higher mean as compared with the wholists. The same pattern was also observed for the verbaliser-imagery dimension, where the imagers' performances increased with T2. Whereas, the verbalisers showed a decline with their T2 mean score. Further analysis on the means of both CPD revealed that both dimensions had an interaction with the different instructional museum exhibit formats; therefore suggesting that cognitive learning preferences do have an effect on museum learning performance.

On the other hand, the CCS analysis revealed that the wholists with preferences in either the verbal or imagery dimension, have similar performances with only slight differences in their mean scores. This result suggests that the wholists, whom presumably process information they receive as a whole (Riding and Cheema, 1991), benefited from the combination of text and graphical information in the web-based museum environment; despite their verbal or visual learning preferences. However, there was a significant difference for the analytics. From these results, it was shown that the analytics with verbal preferences performed the best, whilst the analytics with a visual preference performed the worst. This result indicated that the analytics outperformed the wholists in their web-based museum learning performances when they were a verbaliser.

The way information is presented in a physical museum (scattered individually as objects or individual exhibits) allows analytics to process the information in chunks (Riding and Cheema, 1991). Hence they perform better than the wholists. Whereby, the combination of both textual and graphical information received in a web-based museum gave more advantages to children who were verbalisers than the visualisers. As suggested by Kim and Gilman (2008), reduced amounts of screen-based text provide ample space for graphical instruction that assists certain learners to understand better. However, combination of both textual and graphical instructions displayed together in a web-based museum exhibit may also distort the focus and concentration of the visualisers; conforming to the findings by Schnotz, Bannert and Seufert (2002). Besides, as some of the information was displayed in either text or graphical format only; this may possibly cause the visualisers to focus more on the images and miss some of the verbal information.

Both the CPD and CCS data analysis demonstrates that the visualisers had lower performances with the T1 as compared to the verbalisers. This result therefore suggests that findings from this research are contradicting the previous findings of Parkinson and Redmond (2002), and Riding and Douglas (1993), when they suggested that the visualisers should perform better with combination of text and graphics in a learning environment when compared to the verbalisers. However, the premise remains true for the physical museum exhibits.

6. CONCLUSION

This study investigated the effectiveness of multimedia instruction strategies that contained text and graphics, in delivering museum information, particularly in a web-based exhibit environment. A comparison was made to the traditional museum exhibits that offer similar information using the same multimedia instructional formats. Obviously, general performances of the participating children were better in the physical museum context when compared to the web-based museum environment. This finding indicates that a web-based learning space is useful; yet the traditional learning context remains as the most important. Based on the results discussed earlier, it can be concluded that web-based museum exhibits using the combination of both textual and graphical information benefits both wholists and analytics. However, the nature of the web-based information representation with such combination may provide more advantages to verbalisers than visualisers. Nevertheless, this paper only reports the comparison between the instructional strategies of the museum exhibits (web-based and physical museum exhibits). For future work, it would be interesting to explore further in other web-based environments. Factors such as the use of frame or information structuring and other interface design issues that are likely to interact with cognitive learning preferences to affect the instructional/learning performance. Additionally, involving users during the design and development or evaluation process of such learning environment may also provide richer information and detail understandings.

Apart from that, the study also revealed that children with certain cognitive preference may perform differently (in physical and web-based museum environment). This result has resulted from the way they process the information they receive. Whereby a verbalizer was assumed to perform better when given textual instruction and imager should achieve better when dealing with a graphical instructional strategy. However, when it comes to multimedia instructions that combine both text and graphics, the findings could be different depending on the context of investigation. As discussed earlier, this study demonstrated that the combination of text and graphics gave more advantages to verbalizers than visualisers. Looking at the wholists-analytics dimension, the findings revealed that the wholists preferred the physical museum exhibits, compared with a web-based exhibit; whilst the analytics performed better in the web-based museum setting.

The overall conclusion that is drawn here is; it is necessary to have a good understanding of the relationship between multimedia instructional formats to be offered (in facilitating the learning process) with the way learners perceive the instructional information. To do so, an investigation may be essential to provide a deeper understanding of the learning settings as each is unique and may be different from other learning environment. Furthermore, those findings from other research could be helpful in guiding the design of a learning environment. Yet specific consideration of that particular context will provide more explicit understandings towards designing more effective instructional/learning strategies. Furthermore, this study also demonstrated the importance of allowing for learners' cognitive learning preference differences when designing multimedia instruction. This means to cater for a broader range of human cognitive abilities (McKay 2003).

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HOW DOES THE 'DIGITAL GENERATION' GET HELP ON THEIR MATHEMATICS HOMEWORK?

Carla van de Sande, May Boggess, & Catherine Hart-Weber
Arizona State University

ABSTRACT

Homework is a daily activity for at least twelve years of most students' school experience, and every assignment requires the time, energy, and emotional engagement of all those involved. Traditionally, students seeking homework help could refer to their class notes and textbooks, or ask their friends, tutors, and, perhaps, as last resort, their parents. Now, however, the Internet has greatly extended the set of resources to which students have ready access. By going online, students can read tutorials, watch videos, and even seek personalized homework help from a large community of others in online forums. Students who are currently in high school have grown up with computers, mobile devices, and other technologies that make Internet access a convenience, if not an expectation. Given their exposure to technology, together with an expanded pool of readily available resources, how do students today seek help on their homework? In particular, what resources (digital versus non-digital) do they favor and to what extent? This paper documents how a large population of USA high school students seeks help on their mathematics assignments. Comparisons between students in remedial, core, and advanced courses are also made.

KEYWORDS

Digital resources, Help seeking, Homework, Mathematics, Net Generation.

1. INTRODUCTION

For at least twelve years, homework is a daily activity in most students' schooling experience. Every assignment requires the time, energy, and emotional engagement of all those involved. Traditionally, students in need of help could refer to their class notes or textbooks, or they could ask their teacher, their friends, and, perhaps, as a last resort, their parents (Cosden, Morrison, Albanese, & Macias, 2001; Epstein & van Voorhis, 2001; Hoover-Dempsey et al., 2001; Solomon, Warin, & Lewis, 2002). Now, however, the Internet has greatly extended the set of resources to which students have ready access. By going online, students can read tutorials, watch videos, and even seek personalized homework help from a large community of others who take part in online forums. Students who are currently in U.S. high schools have grown up with computers, mobile devices, and other technologies that make Internet access a convenience, if not an expectation. Given their exposure to and familiarity with technology, together with an expanded pool of readily available resources, how do students today seek help on their homework? In particular, what resources, digital versus non-digital, do they favor and to what extent?

This paper addresses these questions by documenting the help-seeking habits of high school students on their mathematics assignments. Drawing together themes that have emerged from research on homework, the 'Net generation,' and digital resources, we sought to answer four major questions through a survey of more than 1800 students:

1. What resources do high school students use for mathematics homework help, and with what frequency? a) How does their use of online versus offline resources compare?, and b) Are there differences in resource usage between students in remedial, core, and advanced mathematics courses?
2. In what locales do high school students complete their mathematics homework?
3. How much help do students perceive they need compared with what they currently receive?
4. How is desire for help related to resource use and awareness of existing free digital resources?

1.1 Previous Research

A theoretical framing of help seeking as a legitimate learning activity (Nelson-Le Gall, 1985) with a broad impact across varied educational settings sets the stage for our study which hones in on the homework help-seeking habits of today's high school students.

1.1.1 Homework

Homework is a shared part of the daily school routine for students across different grade levels, generations, and even nationalities. Because homework plays such a central role in instruction, it has been an active area of educational research for almost a century (Cooper & Valentine, 2001). Although the findings of individual studies from within this corpus are often conflicting, syntheses of this body of work give a good sense of the relationship between homework and achievement, attitudes toward homework, and homework help (Cooper, 1989).

One of the major purposes of homework is to provide students with additional academic practice and learning opportunities outside of class. Without homework, most instructors find it impossible to cover curriculum content, and thus view it as an essential ingredient for learning and achievement (de Jong, Westerhof, & Creemers, 2000). Indeed, in a quantitative synthesis of numerous studies comparing homework with no-homework, homework with supervised study, and measuring differing amounts of homework completed, Cooper (1989) found support for a positive relationship between doing homework and achievement with few exceptions. Furthermore, the evidence from all three types of study suggested that the relationship between homework and achievement was influenced by the students' age or grade level. Doing homework was more strongly associated with achievement in high school than middle school, and in middle school than in elementary school. Of course, any positive association between homework and achievement is also mediated by whether or not students receive feedback on their work (de Jong et al., 2000) and by the quality of the assignments (Epstein & van Voorhis, 2001).

Given the increasing role homework plays in achievement over the course of schooling regardless of student ability (Keith, 1982; Keith, Reimers, Fehrmann, Pottebaum, & Aubey, 1986), it is unfortunate that on average few students in higher grades do all of their homework. They may be suffering from sheer frustration (Anesko, Schoiock, Ramirez, & Levine, 1987) or simply not ascribe to the same beliefs about the benefits and purposes of doing homework as do adults (Warton, 2001). In particular, students do not view homework as a way of learning valuable time-management or study skills, even though parents may reduce the amount of help that they provide in the expectation that their children will become progressively more autonomous and personally responsible. In addition to perceiving their support role as becoming more emotional rather than academic over time, parents may also become less actively involved in homework because of feelings of inadequacy (Epstein & van Voorhis, 2001), inadequate information (Hoover-Dempsey et al., 2001), and the tension that often results when they become involved (Solomon et al., 2002). Some of the slack in providing students with homework help has been taken up recently by after-school programs and tutor centers (Cosden et al., 2001). Here, tutors can offer effective face-to-face help and support as students work on their homework assignments.

However, technology now provides the opportunity to expand help seeking support from such small-scale, local tutoring locales to much larger, geographically dispersed communities and learner networks (van de Sande & Leinhardt, 2007). The question here is whether, given their familiarity with and exposure to sophisticated technology, the ability to relocate homework help and expand available resources is something that students today value and of which they take advantage.

1.1.2 The Digital Generation

The last decade has seen a massive proliferation of increasingly sophisticated information communication technology (ICT). This boon in ICT has naturally led to questions and concerns regarding the fit between the educational system and the wants and needs of students who became young adults at the time. Although authors differ on the exact date brackets, students born roughly between the early 1980's and the early 2000's are said to belong to the "Net generation" (Tapscott, 1998, 1999, 2008) and are characterized as "digital natives" (M. Prensky, 2001a, 2001b) because of their familiarity with and reliance on ICT. Other authors use the term "millenials" to emphasize that it is exposure to technology, rather than age alone, that characterizes developing trends in how students learn (Howe & Strauss, 2000; Oblinger & Oblinger, 2005). However,

whether using a definition based on age or exposure, proponents for the 'digital movement' hypothesize that today's students have distinct characteristics that set them apart from previous generations and that radically shape how they learn. The claim is that students are now active experiential learners who are facile with multi-tasking and who rely on communication technologies to access information and interact with others. Based on this characterization of new learning styles, commentators warn that the current educational approach is ill suited for the task of helping students learn and must be overhauled in order to adequately serve this new cohort of students: "Our students have changed radically. Today's students are no longer the people our educational system was designed to teach" [emphasis in original] (Marc Prensky, 2001, p. 1). The prediction is that dire consequences will result if there is not a radical change in how students are taught all subjects at all levels.

However, not all researchers agree with these exhortations for full-scale educational transformation. Bennett, Maton, and Kervin (2008) scrutinize two major assumptions underlying the claim made for the existence of a generation of 'digital natives.' Specifically, they question whether students in this generation possess truly sophisticated technological skills and whether they have different learning styles compared with previous generations of learners. Based on their critical review of the research, they find little support for these assumptions. The conclusion reached is that the outcry for the necessity of radical educational reform to meet the needs of the 'Net generation' instead can be construed as a form of 'moral panic' or hype, rather than being empirically and theoretically informed. In its place, they advocate for a more thorough characterization of how today's students interact with ICT, a goal that can only be achieved through "considered and rigorous investigation that includes the perspectives of young people and their teachers, and genuinely seeks to understand the situation" (p. 784). Accordingly, several researchers have answered this call with attempts to flesh out the role ICT actually plays in students' lives, and specifically with regard to ways in which they learn (Helsper & Enyon, 2009; Jones, Ramanau, Cross, & Healing, 2010).

1.1.3 Digital Resources

How might students of the Net generation use ICT to get help on their homework in ways that differ from the help available to previous generations? There are numerous digital resources that relate to homework help, many of which are available at no cost. Students who have questions on their coursework can readily find either generic help (e.g., by watching an instructional tutorial) or more personalized help (e.g., by interacting with others on an online forum). By typing their query into a search engine, students can almost instantaneously get a list of documents or webpages that might contain the sought after answer, or they can get answers to factual queries directly by using a sophisticated computational engine (such as Wolfram Alpha). These are just a few of the ways in which ICT has made it possible for students seeking help on their homework to have a wealth of information and communities at their fingertips.

However, although we know that 95% of students ages 12 – 17 access the Internet (Madden, Lenhart, Duggan, Cortesi, & Gasser, 2013) much less is known about how students are using the Internet for homework help. For instance, although Khan Academy (www.khanacademy.org) has published more than 4,000 instructional videos covering K-12 school topics, we do not know (other than anecdotally) how watching these videos translates into learning or resolving student questions. With regard to the use of open online homework help forums, we know a little more. In particular, members of some of these forums demonstrate a strong sense of virtual community in that they share responsibility for participation, take on different roles, and work to create a safe place for people to share their thoughts and (lack of) understanding (van de Sande & Leinhardt, 2007). Furthermore, because forum exchanges are archived as discussion threads, it is possible to make inferences about the effect of the interaction on student understanding (van de Sande, 2010). In a sample of 100 discussion threads on the topic of the limit from one mathematics help forum, it was possible to infer something about how the student perceived the helpfulness of the interaction in 36 cases; the student demonstrated increased understanding of the problem solution in 23 of these threads, expressed gratitude and thankfulness in 10 of the threads (which may or may not have signaled deeper understanding), and only indicated remaining uncertainty and confusion as the last communication in 3 of the threads. Naturally, these percentages will vary depending on the culture, norms, and practices of the site being investigated (van de Sande, 2010) and do not say anything about long-term learning outcomes, but such studies of resolution and participation do contribute to our understanding of how students who belong to the 'Net generation' are using at least some types of digital resources for seeking homework help.

2. PARTICIPANTS AND METHODS

Students and teachers in all mathematics classes at a large public high school (enrollment of approximately 3000 students in grades 9 – 12) in the southwestern region of the US were surveyed on their homework practices. The school was chosen because it is one of the most representative campuses in the state, with a racial and economic distribution that matches the state average: 51% white, 34% Hispanic, 7 % African American, 4% Asian, and 3% Native American and 60% of the students qualify for Free/Reduced lunch. This study was approved by the Institutional Review Board at the researchers' university, and permission to collect the data and report the findings was granted by the principal and the school district.

The purpose of surveying both teachers and students was to establish the nature of the relationship between teacher policies and self-reported student help-seeking activities. For instance, if teachers approve a particular help-seeking activity, such as taking and using detailed class notes, students may be more likely to gravitate toward using that resource. This paper focuses on the results of the student survey; the results of the teacher survey will be published separately.

The researchers asked all mathematics teachers at the school to administer the student survey during a normal class session late in the semester, and teachers did so voluntarily. Classes at all levels were surveyed: Remedial, consisting of Standard Mathematics I and Skill Builder; Core, consisting of Algebra I, Algebra II, Geometry, Trigonometry and College Math, and; Advanced, consisting of Honors Algebra I, Honors Algebra II, Honors Geometry, Pre-calculus, and AP calculus. Findings are reported across these different course types because we hypothesized that help-seeking strategies might differ depending on how advanced the course material was. The anonymous written student survey consisted of four questions in which students reported on the location where they completed their homework, the type and amount of help-seeking resources that they used, and their perceived need for help. In addition, students were asked about their familiarity with and usage of several popular digital resources. The survey was intentionally designed to be very brief in order to take up only a minimal amount of instructional time and encourage participation.

Exact binomial 95% confidence intervals were calculated for proportions. Independence of two categorical variables was assessed using a Chi-squared test. Averages are calculated with linear regression with bootstrapped confidence intervals, to accommodate lack of normality of residuals. Significance is reported at the 5% level. All data manipulation and statistical analyses were carried out in Stata MP v12 (StataCorp., 2012).

3. RESULTS

A total of 39 teachers and 2473 students participated, giving a response rate of 75%, with representation from every course with the exception of Consumer Mathematics. Participant students were between 14 and 19 years old. The overwhelming majority of the students (~85%) were enrolled in core courses, only approximately 10% were taking advanced math courses, and very few (~4%) were enrolled in remedial courses.

3.1 Resources

Figure 1 shows the percentage of students across course types (remedial, core, and advanced) who reported using a resource for seeking help and to what degree the resource is used for help in a typical homework assignment (for two or fewer problems, for some problems, or for most or all problems). In Figure 1, the results are collapsed across frequency of use: The graph on the left (never or infrequent) represents reported use of a resource for two problems or less, the graph in the middle (occasional) represents reported use for some of the problems, and the graph on the right (frequent) represents reported use of a resource for most or all of the problems on a typical homework assignment.

Below are the major finding for what resources students commonly use and the extent to which they use them:

- Digital resources are much less popular than traditional, non-digital resources for students enrolled in all levels of high school mathematics courses.
- Students do not generally seek help from others at home or from a tutor.
- Students in core or remedial courses who do have a tutor are more likely than students in advanced courses to ask for help on substantial portions of their assignments

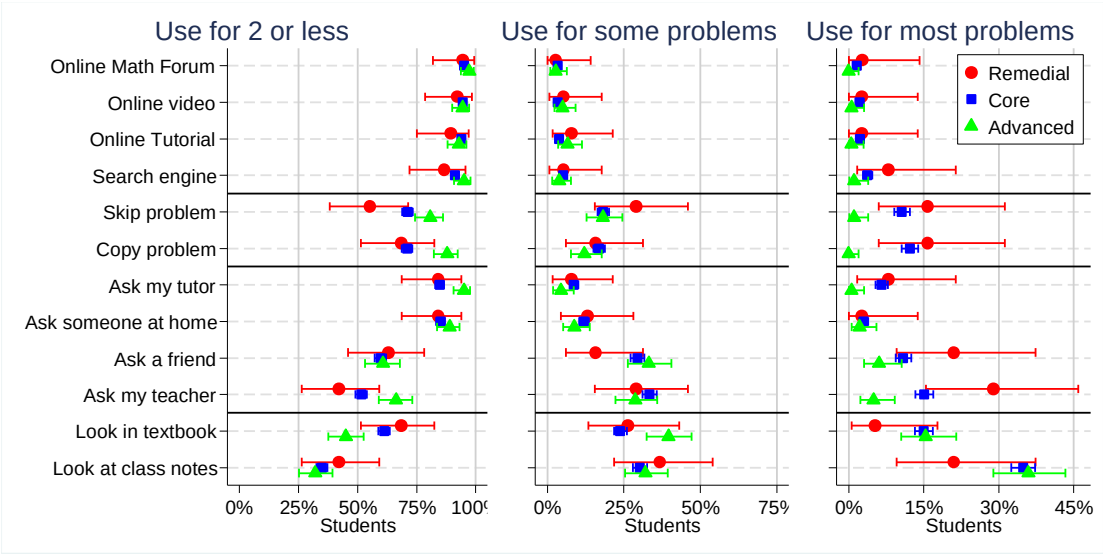

Figure 1. Percentage of students who reported using each resource on a typical homework assignment, by course level (Remedial, Core or Advanced) and level of usage, with 95% exact binomial confidence interval.

- Students seek help from friends and teachers more frequently than others at home and tutors, and this is especially true for students in remedial courses.
- Students in core and remedial courses are more likely than students in advanced courses to seek help from friends and teachers on substantial portions of their assignments.
- Students in advanced courses skip or copy solutions for only one or two problems on an assignment, whereas students in core and remedial courses are more likely to engage in these activities for substantial portions of their assignments.
- Textbooks are used infrequently by students at all levels, and this is especially true for students in remedial courses.
- Class notes are the most popular resource for seeking help on substantial portions of their assignments for students enrolled in core and advanced courses.

3.2 Locale

Table 1 shows the percentage of students enrolled in difference levels of courses by the locale in which they do their homework. Course level was a characterizing factor for where the majority of homework assignments are typically completed.

Below are the major findings for where students complete their homework assignments:

- Students in advanced courses generally complete their assignments at home and very seldom during class, whereas students in remedial courses complete large portions of their assignments in class and very little of their assignments at home.
- Students in core courses complete portions of their homework assignments in varied locations, although the largest portions of their assignments are completed at home.
- Study hall is not used frequently for completing homework by students at any level, and particularly not by students in remedial courses.
- In general, students who do homework in study hall complete less than half of their assignments there

Table 1. Percentage of students using each location to do a typical homework assignment and the amount of help wanted. P-values are from a Chi-square test of independence (Remedial N=37, Core N=1584, Advanced N=182).

		Amount of homework				P-value
Location	**Course Type**	**None**	**Quarter**	**Half**	**Most**	**Chi-sq**
At home	Remedial	29	37	16	13	
	Core	22	22	19	35	
	Advanced	5.5	11	14	69	0.00
In class	Remedial	2.6	26	39	32	
	Core	18	36	23	19	
	Advanced	47	40	7.1	2.7	0.00
In study hall	Remedial	58	16	7.9	11	
	Core	39	26	16	15	
	Advanced	43	37	9.9	6	0.00

3.3 Resource Awareness

Figure 2 show the percentage of students aware of various popular homework help websites. Below are the major findings for how aware students are regarding several popular digital resources:

- In general, students are completely unaware of the existence of several popular online homework help sites.
- Depending on course level, some online sites are more popular than others.

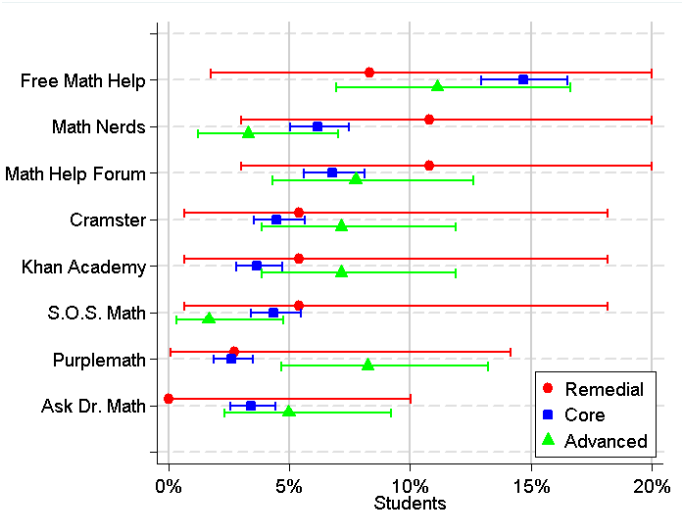

Figure 2. Percentage of students who reported having heard of each online resource, by course level (Remedial, Core or Advanced), with 95% exact binomial confidence interval (Remedial N=37, Core N=1584, Advanced N=182).

3.4 Need for Additional Help

Figure 3 depicts the relationship between the amount of help needed and awareness of digital resources. In general, students reported wanting more help than they are getting. Below are the major findings for how much additional help students perceive that they need:

- In general, students want more help on their math homework than they are receiving.
- As the level of course decreases the perceived need for additional help increases.
- The amount of extra help desired is independent of the awareness of digital resources for students in core and advanced courses.
- Students in remedial courses who are aware of at least two digital resources perceive that they need less extra help than those who have only heard of one at most or none at all.

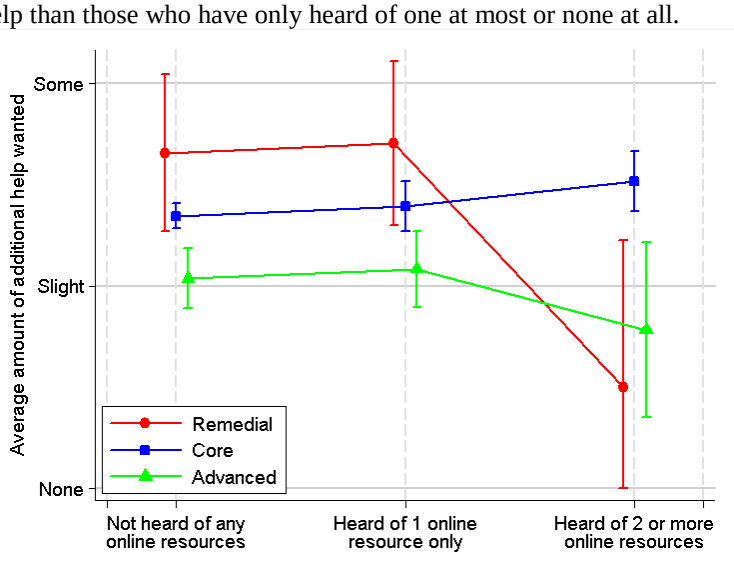

Figure 3. Average amount of additional homework help wanted, by the amount of online resources heard of, and by course level (Remedial, Core or Advanced), with 95% confidence intervals estimated from bootstrapped linear regression model (N=1,729).

4. CONCLUSIONS

4.1 Limitations

The use of a brief survey instrument to investigate homework help-seeking resources allowed us to gather information from a large number of students with relative ease. However, this design choice has several limitations that lead to open questions. Because results were based on self-reporting, there is no way to assess the validity of students' descriptions of their help-seeking habits. This said, we are cautiously optimistic that students were for the most part honest in their reports; on the questionnaire, they freely admitted to the unsanctioned practice of copying problem solutions from others. In addition, though, even if students were straightforward in their responses, they may have had differing interpretations of the terminology used in the survey, such as 'similar problem type' or 'online tutorial.' Related to this, students may only have known some of the digital resources listed by their logo, and may not have recognized them by name.

The survey also did not address questions about general technology availability and use. The assumption made was that students would gravitate toward resources that were viewed as most helpful. However, it is also possible that circumstances, beyond just the location where homework is done, dictate how students seek help. Items that ask students to describe their access to the Internet and their use of technology would be informative additions to this survey.

Furthermore, it would be useful to consider how various resources relate to achievement. If students are able to perform well in math class by relying almost exclusively on their class notes for homework help, then they presumably have no need for other available resources. The results of this study suggest that students may be learning through experience that any 'important' information can be found in their notes. This calls for an investigation of what students' class notes look like, how the content of their notes compares with class instruction as well as with homework and exam questions, and how all of these factors relate to learning and understanding.

4.2 Summary

This study shows that students seem to gravitate toward using traditional rather than digital resources for seeking homework help. At the same time, although many students express desire for more help, they are unaware of the existence of several popular, freely available digital resources. These patterns of resource familiarity and use may reflect students' beliefs about homework, governed by the level of course they are taking, as a school-centered activity, as well as the nature of the resources themselves. In particular, it would be worth researching what digital resources are being used and how by remedial courses since they reported needing less help as their awareness of available resources increased. Another line of research concerns note-taking and how this activity relates to achievement, particularly as students transition from a more structured high school setting to that of university, and, even perhaps online instruction.

In sum, these results raise important issues about resources and their use in instruction. It is important for instructors and researchers to discuss the role of available resources for providing homework help, the quality and affordances of different resources – both digital and non-digital, and to find ways to help support students in their use of these resources. The point is not whether students in the 'Net generation' are doing their homework differently than other generations – but rather how we can maximize their opportunities to develop deeper understandings of mathematics as they work on their assignments.

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PRODUCTIZATION AND COMMERCIALIZATION OF IT-ENABLED HIGHER EDUCATION IN COMPUTER SCIENCE: A SYSTEMATIC LITERATURE REVIEW

Irja Kankaanpää[1] and Hannakaisa Isomäki[2]
[1]*Postdoctoral researcher, Department of Computer Science and Information Systems*
[2]*Research Director, Adjunct Professor, Department of Mathematical Information Technology*
P.O. Box 35, FI-40014 University of Jyväskylä, Finland

ABSTRACT

This paper reviews research literature on the production and commercialization of IT-enabled higher education in computer science. Systematic literature review (SLR) was carried out in order to find out to what extent this area has been studied, more specifically how much it has been studied and to what detail. The results of this paper make a contribution to research by indicating a gap in the recent literature concerning the production and commercialization of higher education on practical level.

KEYWORDS

Commercialization, higher education, productization, systematic literature review, IT-enabled learning

1. INTRODUCTION

The productisation of information technology (IT) enabled higher education is one way to improve the competitiveness of educational organisations, and also the key factor to the global market. Thus, IT-enabled higher education entails many opportunities as it requires careful planning, resources and adoption of the new teaching culture. In order to ensure both the quality and effectiveness of IT-enabled higher education, educational institutions need to consider productization of their higher education.

Productization refers to the modification of a material good or an immaterial service, or their combination, into a commercial product that can be replicated in large quantities using a certain method. In an educational context, the target of productization may be for example course or program, training or consulting service, learning materials and content, learning technologies, or related research results and services. Successful productization necesitates that the company identifies its core competence areas and the possible additional or supporting services (Sipilä 2005.)

A systematic literature review (SLR) was carried out in order to identify current practices for the productization of IT-enabled higher education in computer science. Firstly, we present the SLR method applied, and secondly, the results and, finally, conclude by discussing the resulting nine categories of commericalization and productization of higher education found by the SLR.

2. RESEARCH METHOD

The research process follows Kitchenham et al. (2010) by including the following steps: defining the research questions, describing the search process, describing the how the included papers were selected, quality assessment, and data extraction process. Other guidelines for conducting a SLR (Okoli and Schabram 2010) were used in a complementary manner. The research was carried out by two researchers (later referred to as researcher 1 and researcher 2).

The purpose of our study is to identify studies reporting ways of productizing or commercializing IT-enabled higher education in computer science. Since we were aware of only a few of such studies, the research question was formulated in a broad sense so that it would capture the aspect of how much this area has been studied as well as the aspect of how deeply it has been studied: *"To what extent the commercialization and productization of higher education in computer science and information technology has been studied so far?"*

2.1 The Search Process

The search process started with word search in electronic databases. Researcher 2 searched eight digital libraries (on-line databases) and one automated search engine. The digital libraries included: ACM Digital Library, IEEE Xplore Digital Library, Web of Science, Science Direct, Education Resources Information Center (ERIC), EBSCOhost, InderScience Publishers, and Springer Link. Google scholar search engine was used to complement the above mentioned electronic libraries. The search was carried out between August and October 2011 and it was limited to articles published between 2001 and 2011. The following search words were used: *productization, commercialization, higher education, information technology, computer science, and information systems.* The word search was targeted at title, abstract, review, and keywords. The following combinations of search words were used as a base search for each electronic library:

1. "productization AND higher education AND commercialization"
2. "commercialization AND higher education AND productization"
3. "productization OR higher education OR commercialization"
4. "commercialization OR higher education OR productization"
5. "productization AND higher education OR commercialization"
6. "higher education AND productization OR commercialization"
7. "productization AND commercialization OR higher education"
8. "commercialization AND productization OR higher education"
9. "productization OR commercialization AND higher education"
10. "productization OR higher education AND commercialization"
11. "commercialization AND higher education OR productization"
12. "commercialization OR higher education AND productization"
13. "commercialization OR productization AND higher education"

These basic combinations were adapted to the particular search possibilities of each database. If the database did not have automatic lemmatization option, then the "z-search" was followed by identical search with "s-search" (e.g. productisation instead of productization). Advanced search was used as default if provided. The details of the literature search were recorded along the whole search process (see Okoli and Schabram 2010) in MS Excel file with appropriate metadata.

2.2 Paper Selection

Paper selection process took place in two phases (see Figure 1). Firstly, researchers 1 and 2 undertook an initial screening (Kitchenham et al. 2010) of the found 1559 papers. Papers were distributed to the researchers by database in a way that one reviewed all papers belonging to the allocated database. The researchers read through all the tittles, abstracts and keywords individually and marked each paper as excluded or included. The researchers then discussed about the selected papers and after reaching a consensus made a decision on which articles to exclude and which to include.

Secondly, quality screening was performed. Quality appraisal during the paper selection process was carried out as multiple coding by two researchers who checked the suitability and relevance of the articles regarding the topic of the study. Multiple coding was carried out as parallel coding of the articles and simultaneous discussion about the quality and content of the articles (Barbour, 2001). This way both the coding and content of the papers as well as inclusion and exclusion criteria were double checked during paper selection. The abstracts were read thoroughly and, if necessary, the whole paper was read in order to assess the compliance with the inclusion criteria. Next, suggestions were made for excluding papers that

appeared suitable at first glance but did eventually not meet with the inclusion criteria. Finally, the final included papers were discussed and consensus was reached.

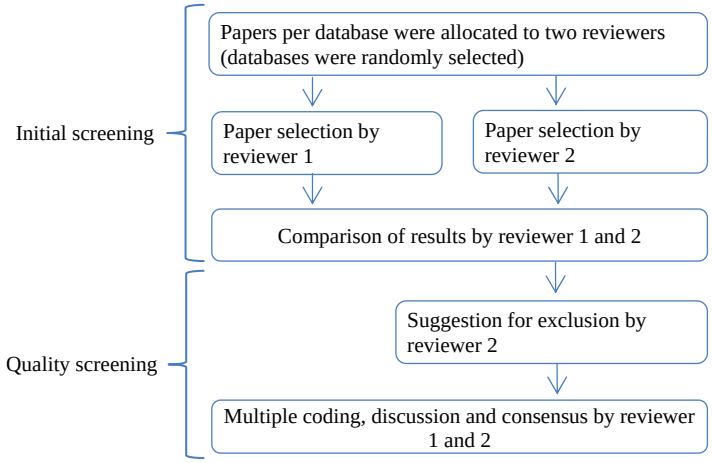

Figure 1. Paper selection process.

The criteria for inclusion were 1) the paper has to deal with higher education or university education, 2) the issue of commercialization or productization had to be present, and 3) the article has to be published in a refereed journal or conference proceedings. Articles concerning the commercialization or patenting of university research were included for additional value. The exclusion criteria included that the article 1) was concerned with lower level education (e.g., high school), or 2) was published on a non-refereed forum.

The initial screening reduced the amount of articles from 1559 to 126. This was followed by a redundancy check after which double articles were removed within the results. This was done in two steps: firstly removing the doubles within each database and then removing doubles across databases. After removing double-articles within each database the amount of articles was 78. After removing all the doubles across the databases and search engines, the amount of articles was 63. As a result of quality screening, 23 articles were removed after which the final amount of included articles was 40.

3. RESULTS

In comparing the content of the included 40 papers to our research question it was obvious that the results did not directly match to the focus of the study. Hence, a classification of the articles was carried out in order to define their subject matter. The articles were classified against the following criteria: distribution of articles by publication forum (journal, conference), and distribution of articles by subject (see Ngai and Gunasekarun 2007).

3.1 Distribution by Publication Forum

The identified papers were mainly published in refereed journals and conferences. The results include a total of 29 journal articles from 21 journals. The highest publishing results were in *Industry and higher education* (4 articles), *Scientometrics* (4 articles), *Globalisation, Societies and Education* (2 articles) and *Assistive Technology Outcomes and Benefits* (2 articles). The rest of the journals had published one article.

The articles were distributed in journals from various disciplines (see Table 1). Majority of the journal articles (24 articles) were published in journals on higher education and related fields. We classified these journals in five categories, namely higher education, teaching and learning, education policy and planning, educational technologies, and international education. The second largest category of journals (7 articles) was based on discipline. It was divided into subcategories of natural sciences, relationship between science and public, library sciences, and information processing and analysis. The third category of journals (1 article) was concerned with European policies.

Table 1. Distribution of papers in journals.

Subject Category	Journal name	Number of articles
1. Education		*(24)*
1.1 Higher Education	Industry and higher education	4
	Research in higher education	1
	Higher Education Quarterly	1
	Thought & Action	1
	Journal of further and higher education	1
	Higher education	1
1.2 Teaching and learning	Journal of University Teaching and Learning Practice	1
	e-Journal of Business Education & Scholarship of Teaching	1
	International Journal of Learning and Change	1
	Learning and Teaching: The International Journal of Higher Education in the Social Sciences	1
1.3 Education policy and planning	Higher Education Policy	1
	Journal for critical education policy studies	1
	The International Journal of Higher Education and Educational Planning	1
	Journal of Higher Education Policy and Management	1
1.4 Educational technologies	Assistive Technology Outcomes and Benefits	2
1.5 International education	Globalization, Societies and Education	2
	Russian education and society	1
	Journal of Studies in International education	1
2. Information sciences		*(5)*
2.1 Library sciences	Scientometrics	4
2.2 Information processing and analysis	Scientific and Technical Information Processing	1
3. European policies		*(1)*
3.1 Planning studies	European planning studies	1
Total		**29**

The results included 11 conference papers (Table 2). There was a great variety in the field and distribution of the conferences, which were categorized according to their subject area in the following categories: computer science, engineering, information technology, technology management, education management, and business management.

Table 2. Distribution of papers in conferences.

Subject category	Conference name	Number of articles
Computer science	IEEE International Conference on Fuzzy Systems	1
Engineering	Canadian Conference on Electrical and Computer Engineering	1
	IEEE International Conference on System Engineering and Technology	1
	IEEE International Conference on Industrial Engineering and Engineering Management	1
Information technology	ICO International Conference on Information Photonics	1
	International Conference on Communication Systems, Networks and Applications	1
	International Convention on Information and Communication Technology, Electronics and Microelectronics	1
Technology management	IEEE International Technology Management Conference	1
	International Conference on Education Technology and Computer	1
Education management	International Conference on Education and Management Technology	1
Business management	International Conference on Business Management and Electronic Information	1
Total		**11**

The distribution of articles by publication forum indicates that our topic was over three times more popular in journals. The high dispersion in both journals and conferences indicates that there is no established journal for the topic.

3.2 Distribution by Subject

The articles were classified according to their subject content. Nine different classes were recognized: *commercialization of research, technology transfer, commercialization of education, educational reform, knowledge transfer, patenting, educational system, academic entrepreneurship, and technology commercialization effects* (Table 4).

Table 4. Classification of papers by subject.

Class #	Class name	Number of papers	References
1	**Commercialization of research**	8	Dube and Lisk (2011), Harman (2010), Hussain et al. (2010), Kerr (2011), Li and Xia (2011), Smith (2010), Suvinen et al. (2010), Yang and Chang (2010)
2	**Technology transfer**	7	Fraser (2010), Gonnova and Kavtaradze (2010), Lane (2010), Leahy and Lane (2010), Prokopiev (2011), Somsuk (2010), Wang and Cao (2010)
3	**Commercialization of education**	6	Arnold (2010), Naidoo (2010), Robertson (2010), Tait (2010), Tsai and Yang (2010), Wong and Westwood (2010)
4	**Educational reform**	5	Aboites (2010), Graeme and Peim (2011), Liu and Crossley (2010), Raciti (2010), Susanti (2011)
5	**Patenting**	4	Benneworth and Jongbloed (2010), Klitkou and Gulbrandsen (2010), Leydesdorf and Meyer 2010), Wong and Singh (2010)
6	**Educational system**	4	Allen (2010), Dubin and Zorkaia (2010), Shore (2010), Yassin et al. (2011)
7	**Knowledge transfer**	2	Bezic et al. (2011), Kuiken and van der Sijde (2011)
8	**Academic entrepreneurship**	2	Arapostathis (2010), Goldstein (2010)
9	**Technology commercialization effects**	2	Powers and Campbell (2010), Wong and Singh (2011)

Commercialization of research class includes nine papers on the enhancement or measurement of commercialization of academic research. It includes, for instance, framework through which the researchers can engage commercialization into the research process as a vital part of it (Smith 2010), perceptions of the success of innovation and research commercialization in Australia (Harman 2010), and the role of intermediary organizations (Suvinen et al. 2010) or university lawyers (Hussain et al. 2010) in the process of commercialization of academic research. Further, it includes studies on the influence of entrepreneurial commitment (Yang and Chang 2010) and federal funding (Kerr 2011) or governmental programs (Dube and Lisk 2011) on research commercialization. Also, the aspects of knowledge commercialization modes and effects in universities (Li and Xia 2011) were included. The papers in this class focus on the means of enhancing or measuring the commercialization of university research in general and do not provide results on the specific area of commercialization of higher education.

Technology transfer class includes seven papers that explain how to enhance, understand and analyse the academic technology transfer. These include factors explain factors influencing improving university technology transfer (Wang and Cao 2010), analysis of university-industry technology transfer programme's success (Somsuk 2010), measurement and enhancement of the impacts of technology transfer (Fraser 2010), enhancement of technology transfer and commercialization by business games (Gonnova and Kavtaradze 2010), description of how Canadian innovation and commercialization program enhances industry-academia technology transfer (Prokopiev 2011), the barriers and carriers of successful technology transfer of assistive technology devices in USA (Leahy and Lane 2010), and the confluence of academic research of technology transfer of assistive technologies for value creation (Lane 2010). These papers focus on technology transfer and not on education.

Commercialization of education class includes six papers on the commercialization of higher education in the changing global business context. Naidoo (2010) examines the export readiness of universities and its implications on export recruitment of students. Robertson (2010) studies the commercialization,

corporatization and competitiveness of U.K. universities emerging from the transformation of higher education toward globally competitive education system. Wong and Westwood (2010) provide empirical findings from the conflicting interests and tension that the commercialization pressure have brought at universities. Arnold (2010) addresses the same issue from university teacher's perspective while Tsai and Yang (2010) discuss about the role and profession of teachers in commercialized education. Tait (2010) studies the commercialization of education from the perspective of Chinese student in Western university format. These papers provide insights on the impact of the global commercialization pressure on university education. They fail to provide, however, views how to productize or commercialize higher education.

Educational reform class includes five papers discussing the strategic and political aspects of educational system reforms and related commercialization of higher education including experiences on marketing the university programmes in China (Liu and Crossley 2010), analysis of the privatization and marketization of higher education in Indonesia (Susanti 2010), the implication of the reform and commercialization of Australian higher education (Raciti 2010), a critical analysis of the negative implications of Bologna Process on Latin American universities (Aboites 2010), and results of the quality of exported higher education (Graeme and Peim 2011). These papers provide knowledge of national university reforms that have shifted higher education from traditional research to commercial business.

Patenting class includes four articles concerning the relationship between academic patenting and scientific publishing (Klitkou and Gulbrandsen 2010, Wong and Singh 2010), the development of university patenting due to external forces such as Bayh-Dole (Leydesdorf and Meyer 2010) and the unequal position of soft sciences in comparison to hard sciences in relation to patenting and commercialization (Benneworth and Jongbloed 2010). In this class, commercialization is related activities leading to patenting while academia is defined as a source for material for patenting.

Educational system class includes four articles reporting the current state of national educational systems. Survey results of Dubin and Zorkaia (2010) show that in Russia the higher education has social value. Yassin et al. (2011) presents an instrument for the evaluation of research performance and results of its use in Malaysian universities. Shore (2010) analyses the challenges of the modern university due to contradictory requirements between the traditional and new, economic and strategic pressures. Allen (2010) analyses the Royal Society's suggestions for enhancing science in UK and contrasts them to United States. The papers in this class address the issues of commercialization and higher education in national context by describing the country's educational systems with its characteristics and recent developments.

Knowledge transfer includes two articles on the transition of scientific knowledge from academia to public sector and commercialization of such knowledge. Kuiken and van der Sijde (2011) study the commercialization and dissemination of academic knowledge by using communication theory in interpreting the results. Their research provides topics for further research in relation to dissemination capacity. Bezic et al. (2011) discuss about the role of Croatian national technology transfer office as a channel for transferring university research results into economy. These studies include some elements of commercialization and higher education without focusing on commercialization process of higher education.

Academic entrepreneurship class consists of two papers studying the role of entrepreneurship within research universities and national politics. They focus on the position of academic entrepreneurship with respect to national politics and innovation policies (Arapostathis 2010), and on national attitudes toward entrepreneurship and commercialization of university (Goldstein 2010). The aspect of commercialization in these articles focuses on university research and innovation in relation to entrepreneurship.

Technology commercialization effects class includes two studies. Powers and Campbell (2010) argue that in U.S. universities the licencing or patenting of technologies do not have an effect on research productivity research. Wong and Singh (2011) examine university-industry collaboration by measuring the amount of university-industry co-publications on technology commercialization. These papers do not take a stand on the ways or extent to which IT-enabled higher education could be commercialized or productized.

4. CONCLUSIONS

The productization of IT-enabled higher education is one solution for improving the competitiveness of educational organisations, and to respond to the increasing demand for globalizing the higher education. We reviewed the current literature in order to identify ways in which the productization of IT-enabled higher

education in computer science has been done. The SLR yielded 40 papers, including 29 journal articles and 11 conference papers. The articles were classified according to their study subject into nine categories: academic entrepreneurship, patenting, educational system, knowledge transfer, educational reform, commercialization of research, commercialization of education, technology transfer, and technology transfer effects. Unfortunately, the results did not provide the answer that we were looking for. The results show that commercialization and productization of higher education has been studied on institutional, national and international level. However, studies concerning productization of courses, learning technologies, contents or learning materials, were not found. Based on this, we claim that there is a gap in research that requires further studying.

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MOTIVATING AN ACTION DESIGN RESEARCH APPROACH TO IMPLEMENTING ONLINE TRAINING IN AN ORGANISATIONAL CONTEXT

Christine Rogerson and Elsje Scott
University of Cape Town
South Africa

ABSTRACT

The purpose of this paper is to explore the effectiveness of Action Design Research (ADR), a combination of Action Research and Design Science Research, as a methodology to examine how the implementation of e-learning will affect the learning outcomes for staff training in an organisational context. The research involves an intervention in the finance course offerings for staff training in the workplace. The paper briefly introduces the research problem of an inflexible and inefficient finance training offering, and the proposed solution of implementing e-learning. It then describes the seven principles of ADR in detail, in a tabular format, with particular reference to their application in this study. The paper then summarises how the seven principles fit into the four stages of ADR, namely, (1) problem formulation, (2) building, intervention and evaluation, (3) reflection and learning, and (4) Formalisation of learning. After discussing the ADR principles and how they relate to the research study, the paper concludes with the suitability and advantages of adopting an ADR approach to e-learning research. These benefits appear to be meeting the challenge of IS as an applied discipline, by implementing a solution in a real world situation, whilst also adding to e-learning theory and academic knowledge.

KEYWORDS

Action Design research, E-learning, Organisational training

1. INTRODUCTION

In the light of the need to accommodate the continually changing business environment, the swift dissemination of relevant, up-to-date information is essential. When using an integrated financial system, changes in the system necessitate almost instantaneous communication, and are often accompanied by training issues. Apart from system changes, there is a basic requirement that the workforce have a working knowledge of the system, and the skill to extract relevant information from it. If as a consequence of insufficient or ineffective staff training, employees are not skilled or technically capable, then a major source of competitive advantage is lost, and the organisation's workforce cannot realise its full potential as a source of intellectual capital. Additionally, there appears to be a need for more input from IS research into the practice of e-learning in the workplace, specifically its effectiveness and on-going usage.

The immediate objective of this research is to convert the current instructor-led finance training courses for employees at an organisation to computer-based courses. The long-term objective is to create a learning environment that meets both the business need for a knowledgeable, skilled body of staff, as well as the individual adult learner's need for meaningful, practical and flexible instruction (Figure 1). The current instructor-led training is rigid as the venue and the trainer need to be booked, and the training schedule is set up a year in advance. This causes problems for trainees, trainers and line-managers. Having established that there is a problem situation, the difficulty is to employ a research methodology that has a practical outcome for the organisation, whilst simultaneously meeting academic standards of credibility, dependability and transferability.

Training Intervention Research Summary

- ***WHO?*** Specific members of the workforce that need access to financial system
- ***HOW?*** Computer based training courses (e-learning)
- ***WHY?*** Learn and/or upgrade technical skills & financial knowledge required to operate the financial system, as well as interpret financial reports (Business need) Meaningful, practical & flexible instruction (individual adult learner's need)
- ***LONG TERM WHY?*** Increased competitive advantage for organisation

Figure 1. Proposed research to investigate the change from classroom based to computer-based training for compulsory finance training

There has been debate as to the nature of Information Systems (IS) research, and where it situates itself, for some time (Lee, 2010; March & Niederman, 2012; Rosemann & Vessey, 2008; Walsham, 2012). Lee (2010) examined key concepts of IS research and concluded that the future of IS research may lie in the "sciences of the artificial", as distinguished from the "sciences of the natural" by Simon (1969). The over-riding knowledge requisite for this type of discipline is "its efficiency and effectiveness for bringing into existence an artefact needed to solve a given problem, achieve a given goal, or otherwise fulfil a given need that is facing people in the real world" (Lee, 2010, p346). This is an opposite view to that of the sciences of the natural, which seek to theorise about things that are already there. As the objective of this research is to intervene in a real world setting, and to make changes based on a designed artefact, two research approaches were considered, namely Design Research (DR), also known as Design Science Research, and Action Research (AR).

Arising from the debate regarding the IS discipline and how it should differentiate itself from other disciplines, such as Computer Science, it may be suggested that the IS discipline stands at the intersection of people, organisations and technology (Hevner et al., 2004; Lee, 2010; March & Niederman, 2012). According to Iivari (2007), Design Research (DR) is problem focused and seeks to design an innovative product, or artefact, that addresses unsolved problems within an organisation. In the context of this paper, artefacts are defined as software and/or hardware that are assembled to form the object to be implemented. This "object" inscribes certain organisational structures into its form as it emerges, involving more than just technology in its conceptualisation and goals. Sein et al. (2011, p.38) describe artefacts as "ensembles emerging from design, use, and ongoing refinement in context". There is a build and evaluate process which forms a loop which is usually iterated as the design is refined, before the final artefact is produced (Hevner et al., 2004). DR must also contribute to research by making "clear and verifiable contributions in the areas of the design artefact, design foundations and/or design methodologies" (Hevner et al., 2004, p83). However, a possible limitation of design science research is that the building of the artefact is separate from the evaluation step, and the value of the research lies in its ability to solve the original problem, rather than testing it in a real life setting (Baskerville et al., 2009; Sein et al., 2011). The intervention or introduction of the artefact into the organisation is a secondary factor for much design science research, as the primary factor concerns the actual design of the artefact and testing is often not taken out of the laboratory (Cole et al., 2005).

According to Baskerville & Wood-Harper (1996, p.243), "Action research is regarded by many as the ideal post-positivist social scientific research method for IS research". They base this statement on the premise that IS, being a highly applied field, requires integration with the psychological and social facets of changing or introducing a technology into the workplace. People are directly affected by these changes, and both monitoring and evaluating their reactions should perhaps be considered an important part of the research. It seems that acting on feedback or evaluations from end-users is an important part of a successful implementation, and action research would appear to be ideally suited to allow for this. In order to increase user acceptance of the online courses, it is felt that feeding user evaluations and comments directly back into the course design would be advantageous for both the trainees and the organisation. Action research involves a strategy of formulating theory (Baskerville & Pries-Heje, 1999) and the researcher not only intervenes but participates in the study, which supports an interpretive, anti-positivist philosophy. Action research is iterative in nature, and the implemented process or object is refined during the cycles. It also includes what McKay and Marshall (2001) refer to as the duality of action research, i.e. the researcher is both participant

and observer. The researcher is required to keep both roles in mind, and separated, as the study progresses. On the one hand, the researcher is acting as the manager of the intervention, and as such is directly involved in the intervention, whilst at the same time, the researcher is required to reflect on the process in order to answer the research questions and formulate theories or themes. According to McNiff and Whitehead (2006, p13), "The purpose of action research is to generate living theories about how learning has improved practice and is informing new practices". However, action research has frequently been criticised for the occurrence of personal bias or over-involvement of the researcher, lack of rigour, and has sometimes been labelled as consulting rather than researching (Baskerville & Wood-Harper, 1996).

The purpose of this paper is to attempt to address the reported limitations of DR and AR research approaches, by adopting the research method proposed by Sein et al. (2011). It is hoped that Action Design Research (ADR) will be effective in addressing an actual problematic situation in an organisational setting. The research encompasses the building of an innovative Information Technology (IT) artefact, whilst allowing feedback from the users and the organisation to influence the construction thereof in reiterative cycles, allowing both learning from the intervention, and simultaneously producing academic theory.

This paper may be of interest to any researchers seeking a research approach that meets the need for relevance and immediacy in an organisational setting, whilst also contributing to empirical research on the effectiveness or otherwise of e-learning, and adding to the body of knowledge regarding theories of organisational learning and training. The need for this type of IS research is endorsed by Baskerville and Wood-Harper (1996) from the AR perspective, and Hevner et al. (2004) from that of the DR perspective, and Cole et al. (2005), who investigated the use of both research methodologies.

2. ACTION DESIGN RESEARCH

Cole et al. (2005) feel it would be proactive of IS researchers to consider using both design science research and action research together in order to achieve a rigorously designed artefact that is evaluated in a real life organisational context to solve or to ameliorate a perceived problem within that organisation. ADR, as described by Sein et al. (2011, p.40), "is a research method for generating prescriptive design knowledge through building and evaluating ensemble IT artefacts in an organizational setting". It has been designed to address the challenge of assisting IS practitioners by intervening in real world situations, whilst also building theory that is academically rigorous. This also serves to answer the call of making IS research relevant to practitioners and other IS professionals, and "promoting engaged scholarship through action and design" (Conboy et al., 2012, p114). It seeks to overcome the perceived limitations of design science research (DR) and action research (AR), as well as addressing Iivari's (2007) concerns regarding the differences between the two methods. By placing the IT artefact at the centre, this methodology also addresses Orlikowski and Iacono's (2001, p.130) call to "increase attention and explicit consideration of IT artifacts in all (IS) studies". ADR has strict, explicit principles which are sometimes lacking in AR, whilst the iterations and simultaneous building, intervention and evaluation address the sequencing difficulties of DR, when attempting to use the designed artefacts in organisational settings. By not taking the setting or context of the organisation into account, whilst designing the artefact, DR does not usually capture its emergent nature. There is interdependence between design and use in the organisation, which needs to be captured or inscribed into the artefact. This interdependence is highlighted by ADR.

There are four stages in the ADR method. These are (1) problem formulation; (2) building, intervention and evaluation; (3) reflection and learning, and finally, (4) formalisation of learning. It is important to note that the four stages are not engaged within a step or waterfall sequence, but are cyclical and reiterative. Sein et al. (2011) also describe seven principles of ADR. These principles are detailed in Table 1 below, with particular application to this research.

Table 1. The seven principles of ADR, as applied to this research

	Principle	***Description (Sein et al., 2011)***	***Application***
1	Practice-inspired research	The problem is drawn from the real-world and is used to create knowledge regarding a class of problems, which are typified by this particular problem.	Real world problem: Need to accommodate continually changing business environment by swift dissemination of relevant, up-to-date information. Class of problem – effective, efficient use of e-learning as a tool that is accepted by both the business and the trainees. This problem – converting current instructor-led training to online training that continues to meet business need for knowledgeable, skilled workforce, whilst accommodating trainee's need for practical and flexible instruction.
2	Theory-ingrained artefact	The original design of the artefact is based on existing theories and technologies, but the design may change once it is evaluated within the organisation.	Extensive literature review of current e-learning body of knowledge resulting in an artefact (the online training module) that encompasses many success factors identified, and allows for learner feedback and evaluation. Review covers system design, system delivery and system outcome; learning approaches and strategies.
3	Reciprocal shaping	This is where the IT artefact and the organisational domain influence each other, causing an iterative cycle to be set in motion. The design of the artefact will change as it is used in the organisational setting, and the organisation may be changed by the use of the artefact.	Alpha version of artefact tested by other trainers, changes to module made based on feedback. Beta version launched in controlled conditions (i.e. in lab, with instructor present, but all other conditions of online environment met – duration, test taken at learner's discretion). Further changes made to module based on learner feedback. Appropriately trained, motivated and enabled workforce has positive effect on organisation's financial reporting, leading to more modules, with targeted objectives, being offered online.
4	Mutually influential roles	This refers to how the multiple participants in the ADR project share their specialised knowledge and learn from each other. The researchers bring in the theory and the practitioners bring in the work practices.	Researcher designs course module using knowledge of best practices gained from literature on e-learning, with input from practitioners regarding course content, and specific working environment. With reiterative cycles, workforce input also influences shaping of module.
5	Authentic and concurrent evaluation	This means that the process of evaluation is never separated from the building and intervention, but is an integral part of both. Depending on the form of the artefact, evaluation can be either formative or summative, but must always be allowed to occur spontaneously in the organisational context, rather than in a controlled setting.	The initial course module is built and offered to trainees, in working environment. Feedback and comments are discussed by researcher and trainers, and changes made to artefact as appropriate. Unexpected consequences are immediately visible, and can be acted upon promptly. The artefact is continuously being evaluated and implemented in on-going wave in dynamic environment.
6	Guided emergence	This highlights the interaction between the initial design and how its implementation in the organisational setting causes a continuous evolvement and re-working of the emerging artefact.	The artefact is rolled out into the real life situation, and feedback from participants and assisting practitioners is immediately acted on by course designer/researcher, with re-designed module being offered almost immediately. Feedback will arise from course content and organisational environment, i.e. equipment, setting, timing, control. Each cycle will result in a re-working of the artefact (course module) as required by the evaluations.
7	Generalized outcomes	This ensures that the learning that has occurred during the iterations is developed so that the solution of the specific problem can be generalised to a class of problems.	The researcher will describe the learning and re-design of artefact based on user feedback and practitioner evaluation. This learning will in turn be linked back to current literature on best practices of e-learning in organisational environment.

The seven principles, detailed in Table 1, are aligned with the ADR method stages, and should be realised during the relevant stage. Thus, the first stage of problem formulation is addressed by the principles of "practice-inspired research" and "theory-ingrained artefact", the second stage of building, intervention and evaluation is addressed by the principles of "reciprocal shaping", "mutually influential roles" and "authentic and concurrent evaluation". The third stage of reflection and learning is addressed by the principle of "guided emergence", and the fourth stage, formalization of learning, is addressed by the principle of "generalized outcomes" (Figure 2, Sein et al., 2011).

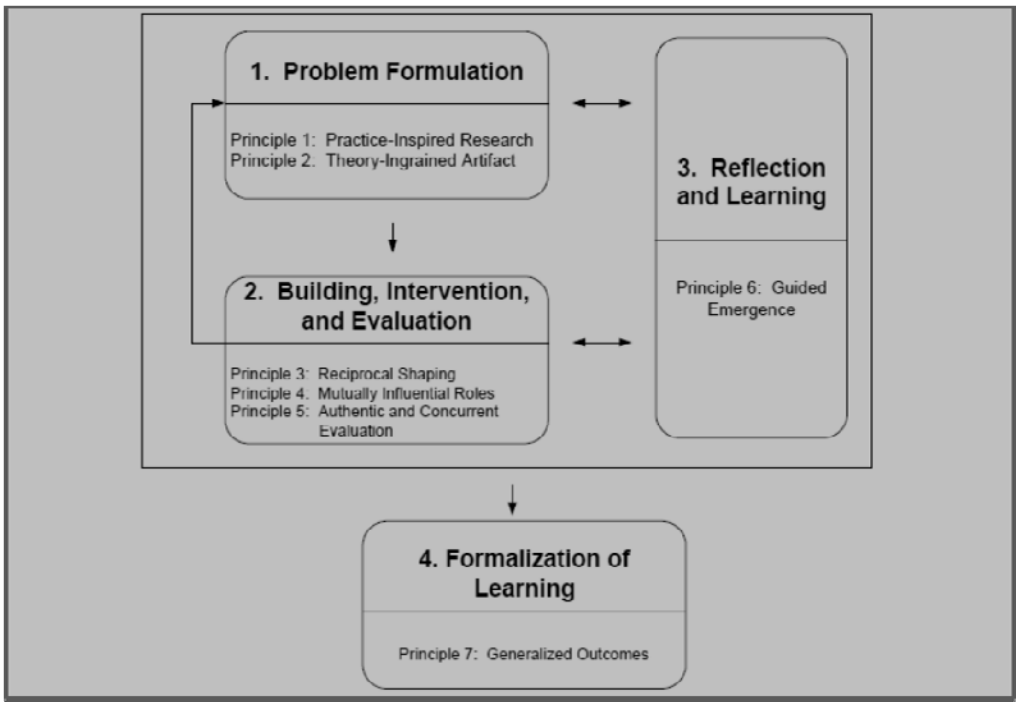

Figure 2. The ADR method: Stages and principles (Sein et al., 2011)
[Figure 2 from M. K. Sein, O. Henfridsson, S. Purao, M. Rossi, and R. Lindgren, "Action Design Research," *MIS Quarterly* (35:1), 2011, p. 41. Copyright © 2011, Regents of the University of Minnesota. Reprinted by permission]

The perceived problem which is to be investigated can arise from many sources within the organisation, such as practitioners, end-users, and the existing technology. In this research, the problems with the current classroom based training have been remarked on by trainees, trainers, line-managers and financial managers. To summarise the four stages, with the inherent principle(s), the first stage of ADR, "problem formulation", requires that the researcher identifies and conceptualises the research opportunity; formulates initial research questions; casts the problem as an instance of a class of problems; identifies contributing theoretical bases and prior technological advances; secures long-term organisational commitment; and sets up roles and responsibilities (Sein et al., 2011, p.41). The aim of the principle of practice-inspired research is that the researcher produces "knowledge that can be applied to the class of problems that the specific problem exemplifies" (p.40). The principle of a theory-ingrained artefact, which is also aligned to this stage, ensures that the artefact to be designed and tested within the organisation is based on current theory, or theories.

These theories should assist with the problem formulation, the identification of possible solutions and the initially created artefact, which is then introduced into the organisation for evaluation, as part of the second stage, "building, intervention and evaluation" (BIE). This introduction of the artefact into the real world situation should result in further cycles of re-designing or re-shaping, and re-evaluation of the artefact. Where the IT artefact is the focus of the research, Sein et al., (2011) suggest that alpha versions of the emerging artefact are tested and evaluated by the practitioners. After this strongly participatory process, a beta version of the artefact is introduced to the end-users themselves, and again, the resulting evaluations refine and shape the artefact (Figure 3).

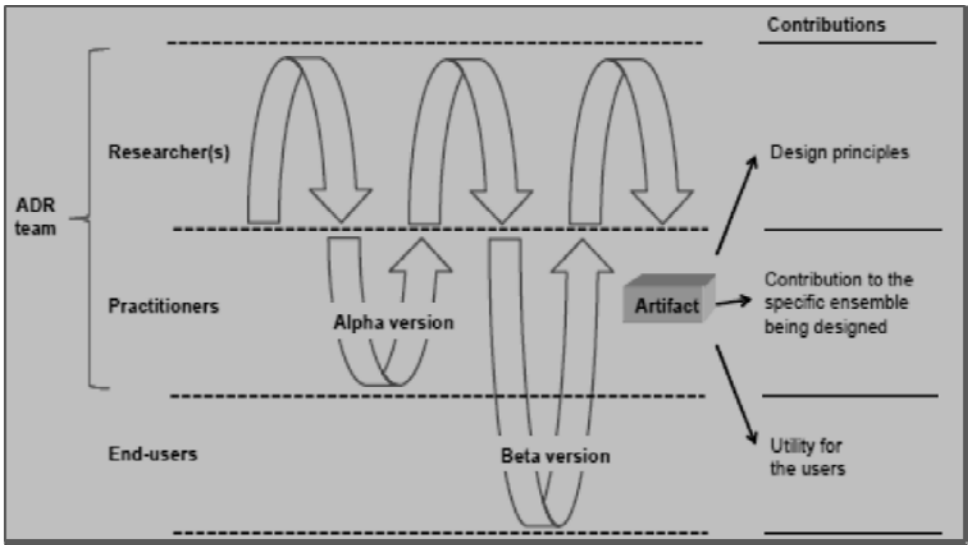

Figure 3. ADR generic schema for IT-Dominant Building, Intervention and Evaluation (Sein et al., 2011)
[Figure 3 from M. K. Sein, O. Henfridsson, S. Purao, M. Rossi, and R. Lindgren, "Action Design Research," MIS Quarterly (35:1), 2011, p. 42. Copyright © 2011, Regents of the University of Minnesota. Reprinted by permission]

The principles of "reciprocal shaping", "mutually influential roles" and "authentic and concurrent evaluation" are addressed during the BIE stage. ADR suggests that the influence of the IT artefact and the organisational context are mutual and inseparable. This may result in the original stance of the researcher being changed by the feedback from the organisation, and the ultimate version of the IT artefact quite different from the original version. Additionally, the researcher and the practitioner also influence each other. The different insights offered by these ADR team members into the creation of the artefact, mean that the end result should be more effective being a combination of both theory and practice. It should be noted that individuals in ADR can perform multiple roles, but that these roles are clearly identified and responsibilities assigned in Stage 1. It should be clearly visible from figure 3, the generic schema for IT-Dominant BIE, that ADR does not separate evaluation from building. It is hoped that any unanticipated consequences are surfaced during the evaluation of the alpha version, which then allows for refinement of the artefact, before the beta version is introduced to the end user. The decisions regarding the shape of the IT artefact and the intervention in the real organisational setting should be entwined with constant evaluation. Sein et al. (2011) emphasise that due to the emergent nature of the artefact, the setting is not controlled. It is their belief is that achieving authenticity in a natural setting is more important for ADR. The tasks in Stage 2 are therefore to (1) discover the initial knowledge-creation target, (2) select or customise the BIE form; (3) execute the BIE cycle(s); and (4) assess the need for additional cycles (Sein et al., 2011, p43).

Stage 3, "Reflection and learning", is continuous, and runs alongside both Stages 1 and 2. This is where the contributions to theory arise, and as the artefact emerges, adjustments to the research process need to be made as the researcher's understanding of it increases. The principle that is attached to this stage is "guided emergence". Stage 3 tasks are (1) reflect on the design and redesign during the project; (2) evaluate adherence to principles, and (3) analyse the intervention results according to the state goals (Sein et al, 2011, p44). The last stage of ADR is the "Formalisation of learning". The effect of the artefact on the organisation should be described as formalised learning, and it is hoped that the changes that were made during the BIE stage, will now be able to be explicated in order to enhance the original theories that were used to create the initial alpha version of the artefact. During this stage, the principle of "generalised outcomes" should be applied. Sein et al. (2011, p44) suggest this implies a shift from "the specific and unique" to "generic and abstract", and that three levels are involved, the "generalisation of the problem instance, the generalisation of the solution instance, and the derivation of the design principles from the design research outcomes". The tasks that should be accomplished during this stage are (1) abstract the learning into concepts for a class of field problems; (2) share outcomes and assessment with practitioners; (3) articulate outcomes as design principles; (4) articulate learning in light of theories selected; and (5) formalise results for dissemination (Sein et al., 2011, p45).

According to Sein et al. (2011), ADR has been developed with the ultimate goal of innovative design knowledge for the particular class of problems. The method acknowledges that the artefact being designed emerges from the meeting of IT and the organisation, and that any unanticipated consequences of implementing the artefact, can be addressed immediately, and to the benefit of both IT, from a theory perspective, and the organisation, from a practice perspective. It is felt that this approach, which combines AR with DR will be the best approach to realising the objectives of this research, as well as delivering research that is "efficacious for solving the practical problems at hand" (Lee, 2010, p345). The performance of the final versions of the implemented modules will be measured using the criteria of efficacy, efficiency and effectiveness (Figure 4), as defined by Checkland & Poulter (2006).

MEASURES:

- ***Efficacy:***
  - *Measure 1*: Trainees able to extract relevant financial reports & accurate inputs in financial system
    Tool: Extracted financial reports, interviews with line managers
  - *Measure 2*: Trainee satisfaction with training
    Tool: Evaluation form
- ***Efficiency:***
  Measure: number of freed trainer hours
  Tool: Report comparing classroom & e-learning trainer hours
- **Effectiveness:**
  - *Measure 1*: Improved Quarterly financial reporting submissions
    Tool: Report comparing quarterly financial reports
  - *Measure 2:* Improved financial job performance as rated by Financial Managers
    Tool: Interviews

(For all 3, researcher diary, notes, minutes of meetings)

Figure 4. Proposed research measures to investigate the efficacy, efficiency and effectiveness of the computer-based training for compulsory finance training

3. CONCLUSION

When implementing e-learning in the context of the workplace, it is the personal experiences of the participants that is important. Whether the implementation is a success or not will depend on the subjective reaction that the trainees have when exposed to this method of training. It would seem that a good approach to ensure that the users of the system are involved is to use their own feedback to adjust the modules so that the final experience is both enabling and positive. Having researched both Action Research and Design Research as possible research approaches that are suitable for e-learning research, it appears that both approaches have their critics and limitations. Therefore, using a combination approach, designated by Sein et al. (2011) as Action Design Research, would seem advantageous. It is felt that this would be the most suitable way of solving the specific training concern, whilst at the same time, attempting to contribute towards improving knowledge in respect of e-learning implementations in the workplace and how to measure the efficacy, efficiency and effectiveness of such training (Iversen et al., 2004). It is also hoped that this approach will address the IS issue of being an applied discipline which needs to consider assisting practitioners, as well as adding to theory about IT and organisations, and the human resources within the organisations that use the IT.

As this study attempts to contribute to practice by intervening in a real world situation, the study is limited to the compulsory training of the workforce at a single institution. The training modules affected are run by the finance department systems and user support team. Therefore, it would be questionable to make statistical generalisation from the findings. However, according to Lee and Baskerville (2003, p230), "In interpretivism, a theory's pertaining only to the setting where it was developed would not detract from its validity or scientific status". Therefore, as this a qualitative study, the objective is to generalise from the

individual findings to a theory within a particular setting, rather than to generalise from the sample to the population (Conboy et al., 2012; Lee & Baskerville, 2003, Merriam, 1988). This study is set within the workforce of a particular organisation that employs a sophisticated, integrated financial system. Whether the findings may be applied to other organisations, both in Africa and abroad, is uncertain due to the composition of the workforce and the nature of the system, but the descriptive and practical nature of the research may enable other researchers facing a similar problematic situation within other organisations to use the theory and findings as a base to develop additional theories, or to compare and contrast interpretations.

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SOCIAL E-LEARNING IN TOPOLOR: A CASE STUDY

Lei Shi, Dana Al Qudah and Alexandra I. Cristea
Department of Computer Science, The University of Warwick
Coventry CV4 7AL, UK

ABSTRACT

Social e-learning is a process through which learners achieve their learning goals via social interactions with each other by sharing knowledge, skills, abilities and educational materials. Adaptive e-learning enables adaptation and personalization of the learning process, based on learner needs, knowledge, preferences and other characteristics. In this paper, we present a case study that analyzes the social interaction features of a social personalized adaptive e-learning system developed at the University of Warwick, called Topolor. We discuss the results of a quantitative case study that evaluates the perceived *usefulness* and *usability*. The results demonstrate a generally high level of learner satisfaction with their learning experience. We extend the discussion of the results to explore future research directions and suggest further improvements for the studied social personalized adaptive e-learning system.

KEYWORDS

Social E-Learning, Adaptive E-Learning, Adaptive Educational Hypermedia System, Evaluation, Social Interaction.

1. INTRODUCTION

The Internet and the World Wide Web have made it possible to provide new types of learning environments where learners can interact with their peers and engage in effective and attractive learning experiences (Welsh, 2003). Social media is comprised of Internet-based applications that stand on the ideological and technological foundations of Web 2.0. These applications allow creation and exchange of user generated contents like never before (Kaplan, 2010). The increasing use of social media and Web 2.0 tools as well as various social features such as sharing, tagging, rating, commenting in e-learning systems can offer new opportunities for communication, collaboration, and active participation in a learning process (McLoughlin, 2011). Discussions and group work are often integrated into collaborative and participative learning practice, providing a range of educational benefits, which are thoroughly discussed in the literature (e.g. (Hrastinski, 2009), (Rovai, 2004) and (Woo, 2007)).

Adaptive (Educational) Hypermedia (A(E)H) (Brusilovsky, 2004) is another research direction that offers improvements to the area of e-learning. AEH systems (e.g. (Cristea, 2007), (Ghali, 2009) and (Foss, 2009)) provide personalized learning experiences to individual learners, according to a range of characteristics, such as learning goals, background knowledge and preferences (Rosmalen, 2009). The use of adaptation, along with the social affordances of Web 2.0 tools, carries a great potential for improving e-learning systems and learning experiences. However, the review of the previous work indicates that current e-learning systems have only marginally explored the integration of social interaction features and adaptation techniques. This research intends to address this gap by evaluating a system that was developed to foster effective social and adaptive e-learning experiences.

The aim of this research is to improve learning experience and learning outcomes via a social adaptive learning paradigm, based on the hypothesis that *extensive social features, personalized recommendations and Facebook-like appearance of a system, anticipated to make the environment more familiar to learners, subsequently increases the usefulness and usability of the system*. To isolate research variables, this paper focuses exclusively on studying the *usefulness* and *usability* of the social features in adaptive social e-learning. It is based on our recent quantitative case study that explores the use of Topolor (Shi, *et al.*, 2013a; Shi, *et al.*, 2013b) – a social personalized adaptive e-learning system. The rest of paper will review the research background, depict the social interaction tools in Topolor, and present the conducted experiment and its results. And finally, the conclusions and the outline of future work will be described.

2. RESEARCH BACKGROUND

Learning is inherently a social experience. Social aspects of learning have been emphasized in a range of theoretical frameworks developed to explain how people learn (e.g. (Vygotsky, 1978) and (Wenger, 2009)). Yet, developing effective and efficient online social learning environment remains an open problem. While online interaction via social networking services has become widely accepted and heavily embedded in day-to-day life, providing solutions that foster creation of effective e-learning spaces are not straightforward.

Online interaction tools have also been integrated and used in AEH (Brusilovsky, 2004). This enabled adaptation of educational hypertext to the personalized needs of learners (Brusilovsky, 2000) in e-learning systems. Since early 2000s, many AH frameworks have been proposed, such as AHAM (Wu, 2002), the Munich model (Koch, 2006), XAHM (Cannataro, 2002), LAOS (Cristea, 2003) and GAF (Knutov, 2008). Few were later extended to accommodate some social features, e.g., Social LAOS (SLAOS) (Ghali, 2009b) added a collaboration mechanism into the framework, and led to the development of the MOT 2.0 system (Ghali, 2009c). It introduced social features such as a chat tool, tagging, rating and commenting on learning content. However, while these systems cater for personal needs within specific learning contexts, they are often limited in their strategies for adapting to social needs or in their social features. Some recent work (Šimko, 2010) has already proposed the need for creating adaptive and highly interactive integrated learning environments. However, their work suggests only a limited number of mechanisms for enabling social interaction. Hence, there is a gap for extending and evaluating social interaction tools in adaptive e-learning settings. Additionally, their framework does not take into account the role of learner familiarity with other social interaction tools from e-learning environments and social networking websites, such as Facebook.

In fact, the features that many of the learners are familiar with from social networking websites remain missing from the current e-learning systems. For instance, sharing a learning status, engaging in a simple question/answer exchange and sharing notes remain cumbersome or impossible in many of the available systems. Subsequently, the potential of adaptation, recommendation and personalization that is based on the use of the above social features remains largely unexplored.

In this paper we address the above gap by introducing and evaluating a range of social features previously missing from the available adaptive e-learning systems.

3. THE TOPOLOR SYSTEM

To evaluate our hypothesis (SECTION 1), based on our experiment of requirement analysis (Shi, *et al.*, 2012), we have developed the Topolor system built on the Yii Framework[1] and Bootstrap[2]. Topolor is made available open source and is hosted on Github[3] for easy sharing and version control. It is deployed[4] and used as a social learning environment to support some postgraduate level modules in the University of Warwick. The registration for using the Topolor system has been recently opened to public. Thus, a larger cohort of users is expected in the near future, providing opportunities for collecting feedback, usage data and suggestions for further improvements.

The Topolor system mainly consists of three sub-systems (Figure 1). Each of these contains a set of interaction features that are generally referred to here as the social interaction toolset (Shi, *et al.*, 2013c). The subsystems of Topolor are the following:

- *Topolor-Home* provides a chronological list of the learning statuses posted by individual learners. It also provides access to a set of interaction tools that encourage informal communication and collaboration such as commenting on, sharing and favoring of learning statuses (Figure 1a).
- *Module Center* offers a warehouse of online courses, as well as provides adaptive learning content recommendation, learning expert recommendation, and interaction tools that encourage personalized social e-learning such as sending messages to recommended learning experts (Figure 1b and Figure 1d).

1 http://yiiframework.com
2 http://twitter.github.com/bootstrap
3 https://github.com/aslanshek/topolor
4 http://www.topolor.com

- *Q&A Center* maintains some lists of questions/answers related to the learning contents, and provides adaptive question recommendation, learning topic recommendation, expert peer adaptation and social interaction tools for discussions and practices (Figure 1c).

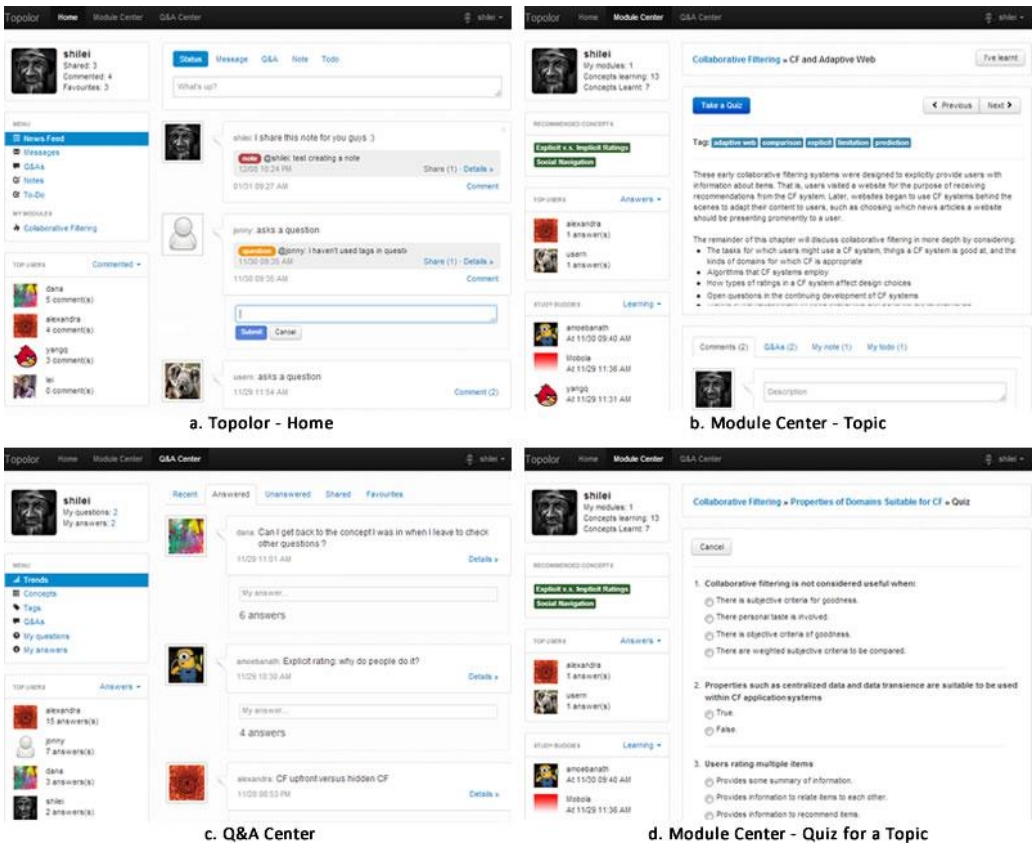

Figure 1. User Interface of Topolor

The social interaction toolset is one of the most important components in the Topolor system. To provide easy access to interaction, this toolset can be accessed from many places in the system. For instance, Figure 2 shows the interaction with this toolset from the *Topolor-Home* index page (Figure 1a).

This paper focuses on three social interaction tools. The *status tool* (Figure 2a) is used to share learning statuses. Learners can favorite and comment on each other's posted learning statuses; the *messaging tool* (Figure 2b) is used to send private messages to others; and the *Q&A tool* (Figure 2c) is used to ask and answer questions. Learners can also use Q&A tool for discussions.

Figure 2. Social interaction toolset: (a) learning status creation tool; (b) messaging tool; (c) Q&A tool

4. CASE STUDY DESIGN

Topolor has been evaluated from various perspectives (Shi, *et al.*, 2013d). In this section, we present the design of the conducted case study. The case study was comprised of three consecutive stages: 1) the

experiment of using the Topolor system, 2) the questionnaire about the usefulness and ease of use, and 3) the analysis of the questionnaire results and some qualitative feedback from the users.

4.1 Experiment Design

The experiment was conducted with the help of 21 students from the Department of Computer Science at the University of Warwick, who were registered for a 4th year MSc level module 'Dynamic Web-Based Systems', and a lecturer who was leading this module. The experiment lasted for 2 hours, during which the students were asked to learn a lesson on 'Collaborative Filtering' from the system as well as ensuring to perform specific tasks to familiarize themselves with the features related to the provided social interaction toolset. The full list of the 18 tasks completed by the students is listed in Table 1.

Table 1. Tasks Performed by The Student

Status	Message	Q&A: Question	Q&A: Answer
Create (1)	Send (7)	Create (9)	Create (12)
Edit (2)	Reply (8)	Edit (10)	Edit (13)
Remove (3)		Remove (11)	Remove (14)
Comment on (4)		Share (15)	
Favorite (5)		Favorite (16)	
Share (6)		Add Tag (17)	
		Edit Tag (18)	

4.2 Questionnaire Design

Usefulness and *ease of use* are fundamental determinants of user acceptance for a tool usage (Adams, 1992). After running the experiment, each student was asked to fill in a questionnaire to measure *usefulness* and *ease of use* of the social interaction toolset. Likert Scale (McIver, 1981) questions were used to get the feedback on all available features, as tested by tasks in Table 1. The students had to select one of the five responses for *usefulness* and *ease of use*, respectively, as shown below. A score was assigned to each response, on a scale of 1-5 as numbered below. After collecting the questionnaires, the responses of the students were analyzed.

- *usefulness*: 1) very useless, 2) useless, 3) neither useless nor useful, 4) useful, and 5) very useful.
- *ease of use*: 1) very hard, 2) hard, 3) neither hard nor easy, 4) easy; and 5) very easy.

5. ANALYSIS AND RESULTS

Out of the 21 students who participated in the experiment, 10 students responded to the optional questionnaire. The results extracted from the questionnaire are presented below. Figure 3a shows the mean of the responses, and Figure 3b shows the standard deviation. The number of total questions in the questionnaire was 36, of which 18 questions were for testing *usefulness* and 18 for *ease of use*.

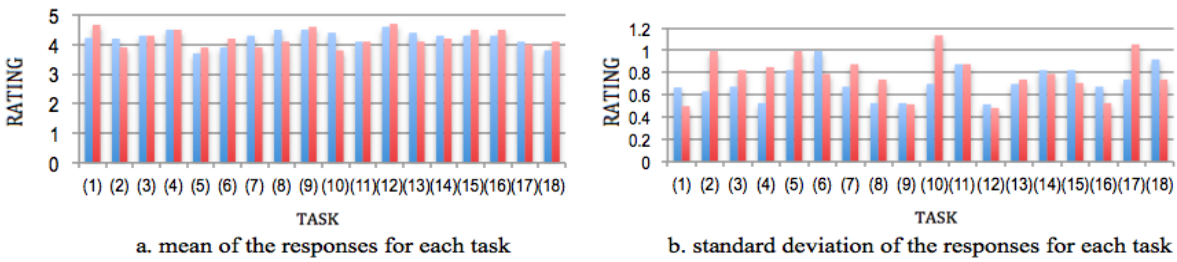

Figure 3. The a. mean and b. standard deviation of the responses for each task (Y-axis presents rating scores; X-axis presents the task order; blue columns present the usefulness; red columns present the ease of use)

5.1 Usefulness

The blue columns in Figure 3a and Figure 3b present the *usefulness* results. The *means* of the summative results rank between 3.7 and 4.6. The *standard deviations* of the overall results are between 0.516 and 0.994. All the reported values of a *mean* are much larger than 3 (the neutral response), suggesting students' attitudes to be generally positive.

5.2 Ease of Use

The red columns in Figure 3a and Figure 3b present the *ease of use* results. The *means* of the overall results rank between 3.8 and 4.7. The *standard deviations* of the overall results are between 0.483 and 1.135. As all the *means* are greater than 3, it enables us to infer that most of the students found the social interaction toolset to be relatively *easy to use*.

5.3 Reliability

We adopted *Cronbach's alpha* to measure the reliability of the test. According to Carmines, a *Cronbach's Alpha* of 0.8 is considered as highly reliable (Carmines, 1979). The values of *Cronbach's Alpha* for each of the questions are shown in Table 2. Both *usefulness* and *ease of use* are considerably larger than 0.8, suggesting a high level of reliability of the results.

Table 2. Cronbach's Alpha (Reliability Statistics)

	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
Usefulness	.934	.944	18
Ease of Use	.948	.957	18

6. DISCUSSION

In addition to the questionnaire data collected from the students, we also received some qualitative feedback from both students and the lecturer of the module. The general feedback was consistent with the results of the questionnaire. However, the responses included some specific suggestions for further improving some of the social interaction features, which ranked lower from the point of *usability* and *ease of use*. Due to the space limitation, this paper focuses mainly on the quantitative results from the questionnaire. However, some of the qualitative feedback is discussed below as appropriate.

Overall, the results from the questionnaire demonstrate that the social interaction toolset is perceived to be useful and easy to use. 83% of all the features have been rated by the students as useful, and 78% of the features as easy to use (i.e., average mean $\geq$ 4). Consistently with the questionnaire, qualitative feedback included a description of the system as "similar to known social networking sites (e.g. Facebook); fast and responsive". Another respondent said: "One of the best aspects of Topolor is the ability to interact with others during the process of learning". We now proceed to a detailed discussion of the individual social interaction tools, namely *status*, *messaging* and *Q&A*.

6.1 Status

The questionnaire results demonstrate that the feature (4), *commenting on a status*, was rated as the third most useful feature (mean = 4.5), and its *ease of use* was ranked as the fourth highest (mean = 4.5) among all the social interaction features. This result is further supported by the qualitative feedbacks. For example, one of the respondents explicitly mentioned that commenting on each other's *statuses* was one of his favorite features for interacting with other students.

On the other hand, (5) *favoring a status* had the lowest rating (mean = 3.7) on *usefulness*. The possible reason for this could be that the students might not have known what the use of favoring a status was. We

assume that it would be necessary to develop a mechanism for providing basic information on less familiar features such as favoring. Additionally, wider use of favoring with other features such as questions/answers might also affect the future patterns of use. Furthermore, the possible reason for the second lowest rating on (5) *favoring a status* for its *ease of use* (mean = 3.9), can be that labels for favoring/unfavoring statuses became visible only when the status message was being hovered over. The suggested improvement would be to keep the labels and the number of times the statuses are favored always visible.

6.2 Messaging

The rating for (7), *sending a message*, was, whilst high, the second lowest (mean = 3.9) with regards to its *ease of use*. The possible reason for this is the current notification mechanism for new messages. More specifically, if a student was on the messaging page, on receiving a new message a notification button, like 'You have 2 new messages', would show up. Clicking on that button would refresh the webpage with an AJAX response and show the received messages on the top of the message list. However, if the students were on other webpages, they wouldn't know whether they received any new messages. Therefore, the students might have had no idea when and how to start messaging. Additionally, whilst most of the webpages in the Topolor system provide at least one tool for sending messages to other students, such as 1) a new message box (Figure 2b) and 2) an avatar list of the recommended learning peers (Figure 4a) that could be clicked on, and then a messaging box (Figure 4b) would pop-up. There are still other webpages that did not provide such tools, potentially affecting the results on the *ease of use* of sending messages.

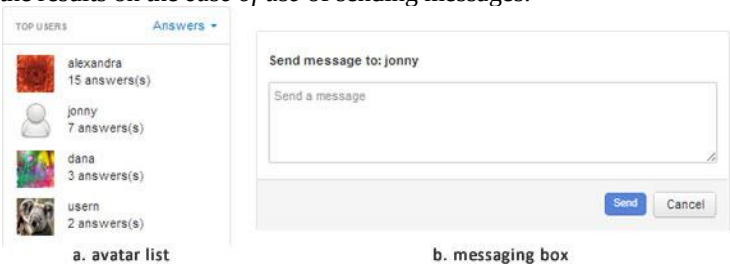

Figure 4. a. Avatar list of recommended learning peers to send messages to; b. the resulting pop-up messaging box

6.3 Asking and Answering Questions

The questionnaire results indicated that (12) *answering a question* was rated as the most useful feature (mean = 4.6) as well as the easiest feature to use (mean = 4.7), among all the social interaction features. A similar result was found from the qualitative feedback, where the way of asking and answering questions was explicitly mentioned as favorable. Furthermore, (9) *asking a question* was rated very high on the *usefulness* (mean = 4.5) and *ease of use* (mean = 4.5) too. Therefore, we can report with confidence that the students were very satisfied with features of asking and answering questions.

However, the *usefulness* of (18) *editing the tags of a question* was rated as the second lowest (mean=3.8), and the *usefulness* of (17) *adding tags to a question* was rated as the fourth lowest (mean=4.1). It seems that *tagging on questions* was not considered as useful as other features of the Topolor system. We can conjecture that when a student asked a question in a given learning content area, the relation between the question and the learning content would have been automatically established, so that tagging the question would not have brought additional benefits. Posting questions beyond the learning content area would be necessary to further comment on this feature.

The *ease of use* of the feature for asking/answering questions, (10) *editing a question* was rated the lowest (mean = 3.8). To provide an attractive user experience, we used AJAX calls to implement the feature. For example, when a student clicked on the title or the description of a question, it would activate the HTML editing box; and when the editing box lost focus, it would be replaced by the updated HTML text. No explicit buttons were provided to trigger editing actions. This might have not attracted student attention to the existence of this functionality. Even though the style of the mouse cursor changes when hovering the title or the description of a question, this hint might not have been a clear enough indication to the students about the provided editing functionality. Moreover, *editing a question* may require engagement with the system over a longer period of time, so the evaluation of this feature is to be finalized after using the system in the long term.

7. CONCLUSION

In this paper, we have 1) presented the social interaction toolset of the Topolor system, 2) reported a case study with a quantitative analysis on its *usefulness* and *ease of use*, and 3) discussed the results and identified potential improvements of the toolset. The developed Topolor system, as shown in Table 1, was designed to include a wider range of social interaction features than previous AEH systems. The results of the case study show that the social interaction toolset is found to be *useful* and *easy to use*. The overall attitude of the students towards the social interaction toolset in particular was very positive. The oral feedback was that they would have wanted to have more lessons in it. Decisive in this, we believe, was the fact that a lot of the social features had a look and feel familiar to them, similar to the popular Facebook environment, familiarity that is essential to consider in designing such systems.

Although all of the questions received positive responses from the students, we are still keen to improve the social interaction toolset further. We reviewed the relatively lower rated features and discussed the possible reasons that might have led to lower ratings. To improve this toolset, we intend to conduct further research based on the presented results and the discussion, particularly in the following directions:

- *Redesign the favoring tool*. First, we intend to find a better way of favoring and un-favoring learning statuses, questions, and learning topics. Second, we intend to explore the use of data on favored items for adaptation and personalization.
- *Provide a status-filtering tool*. We intend to extend the existing mechanism of learning status sharing by introducing a support for filtering and evaluating its benefits for collaboration. This feature has the potential to improve the process of locating relevant statuses and communicating with learning peers.
- *Provide an auto-tagging tool*. While tagging enables to connect various concepts within the system, students are usually reluctant to tag. Hence, we intend to enable Topolor to automatically generate tags for questions and explore inter-relations.
- *Improve AJAX notification messaging*: We intend to identify a more appropriate mechanism for delivering system notifications.
- *Enhance the messaging tool*. We intend to enhance the messaging tool by supporting instant messaging and appropriate notification.

The development of the next version of the Topolor system has been initiated. Future experiments will focus on evaluation of the new and improved features. The future deployment of the enhanced system will especially enable further inquiry into the role of social interaction in adaptive e-learning environments and the benefits for enriching *learning experiences* and improving *learning outcomes*.

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TRAINING EDUCATORS: PLAN FOR REPLICATING THE EXPERIENCE

Ulanbek Mambetakunov[1] and Marina Ribaudo[2]
[1]*Bishkek Academy of Finance and Economics, Kyrgyzstan*
[2]*DIBRIS, University of Genova, Italy*

ABSTRACT

This paper reports on a short survey and a training course offered to the faculty members of the University of Genova with the aim of driving the users of the university Learning Management System in the transition from Moodle 1.9 to Moodle 2, transition that took place in August 2012. The survey has been administered to lectures and staff to understand their needs and gather subscriptions before the actual starting of the training course. A similar process is now in progress in the context of the Bishkek Academy of Finance and Economics (Kyrgyzstan), where the same survey has been recently delivered. Results obtained in both institutions are presented. Indeed, although we are aware of the fact that these two universities represent two different contexts, being geographically far, different in size, and with different diffusion of ICT, we think we can take advantage of the experience of the University of Genova to transfer some practices on the organization and delivery of training courses in the Bishkek Academy of Finance and Economics.

KEYWORDS

Moodle, training educators, blended learning, LMS.

1. INTRODUCTION

In the last two decades schools, universities, and companies had to prepare for transformation and future learning in the knowledge and networked society. In the context of higher education, many universities have posed a great emphasis on promoting ICT solutions for education practices and one of the most popular choice has been the introduction of Learning Management Systems (LMS) to facilitate anytime, anywhere access to learning content and course administration, with different levels of success (Black et al., 2007; Gautreau, 2011; Janossy, 2008).

Among LMSs, Moodle (Cole and Foster, 2007) is probably the most popular alternative when deciding to adopt an open source solution, as witnessed by the wide community of users and by the active community of developers. Many universities are indeed offering Moodle installations to their instructors and learners (see the official Moodle site https://moodle.org/stats/ for some statistics). However, since it is easier to build learning infrastructures than to change one's teaching style, experience shows that many Moodle instances have been (and still are) mostly used as content repositories despite current trends in education suggest to take advantage of the array of available on-line tools to promote a collaborative learning approach with new roles for teachers and students (Downes, 2005; Anderson, 2007).

Embedding ICT in education is a slow but constant process and the universities can play different roles. From a research perspective, experts in education should develop new solutions and pedagogical models for future teachers, including strategies for engaging students of the 21st century (Prensky, 2001). Technologists should enhance traditional LMSs with new learning environment prototypes, open access repositories, social software based on the Web 2.0 paradigm to promote learners communication, peers collaboration, active participation (Mott, 2010).

From an educational perspective, research results in this field should also be internally disseminated and adopted to "modernize" current university teaching practices. Faculty members are rich sources of content in different areas, but they have different teaching philosophy and they are not necessarily instructional designers or media developers. Therefore they need help to transform their domain knowledge into digital

resources to be used on-line, possibly without excessive preparation time. They also need to be trained to take advantage of technology when used as a tool for education (Elgor, 2005; Kampov-Polevoi, 2010).

When possible, universities or single departments have invested into e-learning or media centers to provide this kind of support trying to engage faculty members and students in a mix of face-to-face and on-line sessions. This is indeed the current situation both at the University of Genova (UNIGE) and at the Bishkek Academy of Finance and Economics (BAFE), although with different diffusion, with the experience of UNIGE being more mature with respect to the current situation in BAFE. In this work we first introduce the two contexts (Section 2) and then compare the results of the surveys which have been delivered within the two communities (Section 3). We then briefly present the training course which has already been offered at UNIGE (Section 4) and a plan for a similar course to be offered at BAFE trying to take advantage from the lesson already learned in UNIGE (Section 5).

2. THE TWO CONTEXTS

2.1 University of Genova

The University of Genova, Italy, is a traditional university, delivering face-to-face courses. The educational offer ranges from sciences to humanities, from medicine to engineering, from economics to education. Starting from 2004 UNIGE has offered to its students, faculty members, and staff a Moodle-based software platform which is daily used, mostly following a blended learning approach (Cerioli et al., 2011). The users of the LMS are of several types:

1. *Faculty members*, who extend their teaching practices with on-line sessions.
2. *Students*, who find on-line courses and also other services.
3. *Referents*, i.e. members of the administrative staff involved into the administration and management of organizational procedures related to education.
4. *Technical staff*, i.e. two technicians responsible for its correct functioning.
5. A small *Board* of faculty members with different skills, who supervise the whole project, providing guidelines and directions for future development.

Table 1. Size of the on-line community in UNIGE

	On-line community (21/04/2013)	University (31/12/2012)
Referents	**37**	-
Teachers	**916**	1323 (69.23%)
Students	**28236**	32393 (87.16%)
Courses	**1499**	-

Table 1 shows some absolute numbers on the size of the LMS community; in the third column the number of faculty members and students of the university are given to provide some percentage values. According to these values, 7 lecturers in 10 manage one or more on-line courses, and more than 8 students in 10 access to the LMS.

Although these numbers are significant, the “quality” of the average exploitation of the available software tools for education is generally poor, and therefore the university has organized in the past methodological courses on Instructional Design (Puddu et al., 2008), based on a variant of the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model; see (Molenda, 2003) for a discussion on the origin of the term ADDIE and http://www.instructionaldesign.org/ for links to material on Instructional Design. Technical courses on the use of Moodle's functions have been organized as well to empower teachers in the management of their on-line courses. Anonymous surveys are also periodically launched to assess the acceptance of the platform or for organizational purposes. The last survey has been administered in February-March 2012, to promote a forthcoming technical training course on Moodle 2 among faculty members and referents, before the software upgrade planned for August 2012. The survey will be presented in Section 3.

2.2 Bishkek Academy of Finance and Economics

Kyrgyzstan is a landlocked republic in the eastern part of Central Asia. Bishkek is the capital and largest city. The country counts 52 universities and institutes: 31 state and 21 private. In the capital there are 21 state and 9 private universities. The total number of students across the country currently stands at 230,000 people and the literacy rate is 98.7%. Bishkek Academy of Finance and Economics is a private academy offering mostly scientific and economic courses; the academy counts 53 faculty members and 1200 students.

BAFE started offering its Moodle 1.9 platform in 2011; the users of the LMS are faculty members and first grade students. Like in UNIGE, the platform is administered by a small technical staff coordinated by the chief of the Fundamental Sciences Department.

The survey administered in BAFE, described in detail in Section 3, proposed also some additional questions (see Table 2) to better understand the familiarity with technology for this sample of users. Question S1 checks the frequency of access to Internet and more than one third of the respondents declare they can access only once per month. Question S2 investigates the type of equipment used to access to Internet: 25 respondents use a personal computer, but often this is located in one department room, and shared among several lecturers. The third question, S3, asks about access through mobile devices: Only 2 in 40 respondents answer “Yes”. Indeed, access to Internet through mobile devices for Kyrgyzstan's teachers is still too expensive, and therefore 95% of the respondents gave a negative answer.

Table 2. Additional questions for the survey in BAFE

Question		**Answers**
S1. *How often do you access to the Internet?*	- Every day	14 (35.0%)
	- Twice a week	10 (25.0%)
	- Once per month	16 (40.0%)
	- Other _____	
S2. *Which electronic equipment do you use to access to Internet?*	- Personal computer	25 (62.5%)
	- Notebook	14 (35.0%)
	- Mobile phone	1 (02.5%)
	- iPad	
S3. *Can you access to Internet through a mobile phone?*	- Yes	2 (05.0%)
	- No	38 (95.0%)

Despite the fact that Kyrgyzstan has now 5 Internet providers, residential access to the network is expensive too and only a small proportion of families can afford to have Internet at home. Therefore also students have difficulties in accessing on-line services. Moreover, BAFE has students coming from rural areas and many of them do not have basic skills for using computer programs. The academy provides access to computer labs with modern equipments and Internet access for the lectures but it cannot offer access to the laboratories for self-study.

Given these premises, it should be clear that the current situation in BAFE is different from that in UNIGE: if lectures can use Internet only once per month and students cannot access as they would like, the use of Moodle cannot go quickly formal. However, the adoption of the LMS has started and, despite all the difficulties, the process is not reversible.

3. THE SURVEY

The survey, which has been administered in both institutions, is composed of 10 common questions. Although we are aware that UNIGE and BAFE are very different in size, place, and adoption of ICT, we will present the results in the same figures to save space and discuss the outcomes in parallel.

At UNIGE, the survey has been advertised through the university mailing list, and it has been administered for three weeks using the feedback Moodle module, in February-March 2012. 174 employees, including faculty members and administrative staff involved in the use of the LMS, answered to the proposed questions, on a voluntary base.

At BAFE, the survey has been copied on paper and distributed into the post office box of faculty members, with a letter of the Rector. The survey has been motivated by the need of understanding the use of Moodle in the academy, one year after its introduction. 40 faculty members answered to the survey that means a response rate of 75% (since the academy has 53 faculty members). This high response rate is probably due to the fact that letter of the Rector made the survey official.

Question Q1 is about the use of Moodle and Figure 1 shows the responses in absolute numbers (in this and in the following figures, the caption reports the text of the question).

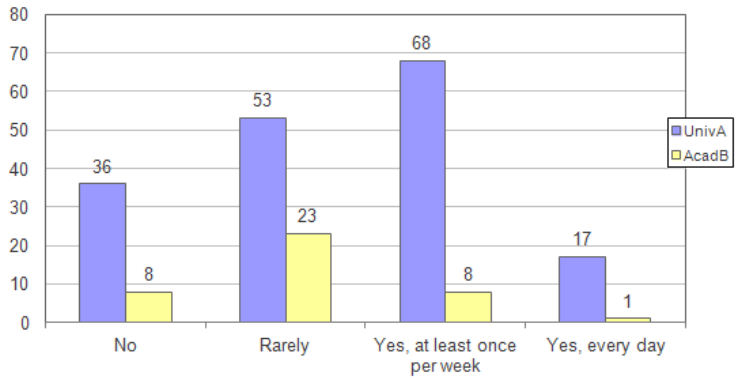

Figure 1. Answers to question Q1 *"Do you use Moodle?"*

Q2 is a multiple choice question, and we asked respondents who use Moodle (138 in UNIGE and 32 in BAFE) to indicate the resources and activities most commonly used. As expected, the content repository function appears to be the most popular in both universities, as shown in Figure 2. Indeed, university teachers are not necessarily instructional design experts and therefore they tend to shift their teaching practices from the class to the on-line platform. This means primarily a transformation of their lectures into digital learning objects. In BAFE, assignments and questionnaires for self-assessment and exams get a score comparable to that of file upload. Lectures who use Moodle are trying to automate content delivery but also assignments and exams that most likely occur within the academy computer labs, during working/lecture hours.

On the other hand, the lack of Internet connection at home, as highlighted in Section 2, does not provide many opportunities for on-line asynchronous communication with students in BAFE, and therefore the use of forum is not much developed, while it results as the second mostly used tool in UNIGE. Wiki is not selected by any respondent in BAFE, probably for the same reason or because the respondents do not really know the meaning/potentiality of such a tool.

The satisfaction level (Q3) for those who use Moodle turns out to be moderate in UNIGE: 45 respondents affirm to be satisfied, answering "Yes, and I could not cope without it", while the second answer "Yes, but it is too time consuming" is chosen by 16. There is of course room for improvement to capture those respondents saying they are "Enough" satisfied (44) and those answering they are not ("Little" or "No" for 8). In BAFE the answer "Enough" gets the highest score (15) followed by "Little" (5) and "Yes, but it is too time consuming" (5), thus suggesting room for improvement also in this case. Figure 3 shows the answers to this question, in percentage values.

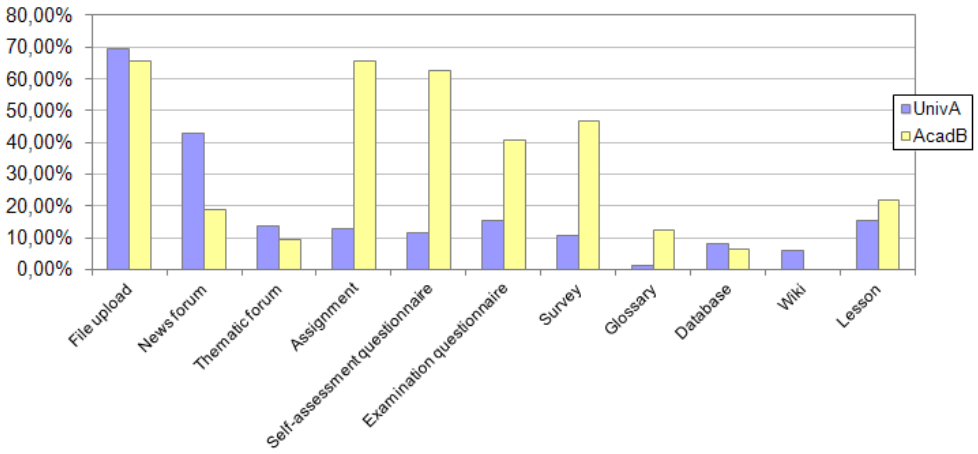

Figure 2. Answers to question Q2 *"If you answered yes to Q1, which are the platform functions you use more?"*

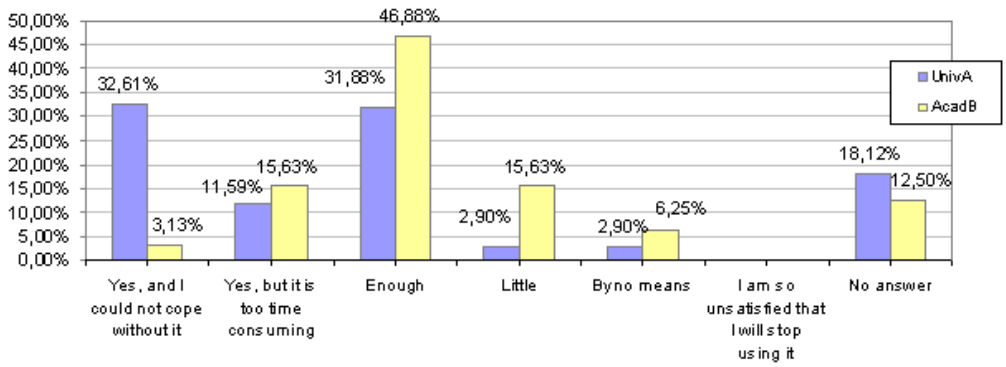

Figure 3. Answers to question Q3 *"If you answered yes to Q1, are you satisfied of Moodle?"*

Q4 is an open-ended question aiming at understanding whether the participants use other external tools for teaching. All BAFE's respondents declare they do not use other on-line tools and the situation is similar in UNIGE for the majority of participants; among the few answers we recall Google Docs (cited 14 times) and personal websites with teaching material (6 times).

Also Q5 is an open-ended question in which respondents should indicate the tools used for the development of their teaching material. In the case of UNIGE, Microsoft PowerPoint is the leader being mentioned in 81 responses. Those who use PowerPoint also mention Word (10) and/or Excel (5). Other tools which received some scores are Adobe Acrobat (11), LaTex (8) and the OpenOffice suite (5). Specialized softwares such as WebMatrix, Adobe Creative Studio, Articulate Studio, HotPotato, and others, got a single point each. In the case of BAFE, only Microsoft Office is reported (with Word, PowerPoint, and Excel).

Q6 asks to list the information sources considered relevant in the construction of teaching material. Scientific papers and journals, digital material accompanying textbooks and slides of the colleagues are the most cited sources for respondents from both institutions. The answers to this question show the differences among the various disciplines. Querying of medical online databases, scientific literature, online consultation of laws and regulations, newspapers and online dictionaries are responses dictated by the disciplines thought by the respondents. Wikipedia is mentioned only twice (and only in UNIGE), probably because its content is considered unreliable by the faculty members of both samples.

The last four questions are related to the organization of the training course itself: 129 respondents in UNIGE claim to be interested in attending it, declaring to be mostly interested into Moodle 2 novelties (110), followed by the always present repository functionality (87), by online questionnaires (76) and by the Lesson module (75). In the case of BAFE, 11 respondents answered "I would be interested but I have no time to attend it" and 2 said definitely "No". Among those who declare an interest in attending the course, the most

required functions result file upload (13), assignment (14), questionnaire (14) and lesson (11); only one respondent is willing to know more about the wiki function. In BAFE's survey question Q8 did not propose Moodle 2 novelties among the possible choices. The adoption of Moodle 1.9 is still recent in the academy, and therefore we thought that suggesting also a software upgrade could have confused (and probably frustrated) the users.

In question Q9 participants had to evaluate their skills in the use of Moodle and identify themselves as "Beginner", i.e., user who had never or very little used the platform, "Intermediate", i.e., user who already had some experience, or "Expert". Figure 4 shows how respondents self-assessed themselves. The answers to this question confirm that the experience in UNIGE is more mature with respect to BAFE where the majority of the sample (39) selected the option "Beginner" and no one selected the option "Expert".

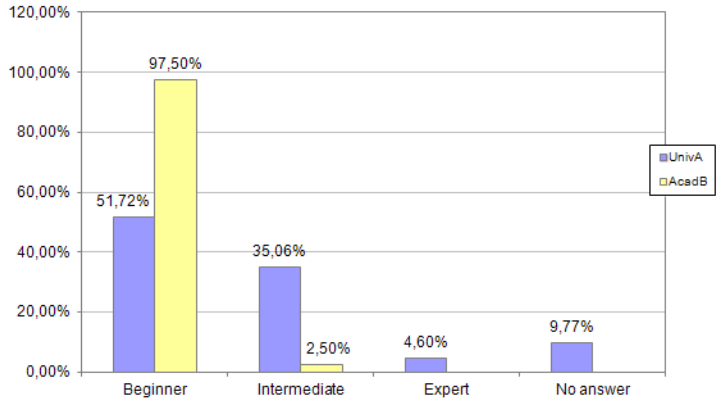

Figure 4. Answers to question Q9 *"How do you evaluate your knowledge of the platform?"*

4. THE TRAINING COURSE IN UNIGE

In May-June 2012 the technical course started in UNIGE. Followed on a voluntary base, the course has offered to the learners the possibility to test in advance the new functionalities of Moodle 2. It has also provided to the technical staff the opportunity of checking the proper functioning of the prototype with small groups of participants, before the full scale adoption for the whole community of users.

Participants have been organized in groups, formed on the basis of their self-reported skills. Another indication for groups formation has been the venue of the practical lessons which have been replicated in different areas of the town. 133 users took part to this phase and where split into four groups, for as many parallel courses (two Beginner and two Intermediate). One tutor, in fact a member of the board "Expert" in the use of Moodle 2, was assigned to each group together with a member of the technical staff.

Lessons followed a blended learning approach: Face-to-face meetings have been organized, supported by on-line tutoring through the Moodle 2 platform itself. The first plenary lecture, organized for all participants, introduced the use of ICT and Web 2.0 in education and some basics on Instructional Design. Then, for each group, technical lectures took place in computer labs. Table 3 shows the course syllabus, with the number of hours dedicated to beginner and intermediate participants.

For each group a working space in a new Moodle 2 installation has been prepared. The Moodle 2 space was organized by topics and each participant has been asked to work in a single block (a topic within a Moodle course), covering the teacher role. With this choice, each participant could see the work of the peers.

No ad-hoc material has been prepared but on-line videos and documents have been used as teaching material, in addition to the resources available at the official website http://docs.moodle.org.

Working in a Moodle 2 course with all participants acting as teachers was not easy since they all had the privileges to update course settings and to add/edit/delete course blocks, resources and activities. In addition, some configurations, such as the notification of the delivery of assignments, caused an unusual number of messages that generally does not occur in a "normal" course with only one or few teachers. However, also these unintentional errors have increased the knowledge of the platform, encouraging the learners to carefully check the configuration parameters of each new element added into the on-line space.

Table 3. Training course syllabus

Content	Beginner	Intermediate
Plenary lecture ICT and Web2.0 in education, Instructional Design.	2h	2h
First practical Course settings, users and roles management, forum, Moodle web page, file and directory management, interaction with external repositories.	6h	2h
Second practical Assignment, poll, reservation, questionnaire, feedback.	6h	2h
Third practical Gradebook, groups, conditional activities.		2h

Particular emphasis has been posed on the Moodle 2 new file management, a feature that has undergone a major change in the new version of the software. The File Picker offers a new solution to file management, but the renewed interface has caused difficulties to most of the users. In addition, the possibility of associating meta data with files, including the license of use, has highlighted a lack of knowledge of this subject among all learners. Fortunately, meta data can be omitted, being an optional feature.

Conditional activities, now present in the default configuration, have been another interesting novelty. Conditional activities offer a sophisticated tool to build different educational paths, dependent from the fulfilment of multiple conditions; none of the course participants had never used them before.

The new graphical interface, including the drag&drop option, has captured some interest. The possibility of hiding blocks in the Dock (an area on the left side of the page where blocks are minimized) has created problems to the users who have inadvertently hidden a block in the Dock and did not know how to restore it.

The Lesson module, even if requested in the initial survey, has not been seen in detail. In fact, with the introduction of conditional activities, personalized learning paths can be obtained without recurring to the Lesson control flow. The Lesson module seemed too sophisticated for the needs of the learners and therefore, although initially planned, was put aside.

As a curiosity, a moment of “confusion” occurred when new links appeared as the content of the course started shaping. This was due to the Autolink feature, activated by default on the site. This feature creates automatic links matching words or phrases used in a course (in web pages, forum messages, etc..) with corresponding names in glossary and database entries, activities and resources. In a course where many users can create resources and activities, often using the same words (“quiz test”, “test message”, “test text”, etc.), an unusual hypertext suddenly appeared. Luckily, Autolink can be disabled, as it was promptly done.

All the four parallel courses reached their end, with less difficulties and more work done - as expected - for the intermediate users who had already some experience in the use of the previous version of the LMS. Even in the absence of a course feedback, the first impression is that learners enjoyed Moodle 2, as witnessed by the enthusiasm demonstrated during the practicals and written in a few private emails.

Formal feedbacks are planned for the end of this academic year. This will be the real test to understand whether the initial enthusiasm of early course participants is confirmed by the majority of colleagues and – even more important - by the community of students.

5. PLAN FOR THE TRAINING COURSE IN BAFE

Despite the difficulties already discussed in Section 3, especially the lack of computers for personal work, the few opportunities for accessing the Internet outside working hours, the lack of specialists who can introduce the use of ICT/Moodle for education, and also the lack of time, the adoption of the LMS has started in BAFE. But, to overcome the initial experimental phase and turn it into a reality, both educators and students need to be trained.

All respondents to the survey, except one, self-assessed themselves as “Beginner”, and therefore a single training course, with the same syllabus for all participants, is planned. The training course cannot be centred

on the mere transfer of technological knowledge but should first introduce some basic knowledge on Instructional Design. University teachers, in fact, rarely come into contact with educational models but in general they refine a personal style in the design and the management of the teaching/learning process mainly based on in-presence lessons. However, this approach cannot work in technology enhanced learning, which depends on instructional design no matter which is the chosen learning approach – content driven learning, blended learning, collaborative learning.

Without becoming experts, teachers should be aware of the design, development and management of online activities and therefore we suggest to start the course with an introduction on this subject. After that, technical lectures on the use of Moodle should be delivered in a computer class using an interactive whiteboard or video-projector, and followed by on-line support in a blended learning style. For each tool, participants should be encouraged to put their hands-on for practical experience. In the first edition of the course we do not think that it is necessary to introduce all Moodle functions, but only a subset of them. Following the experience of UNIGE, we plan a course of 14 hours, whose syllabus is shown in Table 4, and we also recommend that the material used for lectures is translated in Kyrgyz, the official language of Kyrgyzstan.

Table 4. Plan for a training course for faculty members in BAFE

Content	Beginner
Introduction Overview on the use of ICT technologies for educational methods. Content driven learning, blended learning, collaborative learning. Introduction to Instructional Design. Examples.	2h
Moodle practice 1 Course settings, users and roles management, Moodle web page, file and directory management.	2h
Moodle practice 2 Forum (individual and group), assignments.	2h
Moodle practice 3 Questionnaire (questions of different types, building a questionnaire).	2h
Moodle practice 4 Wiki (individual and group), glossary.	2h
Moodle practice 5 Course design, i.e., storyboard of the course with a description of the modules, planned activities, initial forum messages for the class, activities scheduling.	2h
Moodle practice 6 Learning object development: select one of the module defined in the design phase, develop it, and upload into Moodle.	2h

Of course, the success of the use of an LMS cannot be measured by considering only its adoption by faculty members, because it is the community of students that plays the major role. In the case of BAFE this means organizing also brief training courses on the use of Web browsers, to facilitate the access to the on-line platform. First year students at BAFE are offered introductory courses on Microsoft Word and PowerPoint that need to be extended with lectures on how to access to the Web, especially for those groups of students coming from rural areas. An easier access to the network is of course an essential requirement to allow the full adoption of Moodle. In the mean time, to help students who have troubles with on-line assignments, group mates could help their peers in the uploading phase on scheduled hours in computer labs.

6. CONCLUSION

This paper has presented the situation at UNIGE where a Moodle-based LMS, adopted in 2004, is currently used by the majority of faculty members and students. It has also presented the current situation in a different context, where initial steps have been taken to introduce the use of Moodle for teaching and learning, with the ultimate goal of bridging the gap between education and innovation. Taking advantage of the experience already gained in UNIGE, the same short survey has been administered also in BAFE, helping identifying some difficulties but also some expectations for faculty members. A training course for educators is planned in BAFE, hoping that this could become a driving force to promote changes in the educational practices. Of course, the lack of a pervasive infrastructure and the high cost for network access still constitute a barrier to the complete adoption of LMS in education, but the process has started and it is not reversible. Another step in BAFE is the delivery of a survey for the "other side of the coin", i.e. the community of students, to understand their needs and desires. The results of this survey will be used to plan a training course on Moodle for them as well. Finally, we think that both communities (teachers and students) should also become aware of the potentiality of Web 2.0 and collaborative learning, and this is the future 2.0 task.

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CHOOSING LEARNING METHODS SUITABLE FOR TEACHING AND LEARNING IN COMPUTER SCIENCE

Estelle Taylor, Marnus Breed, Ilette Hauman and Armando Homann
North-West University: Potchefstroom Campus
Hoffman Street, Potchefstroom, South Africa

ABSTRACT

Our aim is to determine which teaching methods students in Computer Science and Information Systems prefer. There are in total 5 different paradigms (behaviorism, cognitivism, constructivism, design-based and humanism) with 32 models between them. Each model is unique and states different learning methods. Recommendations are made on methods that can be used in the teaching and learning of Computer Science and Information Systems. Learning can differ greatly from person to person. Clearly a teacher cannot possibly meet every single students needs when it comes to optimal learning. The best and maybe the only possible outcome is to try to determine what methods or combination of methods a teacher should apply to suit the biggest percentage in a class. Students have fundamentally changed with regards to their intellectual, social, motivational, and emotional needs. The modern student not only uses technology on a daily basis, but has become dependent on it. Elements of all theories need to be incorporated into a paradigm that will be sufficient to educate the Computer Science students of today. Technology must be used in the most optimal way to engage with students and to keep them interested.

KEYWORDS

Computer Science, Education, Learning Paradigms.

1. INTRODUCTION AND PROBLEM STATEMENT

A study done at the University of the Free State, South Africa, found that scholars are facing extreme obstacles in the academia due to an alarming low proficiency in literacy skills (Van Staden, 2011). Teachers usually have big classes and each student has their own psychological profile. A students' psychological development should be included when lessons is planned (Cottrell, 2001; Jain, Tedman, & Tedman, 2007; Laurillard, 1997). In combination to this, the students' attitude towards learning also plays a factor in the learning process (Cottrell, 2001; Kong, 2008).

The proportion of school leavers attending university is up from the top 15% to 40% and higher. This means that the range of students in a class is a lot bigger, ranging from the smartest to more challenging students. In South Africa the student population has increased with 77% from the 472 000 in 1993 to the 873 000 in 2009 (Smit, 2011).

Prensky (2001) explains that 'digital natives' refers to a new generation of students who have since childhood been engulfed in technology. The term 'native' indicates that these students 'speak' technology fluently – the digital language of laptops, hand-held computers and, of course - the internet. Prensky concludes that modern students, with such a vastly different upbringing to a generation only ten or twenty years older than themselves, cannot possibly be educated in the same way.

In South-Africa 88.9% of first year students have unrestricted access to a mobile phone with a camera, 73.7% have access to a Bluetooth modem via a mobile phone, 61.1% have access to a desktop computer and a further 49.6% have access to a laptop or notebook (Thinyana, 2010).

Tapscott (1998) is quoted as saying in his book that ''the old approach (of didactic teaching) is ill-suited to the intellectual, social, motivational, and emotional needs of the new generation".

The norm in higher level educational institutes is an hour-long lecture (Beerman, 1996), but studies have found that the attention span and learning ability of students decline after 20 minutes (Shroeder, 1993). This results in students only recording about 500 words out of a lecture consisting of 5000 (Beerman, 1996).

New environments create different ways of using learning theories in order to achieve maximum learning ability. New generations and new learning theories add to the problem (Järvelä & Niemivirtab, 1999). Understanding the way learning takes place is difficult, and this is complicated by changes in the students' environment as well as changing learning styles.

The use of e-learning is becoming more common, but lecturers must be reminded that the structure of teaching is more important than the means of delivery, and that e-learning gives ample opportunity to accommodate the different cognitive levels and preferences of learners (Pange & Pange, 2011). Whether we are developing programs for teaching and learning where e-learning is incorporated, or those without e-learning, knowledge of the learning paradigms and the application thereof is necessary.

When teaching Computer Science, lecturers are faced with all of these problems, as well as the difficulties of balancing practice and theory in classes. We should adapt our teaching methods to possible changes. There are a large number of methods that can be used. How do teachers decide which methods to use?

Our aim is to determine which methods students in Computer Science and Information Systems prefer. Feedback from the students will be analyzed. Recommendations will be made on methods that can be used in the teaching and learning of Computer Science and Information Systems. The paper starts with a problem statement and the motivation for this study. Background is given on learning paradigms and theories. Then the data collection, analysis and results are described, followed by a conclusion.

2. LITERATURE STUDY

There are five paradigms that address the different approaches to learning; these are behaviorism, cognitivism, constructivism, design-based and humanism. Each of these paradigms has theories and models. The five main learning paradigms are: Behaviorism, Cognitivism, Constructivism, Design-Based and Humanism.

2.1 Behaviourism Overview

Behaviorism consists of the view that the students approach towards learning is formed by the teachers' treatment of the student (Guey, Cheng, & Shibata, 2010; Quevedo-Terrero, 2009). The student is influenced by positive, negative or constructive reinforcement. All concepts can be broken down into steps, with these steps ranging from simple to difficult. In this paradigm it is essential that a teacher ensures that a step is fully understood by the students before moving on to a more complex idea. This is more important than going over and over a target concept (Guey, Cheng, & Shibata, 2010). The challenge in practice will be to take both the strong and weak student through the steps.

Skinner (1968), viewed as the father of radical behaviorism, said that teaching as a technology functions through the arrangement of possibilities of reinforcement under which behavior changes. Behaviorism, thus, is methodical and organized. The simple fact is that, as a mere reinforcing mechanism, the teacher is out of date.'' Ten years earlier Skinner (1958) had already described a 'teaching machine' that provided a physical instantiation of what behaviorism is all about. In the 21st century students come standard with their own instrumental aid in the form of laptops, mobile phones and tablet PC's.

Behaviorism could make the most of this. Behaviorism is advantageous in that it sets objectives that are clear-cut. Due to the approach being so specific, success is mostly easily observable. Lastly it ensures behavioral practice – not just theory, and works best for helping learners to attain behavioral skills. The Behaviorist theories include classical conditioning, GOMS model, operant conditioning and Social Learning theory. Social Learning Theory will be discussed in more detail later on.

2.2 Cognitivism Overview

Cognitivism deals in the ability of a person to logically think through information in the learning process (Guey, Cheng, & Shibata, 2010; Quevedo-Terrero, 2009). In contrast with behaviorism (which focuses more on knowledge accumulation) a cognitive learning process laid importance on the discovery process for learning and more importantly understanding to occur.

Creativity is an integral part of this paradigm in order to find the patterns of which we have already spoken (Guey, Cheng, & Shibata, 2010). It is also important to use creative structuring of the material in order to pull the student through the topic and the process of learning by the discovery process.

Cognitvism deals with the cognitive processes involved in learning. These processes include induction, deduction, rule finding, law discovering and pattern recognition.

In educating students, cognitivism focuses on the transmission of knowledge of the objective reality of the environment from the lecturer to the students. At the end of the day students should have the same representation of reality in their minds as the lecturer. Cognitivist theories include assimilation theory, attribution theory, cognitive load theory, cognitive theory of multimedia learning, component display theory, elaboration Theory and Stage Theory of Cognitive development – among others.

2.3 Constructivism Overview

Constructivism is when new information is processed with old ideas and understanding about the subject and an own opinion and the ability to draw conclusions is developed (Guey, Cheng, & Shibata, 2010). Constructivism motivates the student to think for himself (Quevedo-Terrero, 2009).

Constructivism can be described as the capability of constructing knowledge rather than acquiring it. Constructivism as a paradigm or worldview posits that learning is an active, constructive process.

In Computer Science it was found that a passive student with no participation fails in learning. A student needs to be involved in the thought process by contributing to the conversation and listening to other students. Trial and error is the best way for a student to learn skills like programming (Quevedo-Terrero, 2009; Warin, Kolski, & Sagar, 2011).

According to Pange and Pange (2011) most existing e-learning programs follow a constructivist approach.

The constructivist pedagogy involves the following characteristics (Richardson, 2003):

- Attention should be given to the background of each student.
- Group discussion should be facilitated to explore domain elements with the purpose of creating understanding of a topic.
- Formal domain knowledge can be introduced at specific points. Students should be allowed the opportunity to challenge existing beliefs. Students' meta-awareness of their understandings and learning processes should be developed.

Constructivist theories include Case-Based Learning, Cognitive Apprenticeship, Communities of practice, Discovery Learning, Goal Based Scenarios, Social Development Theory and Situated Learning.

2.4 Design – Based Overview

Design-Based learning theory's goal is to find a way to balance the theoretical knowledge and the way it is used to teach. Design-Based Research is a lens or set of analytical techniques that balances the positivist and interpretivist paradigms and attempts to bridge theory and practice in education.

The paradigm design-based, looks at the relationship between the empirical study a student needs and the theoretical knowledge needed to implement these concepts (Alvarez, Alacron, & Nussbaum, 2011; Kong, 2008). It involves complex programs that are studied in educational environment. Combining software designs and educational studies is the most common type of this paradigm (Kong, 2008).

A common feature of design-based research is the fact that the purpose is to produce theories on the process of learning, and teaching. The second feature is that the methodology is of an interventionist nature. The intent is to investigate ways to improve education by developing new forms of learning and then studying them. Thirdly, design experiments create conditions for developing theories and then place these theories in the way of harm.

Design-Based strategies include the ADDIE Model of Instructional Design and the ARCS Model of Motivational Design.

2.5 Humanism Overview

Every person studies to improve their knowledge in order to work in that field one day. Each person sees himself as having a purpose in life. Learning will further us in this. This view, the humanism paradigm, is not so seriously concerned with the ability to learn as it is with the attitude towards learning (Guey, Cheng, & Shibata, 2010).

Humanism is a paradigm/philosophy/pedagogical approach that believes learning is viewed as a personal act to fulfill one's potential. "People learn more easily when they are self-driven and have a desire to acquire knowledge to improve their state of mind" (DeCarvalho, 1991).

The objectives of the humanistic view of education are (Gage & Berliner, 1991):

- Promotion of positive self-direction and independence
- development of the ability to take responsibility for learned knowledge
- development of creativity, curiosity and an interest in the arts
- development of people who are self-sufficient and self-actualized.

Theories included in Humanism are Experiential Learning, Facilitative Teaching and Maslow's Hierarchy of Needs.

2.6 Application of Paradigms in the Teaching and Learning of Computer Science

As can be seen from the above, there is an overwhelming number of choices available. To limit these for further study, fourth year Computer Science and Information System students at the North-West University, South Africa, were asked to study and compare these choices, and to select some of them for further study. This selection was made using the knowledge gained during the study, but of course did not exclude own experience and preferences. Six methods were selected for further study.

Looking at Behaviorism and the **Operant condition theory** in particular, a student should first and foremost be handled with respect and a positive attitude toward each student. Hard work is often repeated after praise is received for an accomplishment (Quevedo-Terrero, 2009). This will motivate the students to work harder in and out of class and will help them to keep focus while the class is in session. Motivation is often a problem with e-learning, and learners should know in advance the goals and benefits obtained from the process and the relevance thereof (Pange & Pange, 2011).

According to the Cognitivism paradigm, and **Elaboration theory**, the entire curriculum should be planned in such a way that the level of difficulty increase throughout the year, starting with the easiest concepts. Elaboration theory approaches education by first taking a 'wide-angle' view of the study material so that students may see the 'big-picture' or holistic view of what must be mastered. Each segment is then elaborated on to provide a more detailed view.

The **Assimilation theory** of the Cognitivism paradigm firstly states that it is better for the learning process if a student understand the work rather than to try to learn it merely as abstract ideas. When planning a lesson, special attention should be given to ensuring that the contents of the lesson will be presented in the simplest possible manner to ensure understanding. A teacher should thus plan a lesson by identifying a single idea per lesson and then building the class around this, structuring each (every) new idea with care. The first idea should be thoroughly described and a few questions should be asked to make sure the students understand the core idea before the rest of the information follows. The rest of the lesson should then be built on this core idea. During all this a teacher should continuously ask questions and give positive feedback if it's deserved. Tests should be discussed, and well answered questions should be mentioned. The feedback should be handled with care to ensure every student is motivated to learn.

Cognitive Theory of **Multimedia Learning** is the method of learning with pictures and other forms of media.

Problem-Based Learning on the other hand focuses on solving real world problems by means of teamwork and creative thinking.

Social learning theory focuses on the interaction between the environment and the student (Taylor, 2003). Students form models of behavior from which learning ensues. Learning from models take on different forms, including new behavior patterns, judgmental standards, cognitive competencies and generative rules for creating new forms of behavior (Bandura, 1989).

3. DATA COLLECTION AND ANALYSIS

A questionnaire was answered by third year Computer Science students at the Potchefstroom campus of the North-West University. Fifty one out of a possible eight five students answered the questions.

Both open questions and multi choice questions were posed to these students. The open questions were grouped into classes of similar answers. The multi choice questions was based on a predetermined scale (1 –I strongly disagree, 2 – I disagree somewhat, 3 – I have no strong opinion either way, 4 – I agree somewhat, 5 – I strongly agree).

The questionnaire was developed after a literature study on the paradigms and methods was done. The questionnaire covered aspects such as the availability of technology, current methods of education and receptiveness towards certain aspects of learning theories.

4. RESULTS AND RECOMMENDATIONS

Results can be discussed under the headings visual aids and e-learning, student research, group work, sequencing of work, motivation, access to technology and general comments.

4.1 Visual Aids and e-learning

A majority of 69% of the learners prefers a lecture that uses slides and the other 31% either has no opinion or prefers no slides what so ever. Results further showed that 78% of the students preferred visual presentations instead of a verbal lecture. Only 7% preferred a verbal lecture and 15% did not mind which method was used by the lecturer. This clearly shows that students in Computer Sciences prefer visual aids in the classroom above a strictly verbal environment. This supports the Cognitive Theory of Multimedia Learning where students learn more efficiently with pictures and other forms of media.

One aspect of education that has stayed decidedly static is the way in which students access study material. Written notes, textbooks and, in some cases, PowerPoint slides made available to students are all that a student has to come home to. Once the lecture is over the student loses some dimensions of the pedagogical process, namely the verbal and interactive components found in a classroom. One way to negate this loss of dynamism is to make videos or sound clips available to students online. A factor that came up even though it was not directly asked is that lecturers sometimes do not speak clearly enough. Two students indicated that lecturers speak too softly, and a further 10 students complained that lecturers sometimes talk too fast in the classroom. In a diverse country such as South-Africa this problem is compounded due to a wide array of languages being spoken at home. The language that is used to instruct in the classroom might be only the second or third language for many students. Therefore e-learning in the form of multimedia tools placed online could be very useful in taking steps to engage students of a new generation.

Two questions were posed to the sample group of students. The first was aimed at measuring how open students would be to use sound bites and videos to assist them in performing tasks or completing assignments. When asked whether they would enjoy the opportunity to watch instructional videos on platforms such as YouTube to assist in completing a task, 67% of students agreed while 28% had no strong opinion on the subject. Only 4% of students did not agree that this would be a good idea. The second question tried to gauge the feeling regarding videos and sound bites recorded in class being made available. When asked this more open ended question whether they would like access to sound bites and video material from classes that they could review at home, all but one student said that it would be very helpful, especially in doing revision. The reaction to this proposed use of technology was almost overwhelming with students using copious amounts of exclamation marks and adjectives such as “great”, “amazing” and “fantastic”.

4.2 Student Research

Social Learning theory advocates self-regulation and the internalization of motivating factors. One way to get students interested in the work being taught is to have students do some research on a subject. Of course this idea overlaps somewhat with the theory of Discovery Learning which states that learning is an information

processing activity, by which students try to understand their environment. Students do this by organizing and categorizing information using a coding system. The most effective way to develop a coding system is to discover it, and what better way to discover information than to do some research and then summarize it? Large proportions, namely 61%, of students feel that they would memorize a concept more effectively if they did some research on that subject themselves. 30% of students had no strong opinion either way and, only a measly 9% of students felt that they would not learn a concept more effectively if they did research on it.

4.3 Group Work

Another big aspect of Social Learning theory is observing the behaviour of others and forming conceptualizations from these observations. The easiest way to engage students in activities that enable them to learn from others is group work. Students don't seem to have a great affinity for group work however, with 50% of students indicating that they would not like to do practical assignments in groups. Extending this question to whether students would like to do a presentation to the rest of the class in a group increased the negative reaction to 54% of all students. This exposed a very interesting pattern and one that is greatly connected to social learning theory. 37% of students felt that they would not remember material effectively if it were presented to the class by another student while 35% felt they would. 28% had no opinion either way. In contrast to this, 63% of students felt that they would definitely learn something from seeing another student perform a practical task in class – whether that task is performed correctly or whether it is performed incorrectly and then corrected by the lecturer. This anomaly might be explained by the next two statistics. Only 48% of students indicated that they ever participate in classroom discussions. Only 54% of students indicated that they would volunteer to answer a question in class, even if they knew the correct answer. So while students feel that they would be able to learn from their peers in an interactive classroom, not many students are very keen to participate themselves. It is clear that there are definite advantages to an interactive classroom, but that the onus is on the lecturer to ensure that students feel safe to voice their opinions, and that all students are given the platform to be heard.

4.4 Sequencing of Work

Elaboration theory places high emphasis on first presenting a holistic view of the material before 'zooming in' on specific parts. Students tend to agree with 59% of students saying they would like to know the structure of the whole course to be studied beforehand. 89% of students said that they like to know and see during lectures how the current material fits into the big picture. 85% of students indicated that they would remember concepts better when they are first explained in a more general fashion and then in more detail. This bodes very well for Elaboration theory as a method of education going forward.

While Social Learning theory might be more suited to the practical side of Computer Science, elaboration theory could effectively deal with learning the theory. Even more practical applications might be taught in this manner. Consider the theory behind object orientated programming. Elaboration theory would provide the students with a holistic view of how problems will be solved using the object oriented approach before elaborating on the more complex details of how to program a specific component.

4.5 Motivation

Another interesting topic that arose is the one of motivation. Where does motivation come from? The question of what motivates them was asked directly and the results showed that 60.87% of students felt that their motivation is internalized. The factors that these students listed as motivation include personal goals, attaining good marks, securing their futures or financial incentives like bursaries. The other 39.13% of students felt that their motivation comes from more external sources like their families, spiritual motivation or the way that they were raised. 23.91% of these students specifically cited interesting work and effective lecturing techniques as motivation.

4.6 Access to Technology

18.18% of students owns or has access to a personal computer, 22.73% of students own or have access to a laptop and 59.09% of students have access to both. That means the whole sample population of Computer Science students have access to either a laptop or a desktop computer. This statistic is supported by the fact that 100% of these students own an internet-capable mobile phone. 25% of the students own a tablet PC, 97.73% of students have regular access to the internet and email. Modern students live and learn in an era where technology is the norm, and for Computer Science students this is compounded. This is a positive, considering the possibility of using e-learning to accommodate different students with different learning styles.

4.7 General Comments

Most students found the current method of teaching engaging and interesting, citing facts such as the lecturers being experts in their field, lecturers being helpful, the students having a great interest in the subjects presented and lectures being well organized as the greatest positives. In fact, only 6 students did not answer emphatically in the positive, with only two students saying that they do not find the lectures engaging at all. There is room for improvement however. Six of the students felt that technology could be used to show practical examples and applications in the classroom. Due to the obvious need for interaction but the unwillingness of students to stick their necks out in a classroom environment there is a definite need for technological assistance in making lectures more interactive. In today's fast paced, internet based world where information is available at the click of a button, students are looking for faster and more effective feedback from lecturers. They want prompt replies on their emails, quick feedback on tests and assignments and immediate answers to their questions. This is where technology could streamline the education process and keep students interested, and where e-learning can be used complimentary to contact sessions.

Some of the main points that can be concluded from this study are presented in table 1, where the second column refers to the relevant paradigm and the third column to the theory. From this it is obvious that different paradigms are represented.

Table 1. Summary of main points

Teaching and learning	Paradigm	Theory
Learners prefers visual presentations (for example slides, videos, sound clips).	Cognitivism	Cognitive Theory of Multimedia Learning
Learners feel that they would memorize a concept more effectively if they did some research on that subject themselves.	Behaviourism Constructivism	Social Learning Theory Discovery Learning
Learners feel that they learn from seeing another student perform a practical task in class.	Behaviourism	Social Learning Theory
Learners prefer to know the structure of the whole course to be studied beforehand and to see how the current material fits into the big picture. Ideas should follow logically on each other .	Cognitivism	Elaboration theory
It is important that teachers create a comfortable environment in the class.	Humanism	In general

5. CONCLUSION

It is important that in a lesson, ideas should follow logically on each other and that a structure of ideas should be created in class. Consider giving the students the structure in assistance with their preparations for tests and exams. The choosing of a main idea and keywords to build on this is paramount in planning lessons as it was found that most of students use these in their learning process.

It is further important that teachers create a comfortable environment for students in the class. It is often found that students won't answer a question for two reasons. The first is the most obvious, they don't know

the answer. The second was found during the processing of the questionnaires. Students are afraid of appearing stupid. Teachers can make the class more comfortable by telling a joke or two, knowing the students names or steer the students in the right path if they don't know the answer. Lecturers with classes that are relatively small can consider giving marks for participation in class discussions. This will not only motivate students to listen in class but may inspire them to prepare for lessons. This will enable them to contribute something to the lesson. Preparing for a lesson will also help them to identify the things they don't understand during a lesson. Once this happens learning will be increased.

Elements of all theories need to be incorporated into a paradigm that will be sufficient to educate the Computer Science students of today. Elements of one theories, for example Social Learning theory, will help to engage, interest and motivate students to learn the course material that has been sequenced so brilliantly according to (for example) elaboration theory in an effective way. Aspects of Humanism such as creating the right environment are vitally important. Elements of Constructivism like setting goals, getting students to discover information and skills and Cognitive Apprenticeship not only overlaps with the fundamentals of Social Learning theory but supports and enhances it in a big way. Other theories in Cognitivism also run parallel with Elaboration theory such as creating schemas and connecting new information to old knowledge. No one theory can succeed on its own.

Students have changed and are now both equipped with and dependent on technology. Computer Science students are even more enraptured with the latest technological tools available due to their interest in the field. Technology must be used in the most optimal way to engage with students and to keep them interested. Using technology to construct a visually attractive lecture, the educator has ample opportunity to demonstrate behavior that will be effective in the field of Computer Science, both in the practical and theoretical arena. If the lecturer demonstrated the correct use of syntax in coding an algorithm the student will form a model of behavior in his mind containing the visual and verbal instructions and processes that was demonstrated in the classroom. This can be reinforced with interaction by questions answered or a student demonstrating problem solving in the class. Also, memory is reinforced by transforming symbolic representations into suitable actions- that is practicing the study material at home through homework assignments. Social learning theory places a high value on self-regulation, so lecturers should encourage students to take an interest in the field of study and take some initiative in conducting research and deepening their knowledge. In terms of group work and presentations or demonstrations by students there would be a solid base to work from to achieve education through altering perceptions of the students' environment, and ultimately changing behavior.

It is clear from research that learning can differ greatly from person to person. There are in total 5 different paradigms with 32 models between them. Each model is unique and states a different learning method. Clearly a teacher cannot possibly meet every single students needs when it comes to optimal learning. The best and maybe the only possible outcome is to try to determine what methods or combination of methods a teacher should apply to suit the biggest percentage in a class.

Some of the main points that can be concluded from this study are presented in table 1, where the second column refers to the relevant paradigm and the third column to the theory. From this it is obvious that different paradigms are represented.

Elements of all theories need to be incorporated into a paradigm that will be sufficient to educate the Computer Science students of today. No one theory can succeed on its own. Students have changed and are now both equipped with and dependent on technology. Technology must be used in the most optimal way to engage with students and to keep them interested. With e-learning it is easy to include structure and to present an overview as well as links to detail. Links to videos, sound bites and graphics can easily be included. Different learning styles can be accommodated. Technology could streamline the education process and keep students interested, and e-learning can be used complimentary to contact sessions.

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TEACHING AI SEARCH ALGORITHMS IN A WEB-BASED EDUCATIONAL SYSTEM

Foteini Grivokostopoulou and Ioannis Hatzilygeroudis
University of Patras, School of Engineering
Department of Computer Engineering & Informatics
26500 Patras, Hellas (Greece)

ABSTRACT

In this paper, we present a way of teaching AI search algorithms in a web-based adaptive educational system. Teaching is based on interactive examples and exercises. Interactive examples, which use visualized animations to present AI search algorithms in a step-by-step way with explanations, are used to make learning more attractive. Practice exercises, which are interactive exercises where immediate feedback is given when a student makes an error, but further help is optional, are also used. So, the student can try by him/herself to correct the error or ask for help from the system. Finally, the student can take a test consisting of assessment exercises, which are interactive, but no help is provided. The result of the test determines the student's knowledge level. Evaluation of the system through a pre-test/post-test and experimental/control group method gave very promising results about learning capabilities of the method. Also, results of a questionnaire show that the majority of the students liked the system very much.

KEYWORDS

Web-based interactive system, interactive e-learning, AI search algorithms, adaptive system

1. INTRODUCTION

Numerous e-learning systems have been developed for education during last decades. A requirement of e-learning systems is their ability to provide personalization that is, interact with learners by taking into account their differences in knowledge levels, learning styles, preferences, goals and so on (Wade and Ashman 2007). Intelligent Tutoring Systems (ITSs) constitute a popular type of intelligent educational systems. They perform their tasks mainly based on Artificial Intelligence (AI) methods. Employed AI methods provide the representation and reasoning basis needed to accomplish the goals of ITSs. More specifically, AI techniques are used to represent theoretical and practical knowledge regarding the teaching subject. Such knowledge provides the foundation for developing mechanisms for customizing the learning process, given information related to learners. AI techniques also represent information gathered from learners' interaction with the system. ITSs are able to intelligently analyze learner responses to presented problems and questions. They are also able to intelligently analyze questions posed by learners to the system itself, regarding the teaching subject. Such intelligent analysis enables provision of intelligent support/assistance/feedback concerning specific parts of the teaching subject, for which learner knowledge is assessed to be incomplete and/or misconceived. ITSs have been used with great success in many challenging domains to offer individualized learning to the students and have demonstrated remarkable success in helping students learn challenging content and strategies (Woolf 2009). Adaptive Educational Hypermedia Systems (AEHSs) are also systems that offer personalized education. They are specifically developed for hypertext environments such as the WWW (Brusilovsky et al 1998). Enhancing AEHSs with aspects and techniques from ITSs creates another type of personalized education systems: Adaptive and Intelligent Educational Systems (AIESs) (Brusilovsky and Paylo 2003).

In an Artificial Intelligence (AI) curriculum, a fundamental topic is "AI search algorithms". It is vital for students to get a strong understanding of the way the algorithms work and also of their implementation on various search problems. However, many students have particular difficulties in understanding and implementing AI search algorithms. Students often have difficulties in understanding algorithms, which are explained to them on the blackboard.

In this paper, we present how an adaptive and intelligent web-based system assists in teaching/learning search algorithms in the context of an AI course. The system provides interactive exercises and examples to assist students to learn and practice by graphically implementing blind and heuristic search algorithms. The system provides a step-by-step guidance and assistance during the application of the algorithms.

The rest of the paper is organized as follows. In Section 2 related work is presented. Section 3 presents the domain knowledge structure and the user interface of the system. Section 4 presents the teaching method and learning materials. Section 5 presents an evaluation of the teaching method and user interface. Finally, Section 6 concludes the paper and provides a direction for future work.

2. RELATED WORK

There are systems developed to assist teaching and learning in the context of AI curriculum. In (Hatzilygeroudis et al 2005, Hatzilygeroudis et al 2006) a web-based intelligent educational system in the context of an AI course that uses AI techniques for teaching and assessing learners is presented. PATHFINDER (Sanchez-Torrubia et al 2009) is a tool for actively learning Dijkstra's algorithm. The highlighting new feature provided by this tool is an animated algorithm visualization panel. It shows, on the code, the current step the student is executing and also where there is a user's mistake within the algorithm running. TRAKLA2 (Malmi et al 2004) is a system for automatically assessing visual algorithm simulation exercises. TRAKLA2 provides automatic feedback and grading and allows resubmission, which means that students can correct their errors in real time. In (Kordaki et al 2007), an educational system, called Starting with Algorithmic Structures (SAS), designed for teaching the concept of algorithm and those of basic algorithmic structures to beginners is presented. Students come across the implementation of algorithms in real life scenarios and the system offers feedback to correct their answers. Also, in (Naser 2008), a visualization tool for teaching searching algorithms is presented. However, none of the above works

3. ARTIFICIAL INTELLIGENCE TEACHING SYSTEM

We developed the Artificial Intelligence Teaching System (AITS), to assist learning and teaching in the context of the "Artificial Intelligence" course in our Department. It is an adaptive and intelligent web-based educational system that teaches AI aspects and uses AI techniques for personalized learning and assessment of the students. Among others, it teaches AI search algorithms. We present in this paper the way it does it at an educational level.

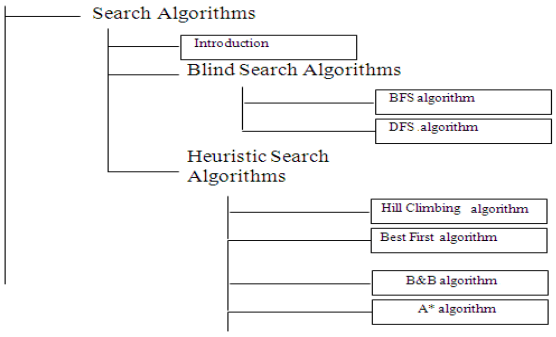

Figure 1. Part of the Tree of the AI Search Algorithms Domain.

3.1 Domain Knowledge Structure

AITS uses a tree-like structure to represent the domain knowledge related to the AI search algorithms. In Figure 1, a part of the tree structure of the AI search algorithms domain is presented. The subject itself is the root of the tree. The subject is divided in sections and the sections into subsections. Each sub-section deals with a number of concepts, which are the leaves of the tree. Subsections may have some concepts in common. The domain knowledge tree, described above, is displayed, as far as the subsections level, at the navigation area, at the left side of the user interface. From that tree the student can choose a learning goal (subsection). Each subsection corresponds to a learning page. Each learning page deals with a number of concepts. So, the concept pages constitute the teaching material of the domain.

3.2 User Interface

A student, through the user interface, initially subscribes to the AITS. After subscription, the student can, at any time, enter the system with his/her personal data. The interface of AITS is illustrated in Figure 2. It consists of two main areas: *navigation area* and *content area*, and also an *info bar*, which accommodates various information. This information concerns the username with which the student is connected to the system, the residence time of the system and the current date and time. Also, it offers to the student facilities for changing personal elements, changing the learning style, view statistics and general information about the system, annotation capabilities of the system, and logout from the system. Especially for the statistics, the student has the opportunity to see all the answers he/she gave and his/her knowledge level for each subsection, subject, and concept.

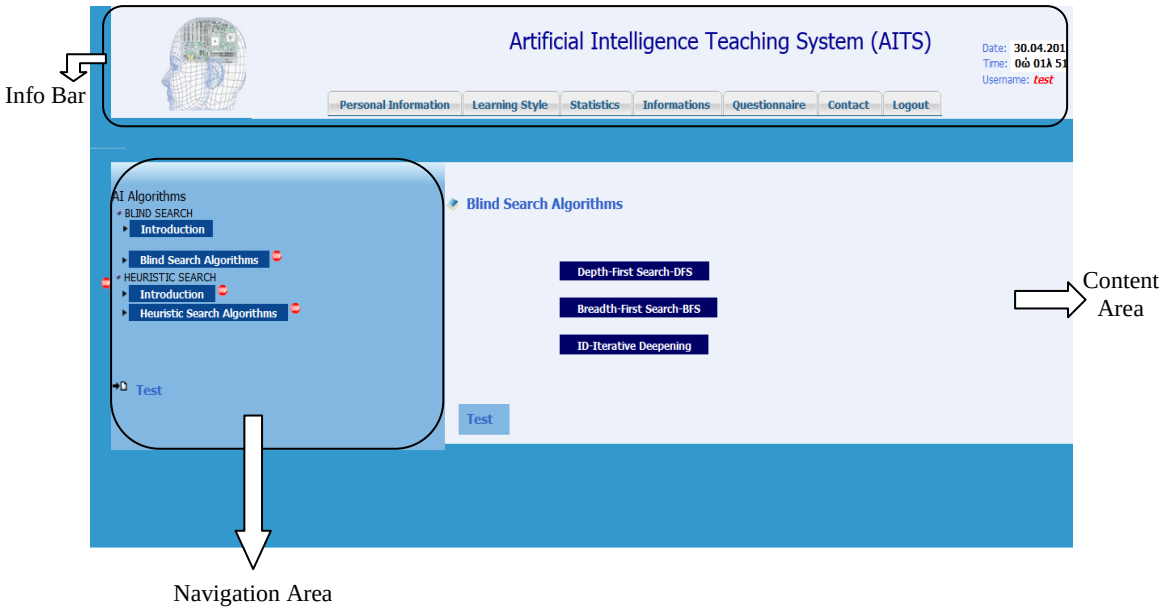

Figure 2. User Interface of the System

4. TEACHING METHOD AND LEARNING MATERIALS

Teaching is based on the traditional theory-examples-exercises paradigm (although the students can follow their own way). That is, for each topic, the theory is first presented. Then, some examples are given. Finally, the student is called to do some exercises. Theory consists in presenting a number of concepts. Those concepts are presented in a simple-to-complex way. That is, the simple concepts are presented first and the complex concepts (that require the knowledge of one or more simpler concepts) are presented afterwards. This is depicted in the ordered list presented to the user, which however is randomly accessible. Furthermore, the student can review a previous concept at any time. He/She is also not forced to follow the system's way

of teaching, but can make his/her own choices for studying a learning page. Any time a student has finished the study of a particular learning page, he/she can take the corresponding concept-level test.

The system offers theory, examples and exercises about AI search algorithms. More specifically, the system offers *theory* about blind search and heuristic search algorithms (breadth-first, depth-first, hill-climbing, branch-and-bound, A* etc), *interactive examples* and two types exercises: *practice exercises* and *assessment exercises*. Practice exercises are interactive exercises that are equipped with hints and guidance during the learning sessions, aiming to help the student in learning AI search algorithms. On the other hand, assessment exercises are interactive exercises that are used to examine the student's progress and comprehension. For example, a test on an AI search algorithm concept consists of a number of interactive assessment exercises.

After a student enters the system can study the theory about blind search and heuristic search algorithms and see interactive examples on the selected subjects. The student can select to interactively deal with a practice exercise to be helped in learning an algorithm. Finally, he/she can take a test consisting of assessment exercises to see what his/her knowledge level is.

4.1 Interactive Examples

The system provides interactive examples of different types on AI search algorithms. Interactive examples necessitate the step-by-step application of an algorithm. Each example consists of a tree or a graph with an explanation for each step of an algorithm. By clinking a button, the next step of the algorithm and corresponding details of the current step are shown. The examples are using animation to present the application of algorithms. In Figure 3, an interactive example on depth-first search (dfs) algorithm is presented.

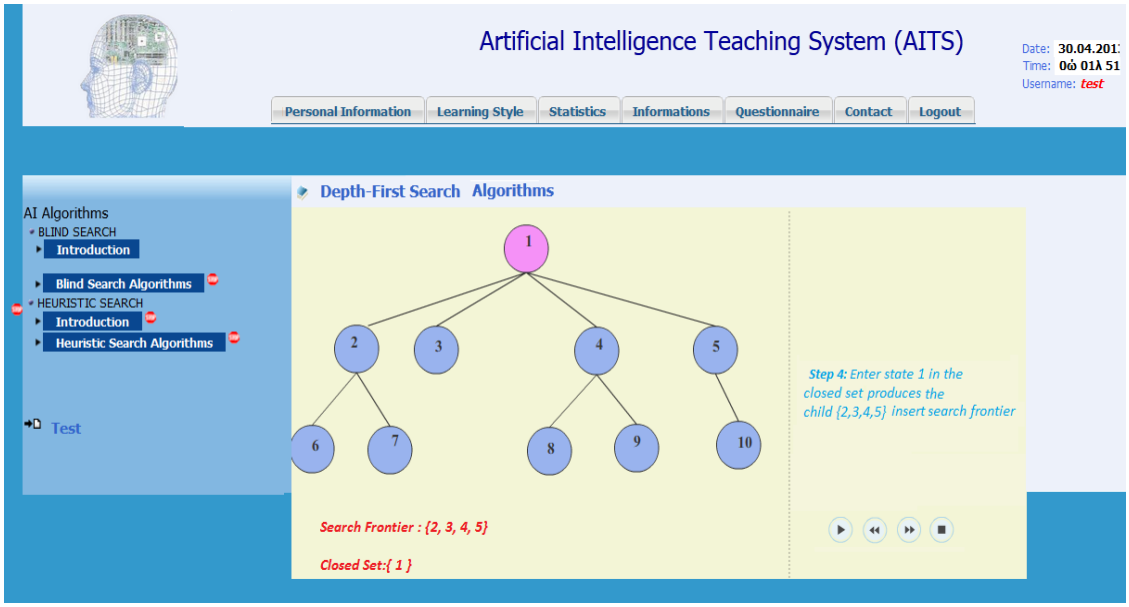

Figure 3. An interactive example on depth-first algorithm

4.2 Practice Exercises

Practice exercises are interactive exercises and their purpose is to assist students in understanding the algorithms through implementing AI search algorithms in an interactive way. A practice interactive exercise presents a graph or a tree and the student is called to reach a specific *goal node* starting from its *root* following an AI search algorithm. The student selects a *node* by clinking on it and the system provides guidance and feedback at student's actions during his/her interaction. The student can request for system assistance when stuck, by clicking on a help button. Then, the system provides feedback on what should do next and also cues regarding the next to visit/select node.

More specifically, as soon as a student selects a node in a practice exercise, the system acts as follows:

1. If the node choice is correct (in which case node color changes to green), then wait for the student to select the next node and go to 1.
2. If it is incorrect (in which case node color changes to red)
   2.1 Provide proper feedback, i.e. adapted to the error made.
   2.2 If the student clicks on the "show solution" button, display the correct algorithm step.
   2.3 If the student selects a new node, go to 1.

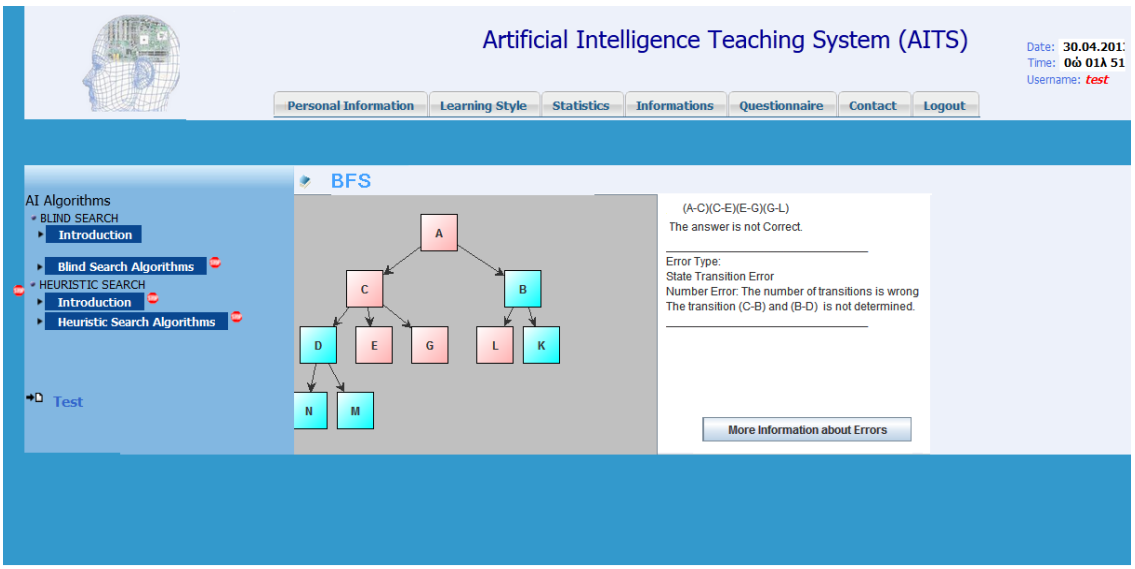

Figure 4. A practice exercise breadth-first algorithm

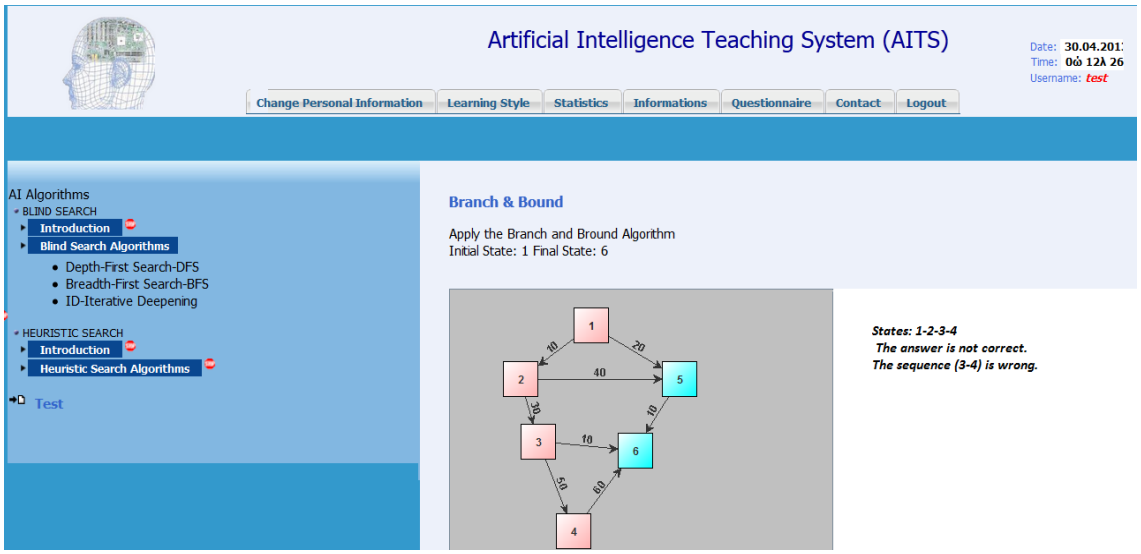

Figure 5. An assessment exercise of branch & bound algorithm

The practice interactive exercises provide immediate feedback after a student's incorrect actions, because the main objective is to assist the student in learning about search algorithms. Also, AITS monitors student's actions and behavior and keep records for each student, regarding the number of hints requested for each practice exercise, the total time that he/she spent to answer it correctly and the number of tries. In Figure 4, a practice exercise on breadth-first search (bfs) algorithm and the corresponding feedback and error report is presented.

4.3 Assessment Exercises

Assessment exercises are again interactive exercises that aim to assess the knowledge level of students in the corresponding concept. Also, it does not provide help either feedback during the student's interaction with the system. An assessment interactive exercise presents a graph or a tree and the student is called to reach a specific *goal node* starting from a *start node* implementing an AI search algorithm. The student selects the *nodes (states)* by clinking on them. After the student has selected the sequence of the nodes, the system provides the errors made by the student. More specifically, AITS presents the selection of the nodes that is not correct and provide detailed feedback on the errors made. In Figure 5, an assessment exercise is depicted.

5. EVALUATION

We conducted an evaluation study of the system during the AI course in the fall semester of the academic year 2011-2012. The students were attending the AI course and had attended lectures covering AI search algorithms. The participants in the evaluation study were 40 undergraduate students from those enrolled in the course. The methodology selected to evaluate the system is a pre-test/post-test, experimental/control group design, where the control group used a traditional teaching approach. The students were divided into two groups of 20 students each. The evaluation process was as follows:

(1) A pre-test was given to the students of both groups. The participants answered to exercises on AI search algorithms.
(2) Main Experiment: The control group was involved in the traditional learning and teaching process about AI search algorithms in the AI course. The students solved exercises given by the tutor individually and then discussed them with the tutor. The participants of the experimental group were given access to AITS, to study concepts of AI search algorithms for one week. The system provided exercises and feedback, as described in Section 4, during their interaction with it. Additionally, the students of the experimental group answered to a questionnaire containing questions about their experience from interacting with AITS.
(3) A post-test was given to the students of both groups. All the participants answered again to exercises about AI search algorithms.

Table 1. Descriptive Statistics of Pre-Test and Post-Test

	Group	N	Mean	SD	SE
Pre-Test	Control	20	5.705	1.448	0.32
	Experimental	20	5.825	1.37	0.31
Post-Test	Control	20	6.3	0.951	0.21
	Experimental	20	7.65	1.027	0.23

In order to reliably analyze students' performance, an independent *t*-test was used on the pre-test. The mean value and standard deviation of the pre-test were 5.825 and 1.37 for the experimental group and 5.705 and 1.448 for the control group. As the *p*-value (significance level) was 0.584>0.05, it can be inferred that the two groups did not significantly differ prior to the experiment. That is, the two groups of students had statistically equivalent performance abilities before the experiment. In Tables 1 and 2 the descriptive statistics are presented as well as the t-test results from assessment of students' learning performance (as calculated by the SPSS v.20 tool). The results reveal that the mean value of the pre-test of the experimental group is higher than the mean value of the pre-test of the control group. The Levene's test confirmed the equality of variances of the control and experimental groups for pre-test (F=0.306, p=0.584) and post-test (F=0.182, p=0.672). Also the t-test result (p=0.000 < .05) shows a significant difference between the two groups. Thus, it implies that the students in the experimental group got a deeper understanding of the AI search algorithms.

Table 2. Descriptive Statistics of Pre-Test and Post-Test

Equality variance		Levene's Test for Equality of variances		t-Test for mean					
		F	Sig.	t	Df	Sig.(2-tailed)	MD	95% Confidence Interval of the Difference	
								Lower	Upper
Pre-Test	Equal	0.306	0.584	-0.269	38	0.789	-0.12	-1.022	0.7824
	Unequal			-0.269	37.8	0.789	-0.12	-1.022	0.7825
Post-Test	Equal	0.182	0.672	-4.312	38	0.000	-1.35	-1.9838	-0.7162
	Unequal			-4.312	37.78	0.000	-1.35	-1.9839	0.7161

Moreover, the questionnaire that the experimental group filled in included 9 questions. Question 1 was of multiple choices and concerned the time needed for a student to adapt to the system. Questions 2-5 were based on a Likert scale (1: not at all, 5: very much) (see Table 3), but they included a ‘please explain’ request too. Finally, Questions 6-9 were of open type and concerned strong and weak points or problems faced in using the system.

Their answers show that the students in general enjoyed learning with the system (Q3, Table 3). Most of them (80%) reported that they needed less than five minutes to start using the system (Q1). Also, they found that the user interface is easy to use (Q5, Table 3).

On the other hand, the students (75%) agreed that the system helped them in learning about AI search algorithms. Also, due to this fact they suggest the system to the next year students (80%) (Q4, Table 3).

Table 3. Questionnaire Results

Q	Question	Answers (%)				
		1	2	3	4	5
2	How much did the system help you to learn AI search algorithms?	0	5	30	40	25
3	Did you enjoy learning with the system?	0	0	20	30	40
4	Will you suggest the system to next year students?	0	0	20	40	40
5	Did you find the interface easy to use?	0	0	25	40	35

In general, students felt that the system was helpful and easy to learn. Moreover, they indicated that the system helped them better understand the AI search algorithms and learn, especially through the errors they made.

6. CONCLUSION AND FUTURE WORK

In this paper, we present an adaptive and intelligent web-based educational system, called AITS, which is used for teaching AI search algorithms. The system offers theory descriptions, but most importantly interactive examples and exercises. A student can study the theory and the interactive examples, which use visualized animation to present AI search algorithms in a step-by-step way, to make them more attractive. Also, some explanations are given during interactive examples sessions. Then, the student can try practice exercises, which are interactive exercises and where immediate feedback is given when the student makes an error, but further help is optional. So, the student can try by him/herself to correct the error or ask for help from the system. At a second level, the system provides the solution to each step, when asked by the student. Finally, the student can take a test consisting of assessment exercises, which are interactive, but no help is provided. The result of the test is an assessment of the student's knowledge level on corresponding concepts.

We evaluated the system through a pre-test/post-test and experimental/control group method. Results are very promising. The experimental group made better than the control group. Also, results of a questionnaire given to the experimental group show that the majority of the students liked the system very much. So, it seems that visualized animation and interactivity are two crucial factors that contribute in better learning, at least for subjects like AI search algorithms.

A point for further improvement of the system is the following. At the moment, the system offers a rather limited number of interactive examples and exercises of both types. Implementation of such learning materials is quite time consuming, because it requires programming. So, a way for semi-automatic or automatic generation of such learning elements (actually programs) is a quite interesting direction for further research. This is one of our next research efforts.

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DIGITAL HISTORIES FOR THE DIGITAL AGE: COLLABORATIVE WRITING IN LARGE LECTURE COURSES

Leen-Kiat Soh[1], Nobel Khandaker[1] and William G. Thomas[2]
[1]*Department of Computer Science and Engineering, University of Nebraska*
256 Avery Hall, Lincoln, NE 68588-0115, USA
[2]*Department of History, University of Nebraska, 612 Oldfather Hall, Lincoln, NE 68588-0327, USA*

ABSTRACT

The digital environment has had an immense effect on American society, learning, and education: we have more sources available at our fingertips than any previous generation. Teaching and learning with these new sources, however, has been a challenging transition. Students are confronted with an ocean of digital objects and need skills to navigate the World Wide Web and numerous proprietary databases. Writing and disciplinary habits of mind are more important than ever in this environment, so how do we teach these in the digital age? This paper examines the current digital environment that humanities faculty face in their teaching and explores new tools that might support collaborative writing and digital skills development for students. In particular, this paper considers the effectiveness of a specially configured multi-agent wiki system for writing in a large lecture humanities course and explores the results of its deployment over two years.

KEYWORDS

History, Wiki, Writing, Digital History, Digital Humanities, Multiagent, Collaboration

1. INTRODUCTION

Students in entry-level courses at large public universities are waiting for a new model of collaborative learning. They hope to engage with the rich digital media all around them and to participate in these courses more actively. Students expect, but often cannot find, courses that build digital materials around their increasingly collaborative learning styles. We developed a demonstration curriculum—enriched and supported through our multi-agent technology—where students in these courses work exclusively with digital objects and produce domain specific reflection, collaborative writing, deep engagement with the subject, and ongoing self-assessment. We wanted to create a new classroom for large lecture courses where there is less anonymity and more dynamic learning, where students truly participate in a "community of scholars."

The goal of our ClassroomWiki experiment was two-fold. First, we wanted to investigate the advantages and disadvantages of using ClassroomWiki in a large classroom for implementing collaborative writing activities. To be specific, we wanted to evaluate the ClassroomWiki's capability of: (1) providing accurate and detailed student interaction data to the teacher – leading to student evaluations that better reflect the level/amount of contribution towards their groups, (2) forming student groups that yield higher student participation and collaborative learning outcomes. To conduct our experiment, we divided the 150 students in a standard U.S. History survey course into two sets: control and treatment. Both control and treatment students used the same ClassroomWiki interface to collaboratively write essays on a given topic. However, the student groups in the control set were formed randomly, and the treatment set student groups were formed using MHCF, a multiagent coalition formation algorithm.

In brief, our results indicate that ClassroomWiki's treatment set students interacted more with the ClassroomWiki site, earned slightly higher scores than the control set students, and rated their peers slightly better compared to the control set students. Furthermore, ClassroomWiki was able to track more detailed information regarding student activities and provided several insights into the collaboration and interaction patterns of the participating students. In addition, the student scores calculated by ClassroomWiki's detailed

student contribution summary (e.g., the summary of student activities) closely represented their performances in other tests/assignments in the class. Finally, in the responses to our survey and self-assessment, the students slightly favored ClassroomWiki over Blackboard's wiki, provided several constructive comments that will help us improve the user-friendliness and usefulness of ClassroomWiki further, and experienced *affective* change in the ways they think about the teaching and learning of history.

2. LEARNING ABOUT DIGITAL HISTORIES

The problem in most large lecture courses is widely recognized. Students are assigned little writing and have few opportunities for engagement with the disciplinary knowledge they will need to be successful. Moreover, "course management software" only contributes to the distance that students feel from the process of learning in the discipline since these systems offer one-way delivery of ever increasing amounts and kinds of content. There is a significant gap in these courses between content and assessment, between the habits of mind we hope to teach and the activities that students perform. This is particularly true in history, where large numbers of students in entry-level surveys are taught through lectures, textbook assignments, and multiple choice tests.

Our idea was to create a learning system that spurs collaborative approaches--groups of students will be able to annotate or highlight new additions to digital objects, make changes, sort, track, and compare versions, as well as rate and evaluate all aspects of their group's work. Rather than write analog essays that refer to digital objects (current practice), we envisioned students' writing digital histories in a digitally native system. We also envisioned collaboration that was active, meaningful, and sustained through the practice of joint research and writing. In this virtual space historical knowledge and thinking can be formed through inquiry, description, analysis, discussion, argument, and collaboration.

Our vision was in large part an extension of our longstanding research efforts in digital history and more broadly digital humanities. Ayers (1999) pointed out in "The pasts and futures of digital history" that "as rapid as the changes have been . . . the actual writing of history has remained virtually untouched and unchanged. New technology has not affected the books and articles that form the foundation of what we teach." Much of this statement remains true today—historians continue to write history in books and articles in the same way—but the foundation of what historians teach has shifted. History teachers are increasingly referring to materials online, weaving them into their assignments, and recognizing the importance of primary source instruction using digital sources. Students, of course, regularly turn first to online searches for historical information.

Ayers (1999) went on to call historians to a new form of digital writing: "to imagine forms of narrative on paper that convey the complexity we see in the digital archives." Digital history, he pointed out, "could be both a catalyst and a tool in the creation of a more literary kind of history." Ayers was not alone in his suggestion that historians write digital histories for the digital age. Robert Darnton, long a leader in this field and a past president of the American Historical Association, called for a "new age of the book" in 1999. He suggested that histories might "instead of using an argument to close a case, they could open up new ways of making sense of the evidence, . . . a new consciousness of the complexities involved in constructing the past." More recently, Ayers (2013) has called for a "more radical online revolution," in which undergraduates participate in and produce "generative scholarship" ("Toward a More Radical Online Revolution," *The Chronicle Review*, February 4, 2013).

In *The Journal of American History* "Interchange: The Promise of Digital History," Steven Mintz drew attention to the ways digital technologies have reshaped teaching: "It has broadened my imagination. I have embraced audio and visual sources because they are much more accessible than in the past. I have created interactive, inquiry- and problem-based teaching and learning activities on the Digital History Web site because new technologies encouraged me to rethink the very nature of history teaching and to reimagine it as active engagement." (Cohen et al. 2008) Scholars have also written about how undergraduate research might spur new pedagogies for humanities disciplines in the digital age (e.g., Crane 2012; Pannapacker 2013; Thomas 2007, Thomas and Ayers 2003; Thomas and Liu 2012).

Digital histories also help us think differently about how we know what we know about the past. Digital historians seeking to reconstruct the social world of, say, nineteenth-century America depend on these records, but by importing them into a digital medium these historians attempt to interrelate and shape the

information in ways that might make invisible histories visible. They create models and visualizations about historical questions, and attempt to uncover patterns and relationships not otherwise obvious. If we are beginning to write new forms of history—digital histories—should we expect our students to do the same, to produce their analysis in these potentially exciting new formats? (Cohen and Rosezweig 2006, Seefeldt and Thomas 2009, Thomas 2007)

The ideas behind the movement in Digital History have coincided with changes in our students' expectations and in our classrooms. Marilyn Lombardi (2007a, 2007b) has recently pointed out the difficulties in teaching survey courses—they are "juggernauts" with a "merciless trajectory", she explains, and depend on traditional modes of assessment. Research studies suggest clearly that content coverage may be less valuable than independent thinking and creativity as a means toward disciplinary understanding. But faculty, she also points out, know how difficult it is to move in this direction. And it is clear that a great deal of transformative faculty development will continue to be necessary to spur active learning pedagogy.

Other recent studies have pointed to the problem of digital information overload, of underdeveloped digital literary skills. Palfrey and Gasser (2010) have raised awareness about the ways the digital generation consumes, but does not necessarily produce, digital media. Similarly, in the field of history, Martin and Wineburg (2008) have indicated the need to support what they have called "the novice in the archive." They ask, "how do we use new digital technologies not only to make sources more available, but also to cultivate skills that teach students to read and think about these sources in meaningful ways?"

At the University of Nebraska, like many land grant institutions in the U.S., the survey courses in U.S., European, and World history comprise an especially high demand cluster. Between 2001 and 2007 over 25,680 students took these courses, averaging just over 3,800 students per year. The U.S. History courses held the majority of these students; indeed over 2,500 students on average took the U.S. survey courses a year. These students came from every college at the University—Art, Architecture, Business, Engineering, Natural Resources and Agriculture, and Arts and Sciences. To explore and evaluate a new model for developing historical thinking and writing in the large lecture U.S. History survey course, we put together a collaborative team. The team included faculty in Computer Science and Engineering, English, and History, as well as graduate students in History and Computer Science and Engineering.

3. CLASSROOMWIKI

ClassroomWiki has several sets of features. First, in terms of communications, it supports threaded forums where students can start a discussion thread and respond to discussion threads. Second in terms of collaborative interactions, it supports versioning-based collaborative editing. This allows contributing students to traverse between versions, review the changes, and collaboratively revise their Wiki essays. It also has a survey instrument for peer evaluation of their group activities. To further support students, ClassroomWiki allows for searching to retrieve archived communication (messages and discussion threads) and also provides automated collaboration reminders to notify students working in a group of any changes to their group pages.

ClassroomWiki has a suite of instructional support features such as a viewable summary of student contributions, teacher announcements, and two options for forming groups: random and intelligent. The intelligent group formation tool uses the Multiagent Human Coalition Formation (MHCF) framework (based on the principles described in (Khandaker and Soh 2007) to form heterogeneous student groups using the data tracked in the ClassroomWiki environment. The novelty of this MHCF framework is in its group formation process which, due to its design and implementation, 1.) adapts to the changing behavior of the students and 2.) balances the heterogeneity of the members so that a student group contains students of all levels of performance. That is, from one assignment to the next, MHCF is able to re-assign students into groups for the next assignment based on how they behaved or collaborated in the previous assignment. The behaviors tracked include online activities such as the number of contributions, amount of words contributed, quality of participation in threaded discussions, and peer evaluation scores. When assigning students to groups, MHCF adopts a heterogeneity principle (Khandaker and Soh 2010): *The group formation algorithm should balance heterogeneity of learner expertise in a group in such a way that they are less likely to give rise to situations where the participating learners would be de-motivated due to too high or too low incongruity between their expertise and the Wiki artifacts they are working on.*

For further details on ClassroomWiki, readers are referred to (Khandaker et al. 2010; Khandaker and Soh 2010).

4. WRITING ASSIGNMENTS

In Spring 2009 and 2010 the lead History faculty member taught a U.S. survey course to approximately 150 students and introduced group writing assignments in the wiki format—asking the groups in each assignment to use library accessed databases with primary source documents (Proquest Historical Newspapers) to research a topic, and to collaborate to write a thesis-driven essay explaining its historical significance based on and from their sources. We attempted to move our approach to digital history as a research enterprise directly into the classroom. The specially designed wiki system, called ClassroomWiki, would allow us a finer granularity of analysis and with it we could test the effectiveness of the group-building algorithm and of the step-by-step instruction in historical reading and analysis or "habits of mind." Our pedagogy of digital history was built around the following concepts: 1.) emphasizing writing as a process of learning and disciplinary thinking, 2.) using digital primary sources to expose students to the complexity and contingency of the past, and 3.) using group collaboration to formulate interpretive analysis of the primary sources.

The writing assignments were carefully sequenced. We began by helping students become better readers of primary documents and by giving them writing prompts for their reading. These prompts were the kinds of questions historians ask habitually: who wrote this, who were they writing to, what did they want or expect, what keywords—i.e., important words or subjects in the text—were used, what themes—i.e., broad concepts that the author or creator is using and emphasizing throughout the text to make his/her point—were adopted, and what rhetorical strategies—i.e., techniques the author or creator is using to convince, persuade, distort, or arrange evidence in his/her favor—were embedded in the document? To help students understand primary sources, we asked them to evaluate every primary source in four steps:

1. Sourcing—find out who wrote, created, or produced this document, when, why and for what audience.
2. Contextualizing—situating the document and the events it reports in place and time.
3. Corroborating—checking other documents and multiple sources to assess the reliability of its claims and perspective.
4. Close Reading—reading carefully to consider what a source says and the language used to say it.

5. RESULTS

For each group writing assignment using the wikis, we built in required steps for the teamwork. Students were asked to evaluate primary sources using the above criteria, conduct research using digital databases to find primary sources related to their topic, formulate a thesis, and complete a written paper. Students worked with entirely digital sources and could mix and remix them into their analysis. For a given assignment hey conducted their initial collaborative work in ClassroomWiki's "sandbox" where they could assemble materials for the group to evaluate and share. They were *doing* history.

Because our ClassroomWiki system had the ability to track individual level work at a high level of granularity, there was a correspondingly higher degree of individual accountability. Our team's main interest was in the viability of the group formation agents and whether the algorithm helped groups achieve better performance. We found that the multi-agent system did result in slightly but statistically significant improvement in a group's success when compared with a control group. With more iteration of group activities the algorithm would probably have had a greater and deeper positive effect.

The ClassroomWiki system also provided instructors with some novel and useful ways to see the work as it progressed. The system's grading and commenting functions were especially useful for our assessments. ClassroomWiki tracked the total word counts of individual students (average was 5,596), the numbers of messages posted, and, especially, the number of days each student logged onto the system and made changes to his or her assignment (average 6.4, high 22 days, low 2). The treatment groups earned higher average scores and a lower standard deviation than the control group, suggesting that treatment groups were better able to work together than if they were randomly formed. For both the treatment groups and the control groups, the total interaction numbers (counts) were remarkably similar, but the treatment group members rated their peers (quality of participation) slightly better.

Table 1 shows the correlations between the students' scores in the ClassroomWiki assignment and their scores in the other tests/assignments in the class. The values in Table 1 indicate that except for the first document analysis assignment, the scores the students received in the ClassroomWiki assignment were well correlated with their scores in the other assignments/exams. These high correlation values suggest that individual student scores that were calculated based on ClassroomWiki's student contribution summary (e.g., number of words added/deleted, number of forum messages posted, etc.) *closely* represented the actual performance of the students in the other tests and assignments in the class. Furthermore, the correlation values in Table 1 indicate that the students' final exam scores were higher for their ClassroomWiki's score than their first assignment in Blackboard's Wiki scores. Since the final exam score represents the knowledge and understanding of the students that they gained in the class, the higher correlation suggests that the detailed tracking of student behavior in ClassroomWiki allowed it to capture the performance of the students more *closely* than Blackboard's Wiki.

Table 1. Correlation Values

Test/Assignment	Correlation w/ ClassroomWiki Scores	Correlation w/ Progressive Era Group Wiki (Blackboard Wiki) Scores
Final 05/01/09	0.69	0.54
Midterm Essay Exam 03/02/09	0.52	0.67
Civil Rights Essay 03/13/09	0.51	0.39
Origins of Segregation Document Analysis 1/13/09	0.30	0.18
Progressive Era Group Wiki (Blackboard Wiki) 02/27/09	0.29	—

The best way to verify ClassroomWiki's impact on the performance of the students would be to have pre-test and post-test *before* and *after* the students have completed ClassroomWiki's assignment to test their knowledge of the Wiki topic. However, we did not conduct such tests, and thus it is difficult to verify the impact of ClassroomWiki on the students' performance/learning. As a result, we have compared the change in students' performances before and after the first Blackboard Wiki assignment with the change in students' performances before and after second ClassroomWiki assignment to estimate the impact of ClassroomWiki on students' performance and learning. Table 2 shows the result of our comparison.

Table 2. Change in Students' Scores. Note that the median for BlackboardWiki's impact was 0.00 because there was no significant improvement in the control set students from the viewpoint of the median value.

	Mean	Median
BlackboardWiki's Impact: Delta1 (Midterm Score – Document Analysis Score)	3.73	0.00
ClassroomWiki's Impact: Delta2 (Final Exam Score – Midterm Exam Score)	2.71	3.00

When we perform a t-test on the students' scores, we see that the *average change* in students' performances due to Blackboard's Wiki and ClassroomWiki were not statistically significant. However, the *median* of the change of the students' scores improved a little after they completed the ClassroomWiki assignment. This slight improvement in the median of the score change of the students suggests that ClassroomWiki might have helped *some* of the low-performing students to perform at a higher level and thus improved the median score. Since, our results are not conclusive, we need to collect more data using pre- and post- tests in our next experiment to better understand the impact of ClassroomWiki on the performance and learning of students.

We also categorized the students according to the change in their scores from the midterm to the final exam. Table 3 shows our results.

Table 3. Student Scores in ClassroomWiki Assignment. Note that the median for the Control Set Students was 0 because there were quite few control set students who did not complete/submit assignments and received a 0.

	Control Set Students		Treatment Set Students		All Students	
	Median	Mean	Median	Mean	Median	Mean
Students with No change in the scores (Final – Midterm)	0.00	31.17	74.00	59.42	69.00	50.00
Students with Positive Change (Final – Midterm)	85.00	80.21	83.00	82.12	85.00	81.16

The results of our analysis show that the students whose performances (i.e., scores) improved from the midterm to the final (second row of Table 3) had achieved *higher* mean (difference statistically significant using t-test with $\alpha = 5\%$) and *higher* median scores in the ClassroomWiki assignment than the students whose performances: (1) did not change or (2) deteriorated.

In self-assessment and self-evaluation surveys at the end of the semester, students expressed a high level of *affective* change. They realized significant gains in historical thinking, analysis, and writing. One student wrote, "It's one thing to read a history text book. It's quite another to play the part of historian and to develop an opinion about historical events. This class I felt was very hands on in that enabled me to be a historian for a little while." Another explained, "I feel that the document analysis assignments and the wiki assignments really helped advance my skills in writing historical analysis. I have never been in a class that required me to write historical analyses like this class did." Students noted that group-writing assignments were valuable because they expected future employers to emphasize team project and team building. "I know that my ability to read primary documents and analyze them has increased immensely," one student explained, "I feel that my writing quality improved throughout the semester as you assigned more papers regarding analyzing primary documents."

But students also expressed considerable frustration with learning historical habits of mind. Students expected a history course to cover events, names, and dates. They expected to be assessed on their capacity to recall these terms and perhaps to explain their significance. As a result there was a considerable gap between what students expected the survey course to *be* and what we were asking them to *do*. One student expressed the friction between these expectations in this way: "First of all, this course was not at all what I expected. I expected a 'standard' history class where the information is presented, notes are taken, . . . While at first I did not like the format of the class, I actually grew to like it and really appreciate what this course was trying to teach me in terms of historical facts but also the critical skills it forced me to acquire and utilize." Another student noted, "In the beginning I was very intimidated by the document analysis projects and the wikis. I had no idea how to analyze historical documents, considering things like perspective, tone, audience etc. . . " We found, therefore, an important though cautious correlation. When students were divided into three groups—those who improved from the mid-term exam to the final exam grade, or did not, or stayed the same—we found that performance on the second wiki correlated with individual exam performance (using t-test). Significantly, the correlation held for students from all grade ranges—that is, if they improved from C- to C+, B to A, or D to C. All improvers, in other words, from the individually assessed mid term exam to the individually assessed final exam were parts of higher scoring Wiki groups whose make-up had been tailored by the ClassroomWiki algorithm, and the relationship was not accidental.

The distribution and size of the bars in Figures 1 and 2 suggest that in general, the students were able to complete their assignment in ClassroomWiki. Also, a higher number of students in the control group did not contribute to their respective groups and received a 0. This could be an indication of our group formation algorithm improving student groups' collaboration by bring students of varying competence together so that no group is formed with students who are unable to collaborate (due to lack of competence) and complete their task. This claim can be further strengthened by comparing the scores of the control and treatment sets' groups. The results show that the treatment set groups earned higher average scores (treatment = 74.67 vs. control = 70.61) and had lower standard deviation (treatment = 15.51 vs. control = 27.40, *p-value* <0.005). The higher average and lower standard deviation suggest that the treatment set student groups were able to work more effectively together as a group.

6. SUMMARY

Students in large lecture humanities courses need to gain mastery over not only content knowledge but also disciplinary thinking. They should in these courses learn to master a process—how to be a historian, a scientist, a sociologist, how to inhabit a major discipline. Mastering a process requires skill development and iteration, and mastery once learned can be transferred and extended. We teach introductory survey courses not to make students know a set of facts, but to teach students the habits of mind and critical inquiry of our discipline. ClassroomWiki's group writing algorithm supported the development of disciplinary thinking in a large lecture history survey course, improved tracking of student work in groups, and may have led to improved performance on individual graded examinations assessing historical thinking.

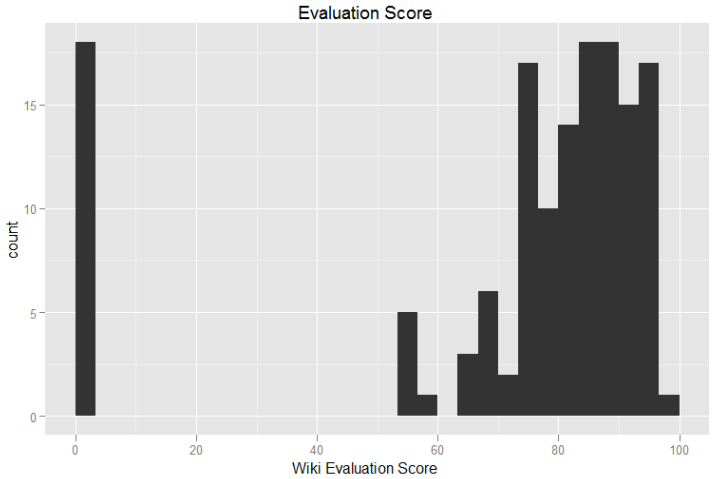

Figure 1. Evaluation score distribution of ClassroomWiki students

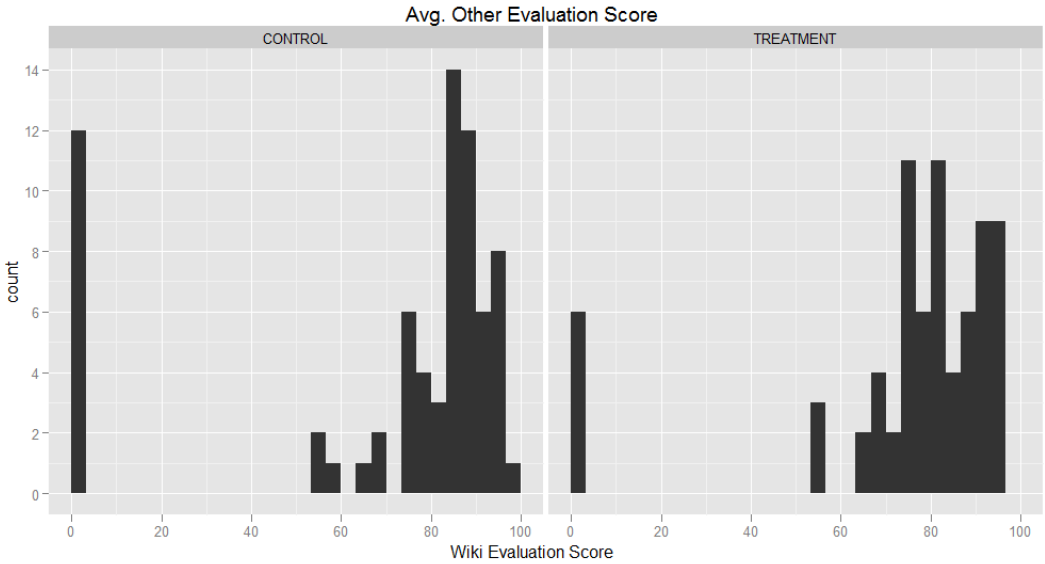

Figure 1. Wiki evaluation score of students in ClassroomWiki

Future work includes conducting more studies with groups formed using different algorithms, with writing assignments that are more structured and spread out over an entire semester, and with additional features such as tagging and rating. We are also interested in how posting previous years' Wiki artifacts online as examples impact student learning as well as their performance over time.

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PROMOTING SCIENTIFIC LITERACY THROUGH THE ONLINE ARGUMENTATION SYSTEM

Chun-Yen Tsai
Department of Information Management, Cheng Shiu University
No.840, Chengcing Rd., Niaosong Dist., Kaohsiung City 83347, Taiwan

ABSTRACT

This study investigated how the scientific competencies advocated by the Programme for International Student Assessment (PISA) could be improved by using online argumentation. An online argumentation system served as an aid for argumentation instruction and activities among students during the experiment. Seventy-one 10th grade high school students took part in this study. A quasi-experimental design was adopted and qualitative and quantitative analyses were used. The results showed that using the online argumentation system to conduct argumentation instruction and activities could improve the students' PISA scientific competencies. The experimental group students outperformed their counterparts in terms of mean scientific competencies. Finally, this study proposed suggestions related to argumentation research and science instruction.

KEYWORDS

Argumentation, online argumentation system, PISA, scientific competencies, scientific literacy

1. INTRODUCTION

The Programme for International Student Assessment (PISA) sponsored by the Organization for Economic Co-operation and Development (OECD) measures students' competencies in reading literacy, mathematics literacy, and science literacy every 3 years. Each survey focuses on a single subject, with the other two as supplementary subjects. The objective of the PISA is to understand how 15-year-old students from the participating countries apply knowledge and abilities in their handling of daily issues before completing their compulsory education (Bybee, 2008; Bybee & MaCrae, 2011; Fensham, 2009; Lin, Hong, & Huang, 2012a; Olsen & Lie, 2011; Sadler & Zeidler, 2009). Not only does the PISA measure the students' understanding of school curricula, it also measures the important knowledge and abilities required in civic society for their future (Bybee, 2008; Bybee & McCrae, 2011; Lin et al., 2012a; Yeh & She, 2010). Nowadays, public debates about governmental policies on socio-scientific issues also rely on the scientific literacy of citizens to make informed decisions (Lin et al., 2012a).

The PISA focuses on the students' competencies in applying their acquired knowledge in daily scenarios (Bybee, 2008). The ability to probe is emphasized in their scientific literacy, including interest, support, and responsibility (OECD, 2009). Likewise, Taiwan's nine-year integrated curriculum for the science and technology domain is similar to the principles of the PISA in terms of cultivating the required competencies in students. However, the global rankings of Taiwanese students in scientific literacy fell from 4th place in 2006 (total score of 534) to 12th in 2009 (total score of 520) (TWPISA National Center, 2012a). The students' performance scores are related to complex factors such as teaching practice, school culture, and family values. Although stating that the international evaluation results such as those of the PISA are due to education performances is controversial (Wang & Lin, 2005), it is still feasible to implement relevant teaching strategies in the classroom for promoting such performance. The enhancement of PISA scientific competencies has become an important issue in the reforming of school curricula by Taiwan's science educators.

Recent studies on the PISA have focused on the effects of demographic variables or transnational culture (e.g., Basl, 2011; Bybee & McCrae, 2011; Kjarnsli & Lie, 2004; Olsen, 2005; Olsen & Lie, 2011; Nentwig, Roennebeck, Schoeps, Rumann, & Carstensen, 2009). Few studies (e.g., Lavonen & Laaksonen, 2009) have

proposed relevant teaching strategies for improving students' PISA scientific competencies. Researchers need to provide more experimental data in terms of PISA scientific competencies in order to contribute to educational policies. Some researchers (e.g., Lee, 2009) have recommended the improvement of argumentation skills in light of the relationship between PISA scientific competencies and argumentation, whereby it is thought that students would cultivate their scientific competencies. In addition, the internet is an effective tool for conducting argumentation instruction and activities (Bell & Linn 2000; Clark & Sampson, 2008; Lin, Hong, & Lawrenz, 2012b; Yeh & She, 2010) and new generation has been used to contact in the social networking service, such as Facebook. The present study considered the use of internet tools and argumentation as a medium to explore the improvement of students' scientific literacy.

1.1 Scientific Literacy

The OECD (2009) has illustrated the definition of scientific literacy and its framework for the PISA science assessment. In this framework, the term scientific literacy denotes an overarching competency comprising a set of specific scientific competencies. Scientific competencies include the abilities to mobilize cognitive and non-cognitive resources in any given context. These competencies are regulated by the individual's appreciation, interest, values, and actions relative to scientific matters, and are characterized as crossing through three interrelated aspects, including context, knowledge, and attitudes (as shown in Fig. 1).

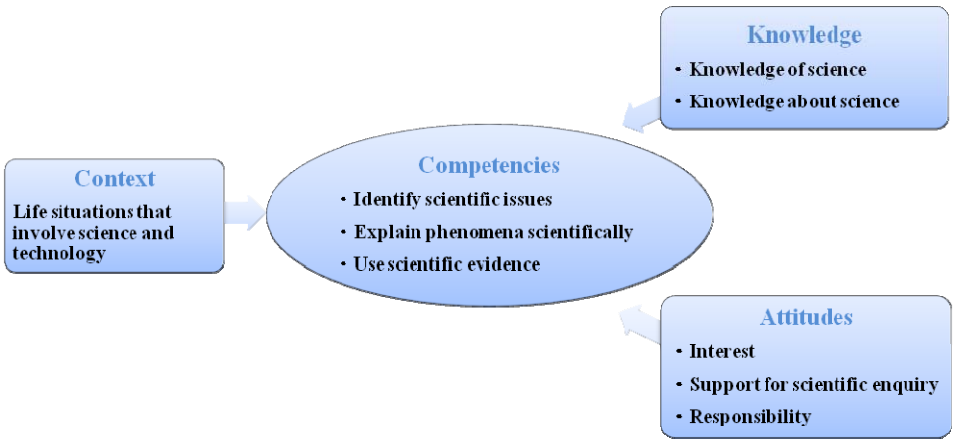

Figure 1. Framework for the PISA science assessment (OECD, 2009)

Scientific competencies comprise a set of three specific constructs (OECD, 2009):

1. Identifying scientific issues: This construct includes recognizing issues that are open to scientific investigation; identifying keywords to use in searching for scientific information; and recognizing the key features of a scientific investigation.
2. Explaining phenomena scientifically: This construct includes application of scientific knowledge in a given situation; describing or interpreting phenomena scientifically and predicting changes; and identifying appropriate descriptions, explanations, and predictions.
3. Using scientific evidence: This construct includes interpreting scientific evidence, making and communicating conclusions; identifying the assumptions, evidence, and reasoning behind conclusions; and reflecting on the societal implications of science and technological developments.

In the dimension of "context" in Fig. 1, the assessment is built around life situations including five aspects: health, natural resources, environment, hazard, and frontiers of science and technology, with each context spanning personal, social, and global scales. The dimension of "knowledge" includes "knowledge of science" and "knowledge about science". The former refers to knowledge of the natural world while the latter entails knowledge of scientific inquiry. The dimension of "attitudes" includes interest in science, support for scientific inquiry, and motivation to act responsibly towards, for example, natural resources and environments.

1.2 Argumentation and Online Argumentation

Argumentation in scientific learning can be defined as a process of connecting claims and data through justification or through the evaluation of knowledge claims in light of empirical or theoretical evidence (Clark & Sampson, 2009; Jimenex-Aleixandre & Erduran, 2008; Osborne, Erduran, & Simon, 2004). Arguments are the artifacts of argumentation and consist of either assertions or conclusions, including their justifications, reasons, or supporting factors (Zohar & Nemet, 2002). In science education, argumentation is seen as entailing three overlapping goals: making sense of the phenomenon under study (i.e., constructing claims and explanations), articulating those understandings (presenting arguments), and persuading others to adopt one's ideas (critiquing and evaluating counter ideas while defending one's own) (Berland & Reiser, 2009, 2011).

Discourse is an essential component of argumentation, and social interaction plays a critical role in knowledge construction. Such social interaction forms an environment for discussion which allows individual thinking to move from implicit to explicit, and this can result in group reflection to reach a common consensus. However, students are often not able to propose evidence or reasons supporting their arguments (Nussbaum, 2002). Argumentation should be imparted to students through appropriate teaching, learning tasks, assisting, and other processes (Kuhn, 1991). It would achieve such teaching objectives more easily by complementing them with scaffolding (Bell & Linn, 2000; Nussbaum, 2002; Osborne et al., 2004).

Argumentation activities require specific steps and thinking processes, of which and information technology can assist in building (Bell & Linn, 2000; Yeh & She, 2010). Computer tools can assist students in becoming researchers and reviewers, helping them to actively evaluate scientific thinking (Linn, 1998). Joiner and Jones (2003) believe that asynchronous computer-mediated communication is much more advantageous than face-to-face communication and is suitable to become the cultivation tool of argumentation skills. For example, the characteristic of asynchronous online discussion is the extension of answering time for students (Joiner & Jones, 2003). High level questions can stimulate more accurate and definite answers from students when given a more sufficient waiting time. Moreover, the context of argumentation requires equality amongst the participants, which cannot be easily established in traditional classrooms (Duschl & Osborne, 2002; Joiner & Jones, 2003). Online discussion is free from the traditional classroom constraints whereby the discussion is led by a few dominant students, and low-achieving students can express their own opinions asynchronously. Therefore, this study hoped to complement argumentation instruction and activities with the advantages of an online environment, and observe how this process might promote students' scientific literacy.

1.3 Argumentation and Fostering of Scientific Literacy

Argumentation is the coordination of evidence and theory to support or refute an explanatory conclusion, model, or prediction (Clark & Sampson, 2009; Osborne et al., 2004). Such a process requires PISA scientific competencies in using scientific evidence and explaining phenomena scientifically. The competency in using scientific evidence involves accessing scientific information and producing arguments and conclusions based on scientific evidence. The competency in explaining phenomena scientifically includes describing, interpreting phenomena, and predicting changes, and may involve recognizing or identifying appropriate descriptions, explanations, and predictions (OECD, 2009). The above comparison shows the potential relationship between argumentation and PISA scientific competencies. Therefore, conducting argumentation instruction and activities may promote the students' scientific literacy.

The improvement of PISA scientific competencies also requires students to go through the scientific learning process in the scientific context. Previous science learning studies have viewed individual learning as a form of conceptual change (Posner, Strike, Hewson, & Gertzog, 1982), and relevant researchers (Dole & Sinatra, 1998; Nussbaum & Sinatra, 2003; Yeh & She, 2010) believe that argumentation can effectively promote students' conceptual change. The process of argumentation allows students to compare and contrast arguments through in depth thinking (Dole & Sinatra, 1998), essentially triggering a cognitive conflict in an individual by giving him/her new information that varies from his/her prior knowledge. This is the first condition proposed by Posner et al. (1982) for conceptual change: the learner has to feel dissatisfaction on a current concept. A cognitive conflict triggered by in-depth thinking can then lead to learning and conceptual change (Nussbaum & Sinatra, 2003).

1.4 Research Question

Based on the above literature discussion, this research used an online argumentation system to complement the argumentation instruction and discussion of PISA issues. This study investigated the improvement of PISA scientific competencies throughout these online argumentation processes. The research question was as follows: Were there any differences in scientific competencies between students who participated in online argumentation instruction and activities and those who did not?

2. METHODOLOGY

2.1 Participants

The subjects of the PISA are primarily 15-year-old students worldwide who have completed compulsory education. Therefore, this study selected 10th grade high school students (15 years old) from a senior high school situated on the edge of the Kaohsiung city center in southern Taiwan. This study was conducted during the students' first summer vacation when they had just finished their junior high school education. A total of 79 students were chosen from two out of six classes. Due to eight students applying for leave during the experiment process, a total of 71 students participated fully in the research throughout, with 36 of them in the experimental group and 35 in the control group. These students had similar academic achievements, having being promoted to senior high school from junior high through the national entrance examinations.

2.2 Experimental Design

The study adopted a quasi-experimental design (as shown in Table 1). A PISA science assessment was conducted on both groups before the experiment. The students in the experimental group then went through argumentation instruction and activity using an online argumentation system for a total of 4 hours. After the experiment, both groups conducted the same PISA science assessment.

Table 1. Experimental design of this study

Group	Pre-test	Treatment	Post-test
Experimental group	O_1	X	O_3
Control group	O_2		O_4

Note: O_1, O_2, O_3, and O_4 were the PISA science assessments; X was the online argumentation

2.3 The Online Argumentation System

The argumentation system is shown in Fig. 2. The upper portion shows the argumentation topic, for which the teacher can set up two opposing viewpoints. The lower left portion is the column for the tree directory of students' arguments titles. This directory provides a way for both the teacher and students to view the arguments of all the students in the class by means of hyperlinking to their saved location in a database. In addition, this column records the thought process of all the students, helping individuals to reflect on their thoughts. The lower right portion shows the argument of an individual student. Students are able to understand the perspectives of other students and achieve the objective of mutual interaction.

As shown in Fig. 3, the interface for students to construct their arguments was designed based on the Toulmin (1958) Argument Pattern (TAP). It provides the scaffold to assist students in formulating their arguments. To ensure that students are not affected by specific terms of the TAP, Nussbaum (2002) suggested that changes to spoken language should be made. Students are given partial statements with textboxes next to them where they can type information to complete the TAP structure. Separate scaffolding provides prompt buttons marked with a question mark for the students, which prompt the students according to the missing or incorrect components of their previous arguments. If a student's information did not adequately complete the statement, the button remains visible and indicates that the information was not adequately complete. Should the preceding argument encompass all five components, then the buttons would not appear to achieve the "fading out" strategy.

Figure 2. The system overview

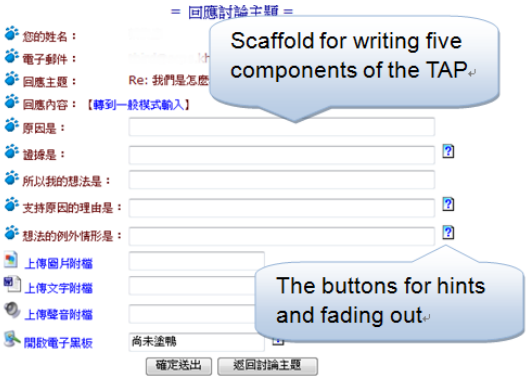

Figure 3. The scaffold for argumentation

2.4 The PISA Science Assessment

The released items of the PISA science assessment can be downloaded from the TWPISA National Center (TWPISA National Center, 2012b). These sample items were constructed or translated by experts and researchers from various fields in the past when Taiwan participated in the PISA. The most items are the same as the OECD released items, which can be downloaded from the PISA official website (OECD, 2006). Five teachers in the research team from the biological, life sciences, physics, chemistry, and earth sciences field were tasked to select items, the constructs of which were then reviewed and verified by two science educators. To achieve construct validity, the Rasch model (Rasch, 1960) was applied for analysis and the infit mean square error (MNSQ) of each item was calculated to be between 0.95 and 1.18. In terms of reliability, the item separation reliability of the whole test was 0.95. The validity and reliability were both within acceptable range. The answering formats of the assessment items included multiple choice questions, true or false questions, and short answer questions. There were a total of 15 items, with each item having a full score of 10, a partial score of 5, and a score of zero for a wrong answer. The full score for the entire assessment was thus 150.

2.5 The Argumentation Instruction and Activities

Students in the experimental group went through online argumentation instruction and activities. Argumentation instruction focused on how to use the argumentation system and the TAP for constructing individual arguments. During the instruction, the researcher tried to allow individual students to construct the arguments that best suited their logical thinking by following the teacher's argument example. The teaching strategy enabled students' learning to progress from simplicity to complexity and from single to diversity (Collins, Brown, & Newman, 1989) in terms of argument construction.

The three lessons of argumentation instruction were conducted, in order, using a three components argumentation pattern (claim-data-warrant), a four components argumentation pattern (claim-data-warrant-backing), and a five components argumentation pattern (claim-data-warrant-backing-rebuttal). The templates used for student practice in argumentation instruction were based on examples in Toulmin's book (Toulmin, 1958). For example, "All three sisters of Ming have red hairs (warrant). As Hua is the fourth sister of Ming (data), she might have red hair as well (claim). The supporting reason is that their family members have red hair genetically (backing). The exception is that Hua's hair turns white during aging (rebuttal)." These examples include deductive reasoning and inductive reasoning. The researcher explained the difference between these two forms of reasoning in the argumentation instruction.

Students experienced difficulties mostly in responding PISA items of identifying scientific issues, especially when they are required to describe specifically about the treatment and dependent variable of a contextual investigation (Lin et al., 2012a). The final lesson of current study conducted argumentation activities based on two topics, including the scientific process encompassing experimental design and control variables. Both topics are related to "identifying scientific issues", to compensate PISA-related competencies for the lack of training in this area for argumentation instruction. During the argumentation, the teacher did not provide any correct answer, just guiding the activities instead.

3. RESULTS

The tests of homogeneity conducted before ANCOVA obtained the following results for "identifying scientific issues", "explaining phenomena scientifically", "using scientific evidence", and "overall score", respectively: $F_{(1, 67)}$=.02 (p=.870>.05), $F_{(1, 67)}$=.15 (p=.695>.05), $F_{(1, 67)}$=.14 (p=.704>.05), and $F_{(1, 67)}$=.30 (p=.583>.05). These results, in which all the tests did not reach significance, matched the basic assumption of regression analyses. Therefore, ANCOVA was conducted as illustrated below.

The ANCOVA results for the various scientific competencies are shown in Table 2. Under the construct of "identifying scientific issues", the post-test difference between groups achieved significance ($F_{(1, 68)}$=7.40, p<.01) with an effect size of 0.098. According to Cohen's (1988) definition, the small, medium, and large effect sizes are 0.10, 0.25, and 0.40, respectively. This shows that the experimental treatment had a medium effect on the competency in "identifying scientific issues". The comparison in Table 2 shows an adjusted mean post-test score of 26.85 for the experimental group, higher than the 21.81 obtained for the control group.

Table 2. The ANCOVA of scientific competencies

Competencies	Group	Pre-test *Mean(SD)*	Post-test *Mean(SD)*	Post-test *Mean'(SE)*	*F*	η^2	Cohen' *f*
Identifying scientific issues	Experimental	26.19(6.81)	27.41(7.36)	26.85(1.28)	7.40**	0.098	0.330
	Control	23.25(8.61)	21.22(8.95)	21.81(1.30)			
Explaining phenomena scientifically	Experimental	30.88(9.14)	33.83(7.38)	33.18(1.10)	1.47	0.020	0.143
	Control	28.17(8.32)	30.62(8.22)	31.29(1.12)			
Using scientific evidence	Experimental	55.69(5.49)	56.52(6.74)	55.92(1.09)	4.84*	0.066	0.266
	Control	53.57(9.59)	51.85(8.91)	52.47(1.11)			
Overall score	Experimental	112.50(12.96)	117.92(14.01)	116.04(2.40)	10.00**	0.128	0.383
	Control	105.00(20.51)	103.14(18.91)	105.06(2.44)			

Note: * p<.05; ** p<.01; *SD*=standard deviation; *SE*=standard error; Cohen's $f^2 = \eta^2/(1-\eta^2)$

Under the construct of "explaining phenomena scientifically", the post-test difference between groups did not achieve significance ($F_{(1, 68)}$=1.47, p>.05) with a small effect size of 0.143. The adjusted mean post-test score of the experimental group was 33.18, compared to 31.29 for the control group.

Under the construct of "using scientific evidence", the post-test difference between groups achieved significance ($F_{(1, 68)}$=4.84, p<.05) with an medium effect size of 0.266. This shows that the experimental treatment had a medium effect on the competency in "using scientific evidence". The comparison in Table 2 shows the adjusted mean post-test score of 55.92 for the experimental group, which is higher than the 52.47 obtained for the control group.

Finally under "overall score", the post-test difference between groups achieved significance ($F_{(1, 68)}$=10.00, p<.01) with an effect size of 0.383. This showed that the experimental treatment had a medium to large effect on the overall scientific competencies. The comparison in Table 2 shows an adjusted mean post-test score of 116.04 for the experimental group, which is higher than the 105.06 obtained for the control group.

4. DISCUSSIONS

In the post-test, the mean overall scientific competencies of the experimental group was higher than that of control group, as is the case with the competencies in "using scientific evidence" and "identifying scientific issues". However, the experimental group students did not outperform their counterparts in terms of competency in "explaining phenomena scientifically". The nature of argumentation is to produce scientific evidence to support conclusions, and the process of argumentation instruction appeared to promote the abilities of students to raise scientific evidence, such as answering questions based on data given in a diagram. The argumentation topics in the current study were based upon identifying scientific issues, and the argumentation process appeared to promote the students' abilities to identify scientific topics, such as understanding control variables and experimental designs. The above two forms of competencies do not require much basic background knowledge from the students as compared to the competency in "explaining

phenomena scientifically". Nevertheless, some items of the "explaining phenomena scientifically" in PISA require students to have basic background knowledge. For example, there is a question under "Acid Rain" that states: "Where do these sulfur oxides and nitrogen oxides in the air come from?" The official answer from PISA is: "Any one answer referring to car exhausts, factory emissions, burning fossil fuels such as oil and coal, gases from volcanoes, or other similar things." The scoring of such questions still requires students to have background knowledge, in order to allow students to answer questions effectively by applying the competency in "explaining phenomena scientifically".

5. CONCLUSION

In summary, argumentation instruction comprising a specific process, online scaffolding assistance, and argumentation conflict scenarios may help to promote students' PISA scientific competencies. Therefore, using the online environment to complement argumentation instruction and organizing argumentation activities focused on related topics is a potential direction to consider in the future for improving students' scientific literacy.

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USING A TECHNO-SCEPTICISM FRAMEWORK TO EVALUATE THE PERCEPTION AND ACCEPTANCE OF A NEW ONLINE READING LIST

Ajmal Sultany and Samantha Halford
City University London
Northampton Square, London, EC1V 0HB

ABSTRACT

There has been an exponential growth of e-learning in the UK Higher Education. However, there is a growing opinion that e-learning practitioners are not critical enough and that they should adopt a more techno-negative or techno-scepticism approach when implementing new e-learning tools.
In this paper we use a techno-scepticism framework to assess the evaluation of a newly implemented online reading list at our UK Higher Education Institution. In particular, we look at the 'The Myths about E-Learning in Higher Education' proposed by Njenga and Fourie (2010).
We present qualitative and quantitative evaluation data collected from the focus groups which shows that the students have a very positive perception of this newly implemented online reading list and believe that it will improve their academic experience. Furthermore, as the student focus groups also produced rich data which deal with the students' experience of e-learning in general, five of the myths of e-learning that relates to the student experience are used to framework these discussions.

KEYWORDS

e-Learning, Online Reading List; Student Experience; Evaluation; Techno-scepticism

1. INTRODUCTION

There has been an exponential growth of e-learning in the UK Higher Education (JISC, 2004; Bostock, 2007; HEA, 2009; HEFCE, 2009, UCISA, 2012) and Worldwide (Educause, 2012). For example, the Virtual Learning Environment (VLE) has become an integral part of the student experience of Higher Education (HRC, 2009; NUS, 2011; Quinsee & Bullimore, 2011, UCISA, 2012). This is not by accident; across the sector e-Learning has had a significant impact on Higher Education's economical and social dimensions and most importantly the pedagogical dimension (Chang & Tung, 2008; Hartley et al, 2011; Barber et al, 2013; Stubbs, 2013). As such there exist a number of organizations both nationally (Association for Learning Technology and Jisc); and internationally (International Association for Development of the Information Society IADIS) that promote technology in education.

Our higher education institution is currently going through significant change. At the institution, e-learning is playing a bigger role in improving the student experience (Quinsee & Bullimore, 2011). Parallel to this continuous investment in learning technologies, the Library is currently implementing a new 'online reading list'.

It is recognised by educationalists that reading lists are an integral part of a student's higher education academic experience (Stokes & Martin, 2008; Bartlett, 2010; Piscioneri & Hlavac, 2012). Reading lists are study tools comprised of lists of books, articles, journals, websites and other resources that students should read and refer to as part of their course, and are generally split into sections based on either their importance to the course, by subject, by time period (e.g. weekly readings), or a combination of all three.

Reading lists are therefore used by academics to communicate vital information about reading for their modules to their students and to other stakeholders; for instance, at our University, reading list's key stakeholders are students, academics, school administrative staff and library staff, particularly Subject Librarians, who are responsible for liaising with and building collections for specific schools and departments.

However, students are the primary stakeholders because reading list plays an important role in their academic experience at higher education. Considering the rapid change in the UK higher education sector, the student experience has never been more important. As such, any technology that attempts to facilitate this academic experience should be considered as an e-learning tool. This understanding is in line with UCISA's (2012) definition of Technology Enabled Learning:

"Any online facility or system that directly supports learning and teaching" (page 2)

Our new online reading list (branded Reading List Online or RLO in short), powered by Talis Aspire, allows academics and the library to manage academic reading lists online. The fundamental aspect of the tool is that it is online; meaning that students can access their module/ course reading lists anytime from anywhere. This cloud storage also means that Talis Aspire can create a community of reading lists across different institution so that students have access to reading lists beyond their particular institution. It is important to note that although, this tool has the potential to be 'social', it is *not* a social media tool at present.

Although there is an increasing number of UK universities that have adopted an online reading list with the purpose of improve the student experience (Talis Aspire, 2013), there is a growing opinion that e-learning practitioners are not critical enough when implementing new e-learning technologies. It is suggested that we should adopt a more 'techno-negative' or 'techno-scepticism' approach when implementing new e-learning tools. In particular, Njenga and Fourie (2010) argue that we should have a more critical and informative discussion on e-learning adoption in higher education.

As such, the focus of this paper is a case study of the implementation and evaluation of a new online reading list. The data is used to first present the students perceptions and acceptance of the technology and then textual analysis is applied to assesses five of 'The Myths about E-Learning in Higher Education' proposed by Njenga and Fourie (2010).

2. BODY OF PAPER

2.1 Myths of e-learning

Njenga and Fourie's (2010) opinion is also voiced by Kinchin (2012) who calls for 'avoiding technology-enhanced non-learning'; pointing out that although the students academic experience should be the primary motivation for the implementation of a new e-learning tool, this is not always the case. e-Learning practitioners are themselves aware of this dilemma (Psotka, 2013), with Comrie (2013) recently asking: "So, how do we ensure learning exploits technology and not vice versa?"

In particular, Njenga and Fourie (2010) propose that there are ten prevailing myths about e-learning in higher education. A myth is defined as 'an idea or story that is believed by many people but that is not true" (Merriam-Webster, 2013). These myths are:

1. e-Learning is a savour; its redemptive power is overreaching and every educational institution should adopt it
2. e-Learning can replace human interaction
3. e-Learning cuts the cost of education, for instance, e-learning courses are cheaper to deliver than the traditional face-to-face or distance learning
4. Providing numerous courses and an abundance of information is beneficial and can enhance learning
5. ICTs should become the primary medium of learning in higher education
6. Leisure (including playing and entertaining) and learning are separate activities

7. e-Learning will make HEIs more competitive and they must seize it or be declared institutionally redundant
8. Establishing the infrastructure (hardware and software) in e-learning is the most difficult part
9. e-Learning will see the demise of traditional campuses
10. e-Learning can decrease absenteeism and lower dropout rates among students

According to the authors, these myths are promoted by technopositivist but are not true to reality. They define 'technopositivists' as those people that repeatedly create and propagate a 'compulsory enthusiasm' about e-learning in higher education for personal motives and without exploring the dangers and rewards of an e-learning tool for teaching and learning.

The focus of our evaluation was the student experience of the new online reading list. More specifically, the aims of the evaluation were to:

- Discover if RLO is an useful and effective education tool for our students;
- Measure and predict students acceptance of RLO
- Understand how our students interact with their traditional paper based reading lists and significantly how this academic experience can be improved with RLO;
- Find out how our students interact with the library in order to obtain items from their reading lists and how the Library Services can improve this process;
- Gain access to insight that could be translated to tangible communication strategies to support the successful implementation of the software across the University.

We use five of the myths proposed about e-learning to assess the experience of out students. These five myths about e-learning and the student experience (Myths 2,4,5, 6 & 9) are first identified and we assess how they relate to the perceptions of our student data. We believe that by assessing the data through the myths, we can assess whether the myth is true in the case of our techno-sceptic approach. The remaining five myths (Myths 1,3,7,8, & 10) relate to the macro issues of e-learning in higher education and as this goes beyond our evaluation data, we do not assess these myths.

2.2 Online Reading List

The Library at our institution decided to implement an online reading list. RLO was made available to students in September 2012. The first year of the implementation is being referred to as a 'soft launch' where the system is made available to students at a 'beta' stage. At this stage traditional paper reading lists are being added to the 'cloud' continuously, until all reading lists from across the University are accessible to students. Wherever a lecturer has decided to use RLO, they inform their students of its availability. The students are either given a link to the open online reading list or the reading list is made available in the VLE as a 'Moodle Block'. Alternatively the students can search for their relevant module via the home page (http://readinglists.city.ac.uk/index.html)

From a Library perspective, online reading lists can be considered as a learning resource management and as a delivery tool as reading lists are a crucial stepping stone between the classroom and students' independent learning (Chad, 2012); harnessing new technology to support efficient and effective use of reading lists will help students to develop the information literacy skills needed to become competent library users and confident learners (Farmer, Maclean & Corms, 2012; Stokes & Martin, 2008). Furthermore, McCormick (2006) points out that reading lists produced by academics for teaching purposes are a valuable academic tool for different purposes, including: they are a lecturer teaching resource, a student learning resource and for librarians, a resource selection tool.

In addition, Piscioneri & Hlavac (2012) propose that issues related to students reading lists at higher education can be approached from at least three angles: skill development framework, such as useful reading strategies (e.g. skim reading), curriculum development perspective, such as looking at the design aspects of the reading list, and pedagogical perspective, which focuses on reading lists as a tool to improve the student education experience.

Taking into account all the student's perception of reading lists, a thematic analysis shows that our students do very much agree that reading lists are part of their academic experience in higher education. The students' definitions of reading list can be stated as follows:

"A recent and comprehensive composition of the most up to date sources as chosen by academics and given to students in a compact form, which acts as a beneficial and important precursor to the students education experience".

Part of the implementation strategy was to evaluate the technology; in particular, we were interested in understanding how this e-learning tool affects the student experience. Due to the changeable nature of the software, it was recognised that student feedback would support the further development of this e-learning tool.

2.3 Methodology

Twenty-one students participated across three focus groups with each focus group lasting approximately two hours. In order to encourage a high participation rate, students from across the University were invited to participate via Unitemps and they were paid for their time. The students (twelve females and nine males) were from a range of study disciplines, consisting of undergraduates, postgraduates (both Masters and PhD), and recent graduates, with all current students being full time. This method is an example of opportunistic sampling: the number of students participating from programmes varied depending on the level of interest from the particular individual that accessed Unitemps job website.

At the broadest level, focus groups are collective conversations or group interviews. Focus groups offer unique insights into the possibilities of critical inquiry as a deliberate, dialogical and democratic practice (Kamberelis & Dimitriadis, 2005). Focus groups have a number of advantages (Farnsworth & Boon, 2010) but we felt the most important advantage in using focus group was that the students discussed the topic of reading lists whilst being part of a group dynamic; participant interaction allowed students to share held truths whilst also co-constructing meaning (Belzile & Oberg, 2012).

There has been a considerable expansion of the use of focus groups as a method of data collection in social science research over the last decade (Peek & Fothergill, 2009). As such, for our purpose, we created an atmosphere that encourages spontaneous contribution by a) setting the scene through a number of premeditated considerations, such as layout of the room and creating informality and b) using space and time more flexibly, such as having group activities and providing refreshments (Morgan et al, 2002).

Each focus group was divided into three parts: in part one, discussions among students were facilitated to gather verbal evidence of students' perceptions about their experiences of reading lists and how they interacted with them in academic and social environments for their higher education degree. In part two, the students were shown a demonstration of RLO then asked to discuss their initial reactions to the online tool and how it could change their student experience. At the end of the focus groups, the students were asked complete an adopted version of the PUEU questionnaire (Perceived Usefulness and Perceived Ease of Use) (Davis, 1989).

Davies (1989) proposed that there are two key determinants of user acceptance: 'Perceived Usefulness' and 'Perceived Ease of Use'. He showed that these two factors could be measured through a reliable and valid questionnaire, the PUEU. Since then user acceptance of technology has been a critical part of the Technology Acceptance Model (Chuttur, 2009). The original questionnaire was adopted to reflect the RLO and higher educational context.

2.4 Qualitative Data: Perception of New Learning Technology

The students were overwhelmingly positive about RLO; once they were shown a demonstration of the online tool and had the chance to ask questions, they were in consensus that RLO will have a positive impact on their academic experience.

"Most of the problems are solved with this system. Like 90% of the problems you face when you have to find a book" (Focus Group 3 student)

A recent graduate from the University summaries his impressions by saying:

“I wish I’d had something like this when I did my Masters” (Focus Group 2 student) whilst another graduate stated that: "this whole system would have been a Godsend if I'd had it..." (Focus Group 3 student)

The students also gave specific reasons as to why they thought that this e-learning tool can improve their academic experience. By far the most important reason was the look and feel of the system. They stated that based on their past experience of traditional paper based reading lists, they find the RLO to be:

- Systematic: a tool that saves time, and increases accuracy of finding books. In particular, the students were very much aware that the RLO reducing the steps to accessing resources
- Efficient: the students recognised that the tool will decrease error of finding the correct materials as the students click directly to reading list material rather than having to type the information.
- Immediate: the list can be edited at any time by the lecturer and the changes would be visible by the students immediately.
- Accessible: the tool is online so it can be accessed at anytime from anywhere

Moreover, the students expressed that there are specific functions of the RLO that will improve their student experience. These include:

- The interface was perceived to be simple and easy to use
- The ability to export RIS files for use with referencing tools
- RSS feeds that inform students when a new resource has been added to their module reading list by the academic
- The ability to annotate reading list and save these annotations for later viewing
- Interlink with other e-learning tools, such Moodle
- External links to buy the books from online stores such as Amazon and Google Books

Notably, when discussing the multifunction of RLO, a student said that "that's so much more than I was expecting to be honest" (Focus Group 2 student).

Furthermore, the students were explicit that this tool will increase their engagement with their academic readings. The positive perception and evident ease of use, led to many of the students stating that the productivity of the tool will motivate them to read and access more reading list material given by their lecturers. One student summarised this feeling by saying:

“Yeah it kind of gives you more edge to it, you know motivation to actually read ... then when we’ve done all this work in one you just go click click and find out something more about it” (Focus Group 2 student). Whilst another student agreed that “you’ve put all that there and it’s so much easier just clicking on the link, getting the book, it’s like in terms of what I work through and efficient would have been just much more higher if we had something like that a few years ago” (Focus Group 2 student).

Finally, we also asked the students to describe how they feel about RLO in one word. The students used the following terms to describe their perception:

Table 1. Summary of one word description students used for RLO

One Word Description
Useful
Time-saver
Streamlined
Important
Efficient
Helpful
Quick
Magic
Easy

2.5 Quantitative Data: Acceptance of New Learning Technology

In addition to the qualitative data, statistical analysis shows that the twenty one students that were shown a demonstration of RLO perceive the RLO as both useful and easy to use and their results indicate that they accept the RLO as an information technology that will support their academic experience. As shown above, user acceptance of information technology is important to the adoption of the RLO and scores from the PUEU could be used to predict how likely these students are to accept the RLO as part of their studies. The mean scores for each item are shown below:

Table 2. Mean Score for each PUEU item

Mean PUEU Scores for each item

	N	Mean
Using the Reading List Online in my studies would enable me to accomplish tasks more quickly	21	6.48
Using the Reading List Online would improve my academic performance	21	5.43
Using the Reading List Online in my studies would increase my productity	21	6.10
Using the Reading List Online would enhance my effectiveness in my studies	21	5.86
Using the Reading List Online would make it easier to do my studies	21	6.24
I would find the Reading List Online useful in my studies	21	6.14
Learning to operate the Reading List Online would be easy for me	21	6.38
I would find it easy to get the Reading List Online to do what I want it to do	21	5.95
My interaction with the Reading List Online would be clear and understandable	21	6.05
I would find the Reading List Online to be flexible to interact with	21	6.00
It would be easy for me to become skillful at using the Reading List Online	21	6.38
I would find the Reading List Online easy to use	21	6.38

Measurement of perceived usefulness explores the tendency of individuals to use a particular system or a product, that is, the extent to which they believe it will help and enhance their academic performance (Adams & McNab, 2012). PUEU is a 12 item five-point Likert scale structured questionnaire. Responses to the statements were coded into 7 point scale, where one indicated unlikely and 7 likely. The higher the score in each individual scaled item would indicate more likeliness to agree with the statement. The mean scores from across the sample was be used to ascertain how likely the students are to accepting the RLO as part of their academic experience.

As can be observed, the highest agreement was with the statement: “Using the Reading List Online in my studies would enable me to accomplish tasks more quickly” with the students scoring the RLO 6.48 out of 7.

Although all the statements were scored high (above 5), the statement that the students least agreed with about this e-learning tool was: “Using the Reading List Online would improve my academic performance” with a mean score of only 5.43.

Furthermore, non-parametric statistical correlation of the two construct show that there was a significant positive relationship between the ‘Perceived Usefulness’ and ‘Perceived Ease of Use’, $r = .43$, p (one tailed) < 0.05.

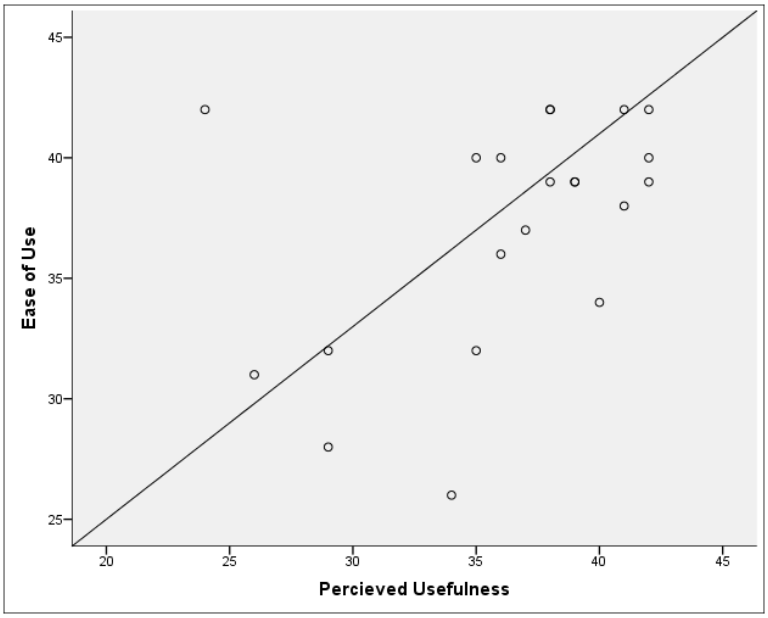

Figure 1. Scatter diagram showing the individual scores of each participants in PU and EUv

Table 3. Pearson's correlation for PUEU

Positive Correlation between Percieved Usefulness & Percieved Ease of Use

		Percieved Usefulness	Ease of Use
Percieved Usefulness	Pearson Correlation	1	.464*
Ease of Use	Pearson Correlation	.464*	1

*. Correlation is significant at the 0.05 level (1-tailed).

Overall, the above quantitative data shows that the students perceive the RLO to be both useful and easy to use. Furthermore, the positive correlation between the two constructs indicates that these students are likely to accept the RLO as a technology that will support their academic experience at this higher education institution.

2.6 Applying a Techno-Sceptic Framework

Despite the overwhelming positive reaction to RLO, the students showed a great level of gravitas and realism when discussing the RLO as a replacement of traditional paper reading lists. In particular they shared their opinion on the wider implications of this online tool and their experience as students.

Of the ten myths of e-learning in higher education presented by Njenga and Fourie, five relate to the student experience. These myths relate to the student experience as they are about the pedagogy of e-learning and the impact it has on the students' relationship with the academia. These are:

Myth 2: e-Learning can replace human interaction
Myth 4: Providing numerous courses and an abundance of information is beneficial and can enhance learning
Myth 5: ICTs should become the primary medium of learning in higher education
Myth 6: Leisure (including playing and entertaining) and learning are separate activities.
Myth 9: e-Learning will see the demise of traditional campuses

From these myths, all but myth 6 deal with similar premises: Njenga and Fourie (2010) point out, technology is just one medium, a means to achieve something and not an end in itself. According to the authors, all four of these statements are fallacies that assume that e-learning can replace human interaction. As much as technology is important and it has become abundant in higher education, it is a myth that it can become the primary medium of learning in higher education and gradually lead to the demise of traditional campuses.

This techno-scepticism makes a particular note that just because more students can be taught at the same time does not mean human interaction can be replaced. They believe that this myth is perpetuated by the constructivist notion of transferring the responsibility of learning to the learners.

Our evaluation data would suggest that it is indeed the case that students are completely opposed to the notion of decreasing human interaction with the academics. They believe that human interaction is required for meaningful student learning to take place. In particular, the students' opinions about this e-learning tool were:

- it should enhance face to face learning, not aim to replace it;
- it has limitations, which should be constantly improved;
- it is only as good as the institution and academics makes it;
- this online reading list can play an important role in improving the students' experience.

These four myths also relates to a more popular myth of the 'Digital Natives'. The digital native theory (Prensky, 2001), states that students entering higher education today are all "native speakers" of the digital language of computers, videogames and the Internet. However, this notion has been criticised (Brown & Czerniewicz, 2010) as being just a myth. Based on our student data, we would also make a similar conclusion as students had strong preference for print format material. In fact when asked for their recommendations for improving the RLO, a prominent answer across the three focus groups were in regards to improving the printing function of the reading lists.

"It's more a question, but can you print the reading list easily?...That's good [that RLO allows for printing of reading lists], just because sometimes online things are really unfriendly to print so if you want to put it in your folder with your module so you can tick bits off you can't" (Focus group 1 student).

It becomes clear that the concept of digital native is a complex and contradictory. For example a number of students scan books and then print the scans rather than reading them online as pdfs. In conclusion, one student's quote summaries the general techno-scepticism trend across all focus groups:

"...in terms of reading lists I prefer to have the hard copy instead but [the RLO] would be more useful as it has more functions so I can easily have access to the books and resources...I can find it online, the consumer can buy it, see how much it costs and to see whether it is available in the library" (Focus group 2 student).

Myth 6 is that 'leisure and learning are separate activities'. According to the Njenga and Fourie, it is a myth that for the students, leisure and learning activities are separate. They argue that in fact these two are not separate, especially in the application of e-learning and that academics will have to adopt technology to meet the students' needs.

The discourse among our student sample was that although it is true that technology is pervasive in all our lives, they still make a clear distinction between technology for leisure and technology for learning. Our students were clear that they did actually differentiate between leisure and learning activities and as such they differentiate between the technologies that assist in them. The following discussion between the students in focus group 1 is particularly revealing:

Student 3: I think the problem with that is it's not adapted for study yet, because the whole problem with e-reading and studying, it hasn't taken off and it probably won't for awhile until they have the capability for people to start writing and highlighting.... Students aren't really taking to it. A lot of people, when they get a PDF they'll print it out.
Student 4: Some people find it really hard to do it on a computer, reading it from …
Student 5: It's just not the same.
Student 2: It's really difficult to study on the computer. Right now I'm doing an analysis of the Leveson Inquiry so I have to go through the whole transcript…Now, when I close my eyes I'm just seeing transcripts in my head. It really, really messes with your mind. That's why books are so essential. Actually picking up a hard text now is like a relief now for my brain. It's really, really, really difficult to study on the computer.
Researcher: But as you said, it could be just that society hasn't reached that point.
Student 3: I think in a few years we'll probably all be using e-readers to study.
Student 4: Agreed. Not our generation.
Student 6: Even if I equally use my i-pad for uni as much as I … it's still not going to replace the fact that I need to replace the fact that I need to study with books.

This is particularly surprising as all our students were 'generation y', the exact group of people identified by Njenga and Fourie (2010) to be the group that do not distinguish between leisure and learning activities. They seem to fail to take into account the complex interaction of the students' active use of information as opposed to its passive consumption.

3. CONCLUSION

In September 2012 the Library launched a new Online Reading List. While having a 'soft launch' of the new software, we took the opportunity to investigate the views of students on how reading lists relate to their academic experience in higher education. In particular, we wanted to understand the perception of the students towards the new e-learning tool.

The results were clear; the students had a very positive reaction to the online reading list. Moreover, their results on the PUEU indicated that they accepted the technology as a tool that can improve their academic experience at the higher education level.

Harnessing new technology to support efficient and effective use of reading lists will help students to develop the information literacy skills needed to become competent library users and confident learners. As reading lists play a central part in higher education, student learning, information literacy skills development and academic achievement, understanding the experiences and perceptions of students using and learning from online reading lists warrants this investigation from e-learning practitioners, such as that by Franklin (2012).

Furthermore, discussions in the student focus groups went beyond just this technology and touched into epistemology of e-learning. These discussions were presented through a techno-scepticism lens, in particular, applying five of Njenga and Fourie's (2010) myths that relate to the student experience.

Our data indicates that the students have much more of a techno-scepticism perspective of e-learning than practitioners sometimes assume. The students made it very clear that although e-learning tools such as RLO have a number of advantages that improve their experience, it cannot replace human interaction of a campus based University. As Njenga and Fourie (2010: 207) point out: "Understanding the human complexities, both of the educator and learner, would therefore ensure more effective e-learning adoption, and will ensure that the difficulty of its use is reduced if not eliminated altogether."

This research demonstrates that when educational institutions step back and reflect on critical questions regarding the use of technology in higher education, the results may be surprising. There are a number of myths around e-learning in higher education and understanding the student perspective adds our philosophical positioning and practical decisions.

Finally, the authors acknowledge that there are a number limitations to the research, including: 1) background of the students were not random and does not represent all students experience; 2) small sample for the quantitative analysis; 3) the focus group and questionnaire observe only a snapshot of the immediate reaction on the acceptance and not their reaction of using the tool as part of their studies in the long term.

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SMS-BASED LEARNING IN TERTIARY EDUCATION: ACHIEVEMENT AND ATTITUDINAL OUTCOMES

Yaacov J Katz
School of Education, Bar-Ilan University
Ramat-Gan 52900, Israel

ABSTRACT

SMS delivery platforms are being increasingly used at the university level to enhance student achievement as well as traits and attitudes related to the learning process. SMS delivery provides access to learning materials without being limited by space or time and sophisticated technological advances in SMS delivery have led to enhanced learner motivation, learner curiosity, learner autonomy, learner self-efficacy, learner technological self-confidence when learning language, vocabulary and concepts. In addition SMS delivery of learning materials has been shown to lead to flexible, user-friendly, controlled and adaptive learning as reported by university students in various research studies. The present study is another in a series of research studies designed to examine the relationship between SMS delivery and cognitive and affective aspects of university level learning. In the present study two groups of first year university students who studied cultural concepts in an elective 14 week long (semester) course were exposed to two different modes of concept delivery. The first group of students received weekly lists of cultural concepts sent via SMS messages to their cell-phones and the second group received weekly lists of cultural concepts sent via hardcopy snail mail messages to their homes. The definitions of cultural concepts studied by SMS and hardcopy delivery strategies were identical and the students received 25 cultural concept definitions on a weekly basis for a period of 14 weeks. At the end of this period the students in the two groups were tested on a standardized cultural concepts learner achievement test and responded to a questionnaire that examined the levels of learner creativity, learner flexibility and learner self-image as perceived by the students' in the two groups. Results of the study indicate that there were no significant differences between students in the SMS delivery group and those in the hardcopy delivery group on the standardized cultural concepts achievement test. However, there were significant differences between the students in the two delivery groups regarding their levels of learner creativity, learner flexibility and learner self-image. The students who received cultural concepts via SMS delivery were characterized by significantly higher levels of learner creativity, learner flexibility and learner self-image than their counterparts who received lists of cultural concepts via hardcopy messages. It appears that SMS delivery of cultural concepts enhances traits and attitudinal variables such as learner creativity, learner flexibility and learner self-image which have a positive effect on the learning experience Thus SMS delivery of learning materials can in fact become a viable technological mobile delivery system in the university learning process and should be considered as a valid pedagogical tool in the university learning process.

KEYWORDS

SMS delivery; hardcopy delivery; learner achievement; learner creativity; learner flexibility; learner self-image

1. INTRODUCTION

Distance learning has developed over the years to overcome the limitations of traditional face-to-face learning which necessitates the presence of the student in a formal classroom setting. Since its inception when distance learning was confined to the delivery of learning material via snail mail, landline telephone and radio broadcasts, it has progressed through delivery systems such as television broadcasts, videoconferencing and email, and at present focuses on digital delivery systems such as internet and mobile learning platforms. It should be noted that almost all of the above distance learning delivery platforms are still in use in different educational systems throughout the world (Katz & Yablon, 2003).

After the development of sophisticated third generation distance learning systems which include interactive video, internet, and mobile learning technologies, learning activity through the medium of these distance learning has been redefined to include and focus on student self-learning (Trentin, 1997). Mobile learning offers tuition that is not bound by space or time and is especially characterized by flexibility. In

addition mobile learning allow tutors to modify, reinforce and even model educational processes, thereby fulfilling the cognitive as well as affective needs and requirements of students (Wilson & Whitelock, 1997).

Some research studies (Katz & Yablon, 2009; 2011; 2012) have indicated that third generation distance learning is especially suited to higher education mainly because of increased flexibility due to the mobile learning systems that are increasingly used at present. Other studies have emphasized the importance of student activity provided for by current distance learning systems and have indicated that the student activity variable contributes significantly to improved student achievement (Trentin, 1997).

Mobile learning in general and SMS based learning in particular have advanced steadily over recent years and have become potential learning platforms at the university level. In certain areas, such as the learning of vocabulary (Katz & Yablon, 2009; 2011; 2012) and concept learning (Katz & Katz, 2011) SMS-based learning has advanced rapidly and is becoming an integral part of the learning process in many universities throughout the world. Research studies have indicated that the use of SMS as a delivery system for university learning is suitable for both cognitive and affective aims (Divitini, Haugalokken & Norevik, 2002; Garner, Francis & Wales, 2002; Prensky, 2005).

In the present study learner achievement and the traits and attitudes of students toward SMS delivery of learning content are to be examined. More specifically, the study will investigate the academic grades achieved by students in cultural concept acquisition as well as some of their traits and attitudes, namely learner creativity, learner flexibility and learner self-image, towards SMS-based delivery of learning material at the university level.

2. SMS DELIVERY AND THE LEARNING PROCESS

Katz & Yablon (2009) found that technology based learning in general and, more specifically, SMS-based learning, offers a learning environment that is especially characterized by flexibility offered to the learner. In addition SMS learning technology offers possibilities that include sophisticated text capabilities that enhance the learning process. Moreover, learning is not bound by space or time and students can choose to engage in learning without almost any limitations (Dieterle & Dede, 2006).

SMS delivery of learning materials has become a focus of research in recent years. Learning projects based on SMS delivery of learning material and initiated by several universities worldwide have indicated positive outcomes (Divitini, Haugalokken & Norevik, 2002; Garner, Francis & Wales., 2002; Seppala, 2002). Stone & Briggs (2002) indicated how exercises were efficiently delivered to students via SMS based messages and positively contributed to effective learning. Thomas, Orthober & Schultz (2009) pinpointed the benefits gained by high school students in their language learning after receiving language related learning materials via SMS messages sent to them by their teachers. Additional studies have described how vocabulary transmitted by SMS in a spaced and scheduled pattern of delivery contributed to student proficiency in English or other languages. (Kiernan & Aizawa, 2004; Katz & Yablon, 2009; 2011; 2012). Katz & Katz (2011) indicated how SMS based delivery of learning content is closely connected to effective concept learning.

2.1 SMS Delivery and Students' Traits and Attitudes

In recent studies researchers (Cavus & Ibrahim, 2009; Thatcher & Mooney, 2008; Thornton & Houser, 2008) concluded that mobile technology including SMS-based delivery of learning materials is increasingly welcomed and accepted at the tertiary educational level as a valuable teaching tool. Ismail, Idrus & Johari (2010), Katz & Katz (2011), Katz & Yablon (2009, 2011; 2012), Moos & Azavedo (2009), Rosli et al (2010) as well as Song (2008) have confirmed the existence of a positive and significant relationship between SMS delivery of learning material and students' traits and attitudes at the university level.

Additional research studies have investigated the relationship between SMS delivery of learning material in the course of the learning process and students' specific traits and attitudes. Learner motivation, learner autonomy, learner control of the learning process, learner curiosity, learner self-efficacy, learner technological self-confidence, and user friendliness have been found to have a positive significant relationship with SMS delivery of learning content (Cavus & Ibrahim, 2009; Katz & Yablon, 2009; 2011; 2012; Mainemelis, Boyatzis & Kolb, 2002).

As academic achievement (Perveen, 2010; Weng, Cheong & Cheong, 2010), learner creativity (McWilliam & Dawson, 2008; Tillander, 2011), learner flexibility (Greener, 2010; Mainemelis, Boyatzis & Kolb, 2002) and learner self-image (Offir & Aflalo, 2008; Renes & Strange, 2011) are issues, traits and attitudes considered important in the learning process, the present study examines the issue of learner achievement attained by students when using SMS delivery for concept learning. In addition the research pays particular attention to the examination of the relationship between learner creativity, learner flexibility and learner self-image of students on the one hand and SMS delivery of cultural concepts on the other.

2.2 SMS Delivery and Academic Achievement

A number of researchers have addressed the issue of technology based learning and academic achievement. Guzeller (2012 indicated that senior high school students who utilized technology based learning strategies achieved higher academic scores in tests that assessed language learning than their counterparts who studied language without technology-based facilitators. Efendioglu (2012) investigated the use of technology in a pre-service teachers' training course and its relationship with academic achievement of the teacher trainees. Results of the study indicated that technology-based instruction facilitates a higher level of academic achievement than more traditional instructional strategies. Huffman & Huffman (2012) indicated that use of technology in the instruction of college students enhanced their academic success and grades. On the other hand Katz & Yablon (2009; 2011; 2012) found no significant differences between the academic achievement attained by first-year university students who utilized technology in the learning process and that attained by their counterparts who studied without technology-based instructional strategies. Although the relationship between technology-based instruction and academic achievement is not quite clear, this study will investigate the potential link between SMS-based delivery of learning content and academic achievement as the confirmation of such a relationship could have major implications for university learning

2.3 SMS Delivery and Learner Creativity

Black & Browning (2011) reported that the use of technology in education leads to an increase of learner creativity. Hope (2010) indicated that creative learning is enhanced by innovative learning environments as found in technology-based learning. Lussier & Achua (2004) indicated that a major goal necessary in the process of strengthening a learning organization is the promotion of creative thinking which can be facilitated by the use of technology. Antonenko & Thompson (2009) contended that the use of technology in the learning process significantly contributes to the promotion of learner creativity. Eaglestone et al (2007) stated that the use of technology in learning can enhance creativity in the cognitive process and facilitate knowledge acquisition as ell as affective well-being. Akinwamide & Adedara (2012) confirmed that technology based learning platforms contribute significantly to the enhancement of learner creativity, mainly because of the facilitation of self-discovery and autonomy inherent in the new digitalized pedagogy. Because of the confirmed importance attached to creativity in the technology-based learning process, this study will examine the relationship between SMS-based delivery of concept learning and learner creativity.

2.4 SMS Delivery and Learner Flexibility

Osborne & Oberski (2004) as well as Jeffries (2005) contended that the multidimensional nature of technology can effectively enhance student flexibility in the learning process. Luppicini (2006) indicated that students who studied in a technology based environment adapt to the environment and enhance their learning flexibility so as to increase the quality of their learning. Lee (2007) concluded that technology based learning sensitizes the students ' awareness of others in their learning environment and facilitates their ability to react flexibly in the class or group learning process. Sweeny (2010) postulated that technology used in current learning situations promotes learning flexibility among students. This learner flexibility encourages students to utilize various and appropriate technologies in their learning processes. In view of the relationship between technology and learner flexibility indicated in the abovementioned studies, this research will test the connection between the reception of learning material through the medium of SMS messaging and learner flexibility of the student recipients.

2.5 SMS Delivery and Learner Self-Image

Sami & Pangannaiah (2006) investigated the relationship between the use of technology in the learning process and the self-image of learners. They indicated that students who used technology efficiently in the library during their learning process acquired a more positive learner self-image than those who were less able to make efficient use of technology during the time they spent learning in the library. Tabata & Johnsrud (2008) confirmed that students who used technology more effectively in their learning developed a more positive self-image of themselves as learners than those less able to constructively utilize technology in their learning processes. Nicolle & Lou (2008) confirmed that using innovative technological innovations in learning enhances students' perceptions of their learning as well as their learner self-image. In light of the above research findings this study will investigate the link between learning delivered to students via SMS messages and their learner self-image.

The research model depicting the independent and dependent variables are presented in Figure 1.

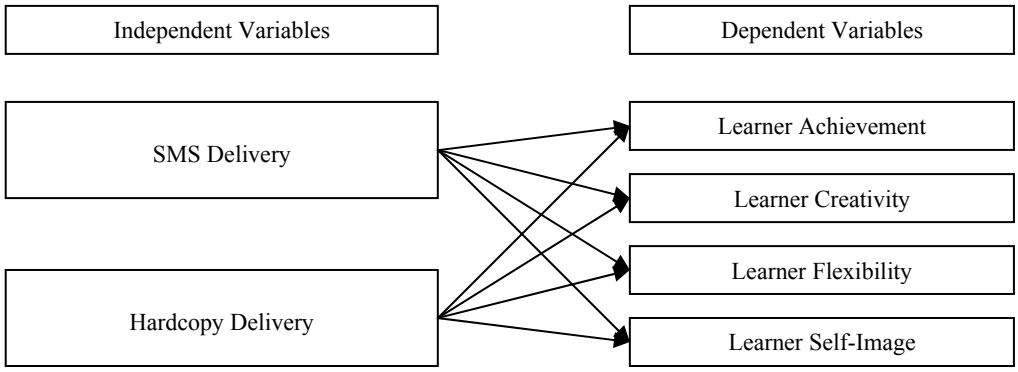

Figure 1. Graphic Illustration of the Research Model

3. METHOD

3.1 Sample

The research sample consisted of 296 first year students enrolled in a 14 week semester-long cultural concepts foundation course offered at one of the seven chartered universities in Israel. Students came from similar socio-economic backgrounds and all were accepted to the Faculty of Social Sciences at the university after attaining the university acceptance criteria of a mean matriculation grade of at least 80% as well as a mean psychometric university entrance score of 600. The students were randomly assigned to the two different research groups in which they were provided with lists of definitions of cultural concepts via two alternative learning content delivery methods. The first group of 163 students received their cultural concepts via SMS delivery to their personal cell-phones and the second group of 133 students received their cultural concepts in hardcopy format by way of regular snail mail.

3.2 Instruments

Two research questionnaires were administered to the students in this research study. A standardized cultural concepts learner achievement test was administered to the participants in order to assess students' mastery of definitions of cultural concepts relating to Israeli culture. The test scale ranged from 0-100, the higher grades indicating higher levels of achievement on the cultural concepts test. The second instrument administered was a 30 item Likert type scale response questionnaire (students responded to a five point scale with 1=totally disagree and 5=totally agree) designed to examine the students' perceptions of the trait and attitudinal research factors as follows: The first factor, learner creativity, contained ten items (Cronbach α=0.79), the second factor, learner flexibility, consisted of eleven items (Cronbach α=0:83) and the third factor, learner self-image, was made up of nine items (Cronbach α=0.78).

3.3 Procedure

Students who studied in the Faculty of Social Sciences, and were enrolled in the elective cultural concepts foundations course and possessed personal cell-phones with texting capacity were eligible for participation in this study. Following the selection of the students who met the above criteria, they were randomly assigned to the two delivery platform groups. Students in the first group received cultural concepts via SMS messages sent to their personal cell-phones and those in the second group received cultural concepts in hardcopy format via snail mail. The students in the two groups were sent weekly lists that contained concise definitions of the cultural concepts studied in the course, each weekly list contained definitions of 25 new cultural concepts delivered via the respective learning strategies. Thus each of the students received definitions of 350 cultural concepts during the 14 week long course. On completion of the course the students in the two groups were administered a standardized cultural concepts learner achievement test in order to asses their level of knowledge of the 350 cultural concepts taught in the course. In addition they were administered the 30-item trait and attitudinal questionnaire which examined their scores on the three attitudinal research factors, namely learner creativity, learner flexibility and learner self-image.

4. RESULTS AND DISCUSSION

The main aim of this study was to examine the efficiency and effectiveness of two different learning delivery platforms, namely SMS based delivery and hardcopy delivery. Two research questions were posed: the first examined the acquisition by students of knowledge focusing on cultural concepts and the second investigated students' attitudes connected to the two delivery strategies. The mean scores of each of the attitudinal factors were standardized in order to allow for a comparison between the factor scores. Standardized means and standard deviations of students' scores on the achievement test and on the attitudinal factors are presented below.

Table 1. Mean Scores and Standard Deviations for Students in SMS and Hardcopy Delivery Groups for Learner Achievement, Learner Creativity, Learner Flexibility and Learner Self-Image

Research Variables	SMS Delivery (N=163)		Hardcopy Delivery (N=133)	
	Mean	S.D	Mean	S.D.
Learner Achievement	84.67	8.64	85.32	9.31
Learner Creativity	3.83	0.44	3.44	0.50
Learner Flexibility	3.48	0.50	3.32	0.60
Learner Self-Image	4.00	0.66	3.30	0.73

One-way analyses of variance (ANOVA) were conducted in order to investigate intergroup differences on the four research variables. No significant differences were found between students in the SMS and hardcopy delivery groups on grades attained on the standardized learner achievement test. On the other hand significant differences between the two delivery groups were yielded for learner creativity [$F(1,292)=37$, $p<0.001$, $\eta^2=11.2\%$]; for learner flexibility [$F(1,292)=5.36$, $p<0.05$, $\eta^2=1.8\%$]; and for learner self-image [$F(1,292)=55.26$, $p<0.001$, $\eta^2=16\%$]. Post-hoc Scheffe tests, conducted to ascertain specific inter-group

differences for the three affective variables, indicated that students in the SMS delivery group attained higher scores on the three trait and attitudinal variables than students in the hardcopy delivery group

A discriminant function analysis was conducted in order to check the significance of the results obtained in the one-way analyses of variance and post-hoc Scheffe tests. The results of the discriminant function analysis, indicated that for the three attitudinal variables, namely learner creativity, learner flexibility and learner self-image, an average of 64.33% of the students were correctly classified as members of their respective learning groups, thus affirming the significant differences indicated between the SMS and hardcopy learning content delivery groups regarding the traits and attitudes characterizing group members.

The research findings of this study indicate that neither the SMS nor the hardcopy delivery strategies held any advantage regarding learner achievement on the standardized cultural concepts achievement test. Students who studied the 350 cultural concepts via SMS delivery of concepts sent to their personal cell phones or by concepts delivered to them by hardcopy via snail mail attained similar grades on the standardized learner achievement test. Thus it seems that different learning content delivery strategies do not necessarily lead to differential academic achievement. Although this result contradicts evidence presented by Guzeller (2012 and Efendioglu (2012), it confirms similar results which have indicated that academic achievement is not conditional to type of learning strategies or delivery platforms used to facilitate the learning process (Bohlen & Ferratt, 1993; Dyer & Osborne, 1996; Katz & Yablon, 2009; 2011; 2012).

Additional research results clearly indicate that the two different content delivery strategies employed in the present study are related to significantly differential levels of learner creativity, learner flexibility and learner self-image. Scores attained by students in the SMS-based learning content delivery group on the three trait and attitudinal factors were significantly higher than those of students in the hardcopy learning content delivery group. It appears from the nature of these results that SMS-based delivery of learning material is linked to higher levels of learner creativity. This finding confirms similar indications regarding the unique advantages of technology in enhancing learner creativity as reported by current researchers including Akinwamide & Adedara (2012), Antonenko & Thompson (2009) and Black & Browning (2011). Similarly the research result that indicates that SMS delivery of learning content appears to be more significantly related to learner flexibility than delivery by hardcopy via snail mail confirms the findings of Lee (2007), Luppicini (2006) and Sweeny (2010) who suggested that technology has the potential to enhance learner flexibility. In addition the finding of the present study that SMS delivery of learning content is more significantly connected to learner self-image than hardcopy delivery strengthens the findings of Nicolle & Lou (2008), Sami & Pangannaiah (2006) and Tabata & Johnsrud (2008) who reported that research studies conducted by themselves indicated that technology based learning leads to an enhancement of learner self-image.

5. CONCLUSION

The results of the present study indicate the potential of SMS messaging of relevant subject matter as a positive delivery platform significantly related to trait and attitudinal variables such as learner creativity, learner flexibility and learner self-image. It should be noted that no relationship was found between the two delivery platforms and learner achievement. Further studies need to be conducted so as to further explore the possible relationship between delivery SMS and other technology based learning content delivery platforms and learner achievement. However, even if no significant relationship is found between the delivery platforms and learner achievement, the fact that a significant relationship exists between SMS delivery and trait and attitudinal variables such as learner creativity, learner flexibility and learner self-image as well other similar attitudinal variables as reported in earlier studies indicates the potential of SMS delivery for the university learning process.. From a pedagogical point of view it appears that cell-phone-based SMS learning content delivery leads to positive attitudes of students as previously indicated, among others, by Katz & Yablon (2009; 2011; 2012) and Song (2008) and should be universally considered as a legitimate and positive learning strategy at the university level.

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E-PORTFOLIOS @ TEACHER TRAINING: AN EVALUATION OF TECHNOLOGICAL AND MOTIVATIONAL FACTORS

Alfred Klampfer, Mag. Dr.[1] and Thomas Köhler, Prof. Dr.[2]
[1]*Private University College of Education Linz, Salesianumweg 3, A – 4020 Linz*
[2]*Technical University Dresden, Weberplatz 3, D – 01217 Dresden*

ABSTRACT

In recent years e-portfolios have received a great deal of attention in the educational discourse and it is associated with individualization of the learning process, competence-oriented assessment and institutional personnel development.
Since the beginning of the academic year 2008/09 students of the Catholic College of Education Linz had the opportunity to create and write their own e-portfolio in the context of the teacher training. Here the e-portfolio serves as an instrument for professional development in teaching by reflecting one's own learning process and by illustrating the way of competence development as well as an instrument for professional feedback.
The objective of this research is to evaluate motivational and technological factors towards using e-portfolios among students. Furthermore e-portfolios shall be developed as a tool and a method in teacher education. Authors will address the following research questions:

- How is the e-portfolio assessed by students (attitudes, benefits, relevance, usability, motivation, acceptance, etc.)?
- What factors do acceptance and motivation towards working with e-portfolios depend upon?
- Does the frequency of feedback influence acceptance and motivation?

Theoretical basis for the research is an adapted version of *model of motivation and acceptance with technology* for working with e-portfolios by students in teacher training. It will be validated and adapted through an empirical-quantitative study based on hypothetical principles. In a second step, the resulting model is undergoing a partial least square (PLS) calculation – an analysis in order to estimate and interpret interrelations and causal effects and to optimize the model of our research.

KEYWORDS

E-Learning, E-Portfolios, Motivation, PLS, Technology Acceptance, Teacher Training, Usability

1. INTRODUCTION

With the Bologna-compliant revision of curricula at colleges and universities and the orientation of the studies towards studentical competences or „learner centred approach(es)" (i.e. outcome instead of input orientation) more and more e-portfolios have found their way into the curricula of various training and continuing education courses. They are associated with individualization of the learning process, self-organized learning, reflection of the learning process, but competency based assessment discussed with institutional staff development.

Barbara Cambridge, former Vice President of the American Association for Higher Education indicated already in 2005 in her presentation at the „e-Portfolio Forum Austria"F[1]F that:

> „Learners in the 21st Century, who are able to describe, apply and evaluate their knowledge and skills, will progress in their role as individuals, citizens and will perform better at work. E-Portfolios are a way of supporting learners through reflection, integration, development, self-management, lifelong learning and social development."

In many areas of the teaching / learning process is not enough to identify and grade results selectively. In the specific case of school practical studies within teacher education only an individual learning process

[1] http://eportfolio.salzburgresearch.at/index.php?option=com_content&task=view&id=13&Itemid=41&lang=deH [1.7.2010]

allows acquiring „professional" teaching behaviour by making the individual performance visible. Unlike traditional forms of testing, such as tests, exams or essays, assessment methods enable focussing on problem solving strategies and processes as well as a greater insight into the underlying skills of prospective teachers.

A portfolio in general and an e-portfolio in particular can be valuable tools for presenting, discussing and questioning developmental processes. At the Private University College of Education Linz e-portfolios have been used for four years in the practical school studies with internal tests and external reports based upon the e-portfolio management system „Mahara" (cp. Himpsl & Baumgartner 2009). Through a comprehensive care plan students but also teachers receive maximum support when working with e-portfolios. Even though e-portfolios are not assessed per se they are an essential component in teacher training to represent the students' growth of competence during the practical training of teaching.

During practical training of teaching (that takes place at selected schools) students are accompanied by the practice teacher inside the respective schools as well as by the docents from the College of Education. Practice teachers observe every teaching activity of the students and discuss it with them on the very same day. In addition, students can join the lectures of their practice teachers. Docents from the College of Education observe the students' teaching activity about two to three times a semester. They serve mainly as didactic and methodological experts and assist students for professionalizing their teaching skills. Through feedback from the practice teacher and the peers the students' teaching should be questioned and developed continuously.

Within that setting the e-portfolio serves the individual documentation of the students' learning process. To use e-portfolios throughout the complete teacher training process students must be highly motivated. Yet it is not clear how motivation as a condition of acceptance behaviour and attitudes is functioning specifically. For a successful and sustainable implementation of the e-portfolios it also needs to be analysed how motivation as a key element of the acceptance process can be developed.

2. THEORETICAL FRAME

2.1 Definition of „E-Portfolio"

For an appropriate definition of e-portfolios we can find in the literature numerous proposals along with a variety of different terms such as reflection, collection, competence and summary. Since the process of personal skills development in the practical training of teachers is an essential criteria in teacher training, the following definition of Hilzensauer and Hornung-Prähauser (2005, p.4) was taken over from Salzburg Research as a basis for this research project, who defines as e-portfolio:

> „a digital collection of 'skilfully produced work' (artefacts) of a person purporting to document the product (learning outcomes) and the process (learning path / growth) of their competence development within a certain time and for certain purposes and illustrate if the person concerned has made the selection of the artefacts itself and if it is organized in terms of the learning goal itself. As the owner this person completely controls who, when and to what extent it is allowed to view information from the portfolio."

This definition emphasizes both product-orientation and process-orientation as important aspects of the work with an e-portfolio. The key objective is therefore not collecting of artefacts but the documentation of the Learning and performance-related progress of the learner on cognitive, social and emotional level. By designing portfolio-documents over a longer period of time an increase of self-responsibility, self-control and self-assessment by increasing metacognitive (self-)reflexivity of those involved is triggered (cp. Stangl 2004).

2.2 Self-Determination Theory of Motivation (Deci & Ryan, 2000)

Motivation plays an important role in the development of a human being in general, but for learning as well as for learning with e-portfolios in particular. Two scientifically widely accepted theoretical approaches can be found which are the „Self-Determination Theory of Motivation" (SDTM) and the "Attention Relevance Confidence Satisfaction-Model" (ARCS), which partly overlap.

In the self-determination theory of motivation SDTM developed by Edward L. Deci and Richard M. Ryan (2000) is assumed that people have the innate (intrinsic) desire to explore actively and to understand the environment but also involving themselves into social structures, to make connections and expand their skills. These innate tendencies are essential to Deci and Ryan, down to three basic psychological needs, the need for autonomy, the need for competence and effectiveness as well as the need to belong, to satisfy. The fulfillment of these basic needs is a prerequisite for a healthy personality development and the basis for the intrinsic (self-) motivation:

> „The findings have led to the postulate of three innate psychological needs - competence, autonomy, and relatedness - which when satisfied yield enhanced self-motivation and mental health and when thwarted lead to diminished motivation and well-being." (Deci & Ryan, 2000a, p. 68).

The need for autonomy is more powerful than the other two requirements. Only in a self-directed and informal learning environment one can experience competence and social integration, leading to intrinsic learning. When missing one of the three factors learners will avoid this learning setting or it has a negative influence.

2.3 The ARCS – Model (Keller & Kopp, 1987)

Already in the 80's of the last century John Keller developed the ARCS model for designing instructions at school. The model provides strategies for a systematic and targeted promotion of a student's motivation. It is based upon the differentiation of four main categories of motivation: attention, relevance, confidence in success and satisfaction.

Table 1. Main categories of the ARCS-Model

Main Categories	Task of the Motivation Design
Attention	Creation and maintenance of attention and interest of the learner.
Relevance	Transferring the usefulness of the learning unit for reaching personal goals and for the satisfaction of specific needs.
Confidence	Building of a positive expectation toward success and competence opinion and perception of one's own control.
Satisfaction	Offer of attractive possibilities for action, rewards, feedback and opportunities to assess their own performance.

Based on the ARCS - model recommendations for the design of multimedia learning environments have been developed (cp. Niegemann et al., 2008, p 370).

2.4 Models of Acceptance

Securing the acceptance of the use of e-portfolios in teacher-training is essential for a successful implementation of e-portfolios.

Simon's (2001, p 87) „acceptance" means a „positive decision concerning of an innovation taken by the user" in contradiction to the concept of rejection. By innovations novel products or services are understood. Muller & Muller-Boling established (1986) the distinction between attitude and behaviour acceptance. The setting of acceptance includes an affective (motivational-emotional) and a cognitive component and is not directly measurable. With the acceptance behaviour the observable behaviour toward the innovation (e.g. use) is explored. This dichotomy is accepted in many acceptance models (e.g. technology acceptance model of Davis TAM1 1989, TAM2 of Davis and Venkatesh 2000, Dynamic Acceptance Model by Kollmann 1998, Model for the use of e-learning among teachers from Traxler (2009). Bürg and Mandl (2004, p. 5) transferred this distinction of behaviour versus attitude of acceptance into a model of acceptance of e-learning in companies and emphasize the importance of individual characteristics plus characteristics of the learning environment. For the empirical study of the acceptance of e-portfolio work, this notion of acceptance is also useful due to the common focus on the use of acceptance of IT systems.

2.5 Motivational and Technological Factors of e-portfolio Usage

Based on the self-determination theory of Deci and Ryan (2000), the ARCS-model of Keller and Kopp (1987), on the work of Bürg and Mandl (2004, 2005) and in the acceptance model for e-learning as well as a model for the integration of acceptance motivation in media-based courses by Buck (2006) we were able to derive personal factors versus contextual factors in the acceptance of working with e-portfolios. These factors were checked on motivational aspects in the sense of self-determination theory and the ARCS model. The following diagram illustrates these relationships in an extended model for motivation and acceptance of working with e-portfolios. Factors that could have influence on the motivation in the sense of self-determination theory („S") and the ARCS model („A") were characterized.

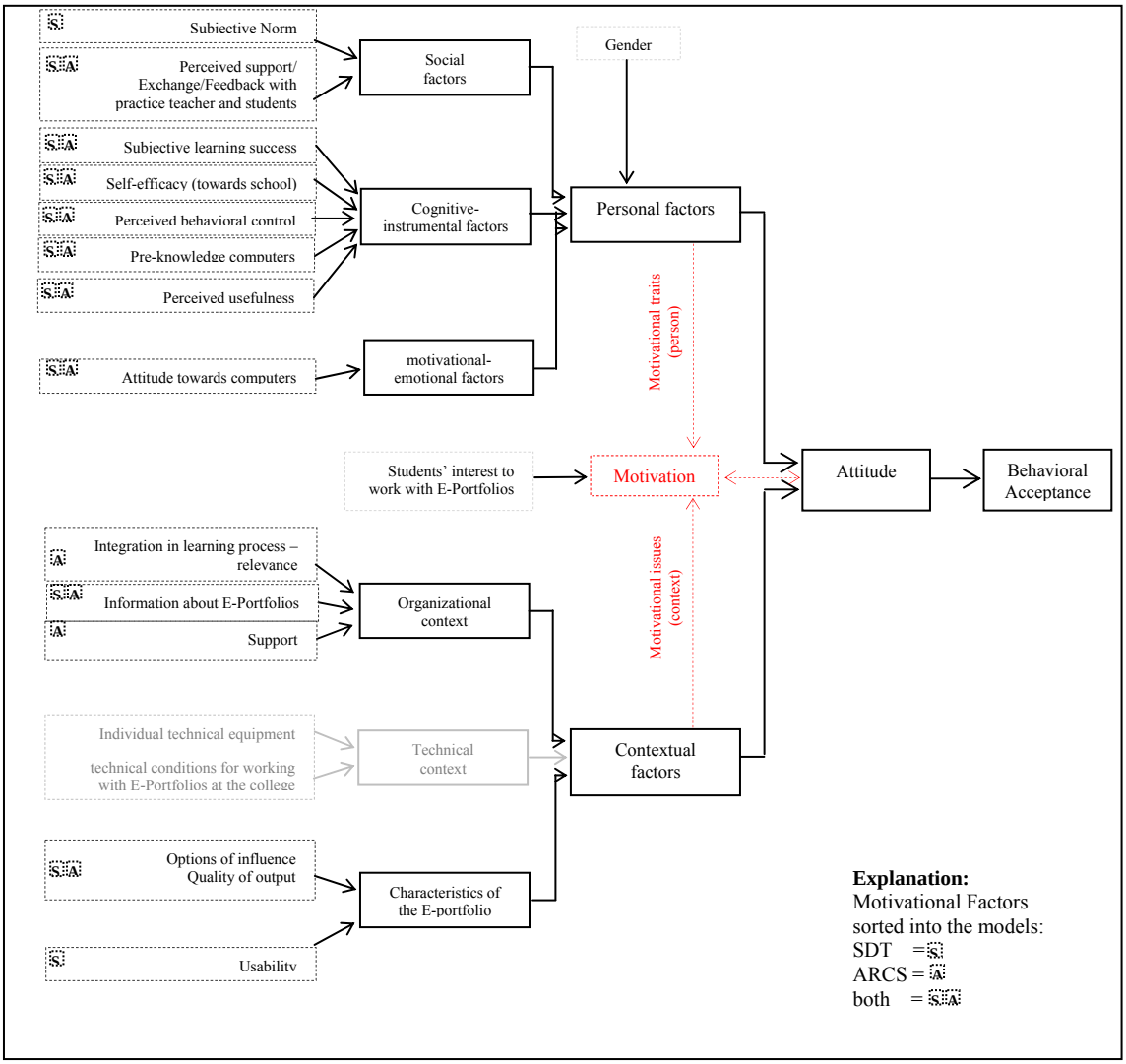

Figure 1. Model of motivation and acceptance toward working with an E-Portfolio (own figure based upon the models of Bürg & Mandl, 2004, combined with Buck, 2006)

From the model, the following research questions can be derived:

1. To what extent there is a relationship between the collected personal characteristics and the motivation toward working with e-portfolios?
2. To what extent there is a correlation between the assessment of the contextual factors and the motivation to work with e-portfolios?
3. To what extent there is a relationship between motivation and attitude?
4. To what extent there is a link between behaviour and attitudes?

3. METHOD AND RESEARCH DESIGN

To answer the research questions based on the presented „concept of acceptance and motivation of e-portfolio work" field experiment with two quantitative (written) surveys was used. Using this design the hypotheses could be tested. Below is a structural overview of the chosen research design:

Figure 2. Empirical Research Design

Two non-randomized groups were formed, one treatment group (T) and one control group (C). Members of the treatment group should have reported their personal progress, reflections, sketches, etc. continuously for the practice teacher by using the e-portfolio and also got amplified feedback from the practice teacher (at least once a month). Members of the control group could decide independently if and when they opened their e-portfolios for the respective practice teacher. Those received feedback only at the end of the semester, either orally or through a note in the e-portfolio. Both, the treatment as well as the control group were monitored by using a pre (O1) and a post (O2) test survey.

The quantitative data collection was realized as a written survey in web-based form at the beginning of the semester in October 2011 (the first survey) and at the end of the semester, conducted in February 2012 (the 2nd survey). The students received the link to the survey via e-mail and were asked to participate. Simultaneously they were informed that the survey would be completely anonymous. As instrument for the survey the professional standard software for online surveys EFS Survey (www.unipark.info) was used.

The following table provides an overview of the participants of the survey, who completed the entire questionnaire:

Table 2. Sample

Survey	female		male		total
	N_f	%	N_m	%	Σ
1 (2011/10)	54	80,60%	13	19,40%	67
2 (2012/02)	54	78,30%	15	21,70%	69
Participants in both surveys	**52**	**81,25 %**	**12**	**18,75%**	**64**

The response rate of the participants that participated in both surveys and filled in both questionnaires completely was 71%.

Based from theoretical considerations and research hypotheses for the creation of the two questionnaires validated survey instruments were adopted from the field of teaching and learning research and checked on its applicability to our research projects. The following instruments were applied:

- Questionnaire on the „*Content differentiated collection of computer-based settings*" (abbreviated FIDEC)
- and Questionnaire „*Confidence in dealing with computers and computer applications*" (COMA) of the "*Inventory of computer education*" (INCOBI-R) by Naumann, Richter and Horz (2010)[2]
- Questionnaire of „*Academic self-efficacy*" of Jerusalem and Satow (1999)[3]
- „*Intrinsic Motivation Inventory*" (IMI) von Deci und Ryan (1990)[4]
- „*Short scale for intrinsic motivation*" KIM (2009)[5]
- Items from the „*Research Report 148*" by Kopp, Balk and Mandl (2002) and
- „*Research Report 161*" by Kopp, Dvorak and Mandl (2003)[6]
- „*System Usability Scale*" (SUS) by Brooke (1986)[7]

Missing questions were derived from the theoretical considerations. In this study, a five-level rating scale with the levels -2 (strongly disagree) to +2 (strongly accurately) was used.

4. RESULTS

4.1 Correlation Studies

In a first step bi-variate correlations were calculated as presented in table 3. Obviously there is a highly significant correlation for both, personal factors as well as contextual factors, whereas personal factors contain social, cognitive-instrumental and motivational-emotional components and the contextual factors cover the organizational context plus the technical characteristics of the E-Portfolio.

Table 3. Bi-variate correlations

	Motivation r_s	Attitude r_s
Gender	,079	,128
Personal Factors	**,658****	**,553****
Social Factors	*,677***	*,574***
Subjective Norm	,659**	,591**
Perceived Support (N=45)	,539**	,494**
cognitive-instrumental factors	*,768***	*,645***
subjective learning success	,598**	,495**
School-related self-efficacy	,045	,101
Perceived Behavioural Control	,602**	,585**
Preliminary Computer Knowledge	-,049	-,034

[2] Pädagogische Psychologie, 24 (1), 2010, Hans Huber, Bern, pp 23-37.
[3] http://userpage.fu-berlin.de/~health/self/skalendoku_selbstwirksame_schulen.pdf [1.7.2012]
[4] http://selfdeterminationtheory.org/questionnaires [29.12.2012]
[5] http://www.ipn.uni-kiel.de/zfdn/pdf/15_Wilde.pdf [15.8.2012]
[6] http://epub.ub.uni-muenchen.de/273 , http://epub.ub.uni-muenchen.de/256 [12.12.2012]
[7] http://www.measuringusability.com/sus.php [29.12.2012]

Perceived usefulness	,730**	,573**
motivational-emotional Factors		
Attitude towards Computers	,159	,150
Context factors	**,607****	**,605****
Organizational context	*,671***	*,529***
Relevance	,731**	,592**
Information	,224	,186
Support	-,213	-,254
Characteristics of the E-Portfolio System	*,572***	*,584***
Quality of Output	,498**	,610**
Usability	,561**	,569**
Attitude	,803**	
Behavioural acceptance (usage)	,506**	,512**
Personal + contextual Factors	,639**	,629**

r_s = Spearman correlation coefficient - Note: * $p \leq .05$, ** $p \leq .01$ (two sided significance test)
$r_s \geq$+-0,1 minor effect, $r_s \geq$+-0,3 medium effect, $r_s \geq$+-0,5 strong effect

	Behavioural acceptance r_s
Attitude	,512**

For the following assumptions very high correlations had been confirmed as significant:

- The subjective norm and the type of care influence the motivation to work with e-portfolios.
- The higher the subjective learning success, the perceived behavioural control as well as the perceived benefits are, the greater the motivation to work with e-portfolios will be.
- The perceived relevance of the curriculum, the quality of output and the perceived usability of Mahara have a positive effect on the motivation for e-portfolio work.
- Motivation and attitude of acceptance are closely related. The higher the motivation to work with e-portfolio is estimated, the higher the attitude will be.
- As in other studies also in this study a relationship between attitude and actual usage have been confirmed.

Interestingly, no significant correlation between gender, school-related self-efficacy, computer technical knowledge, the IT-affinity, information about the e-portfolio system as well as the support and motivation to work with e-portfolios has been found.

In the following, the resulting model for motivation and acceptance of working with e-portfolios in the school of practical studies teacher / internal training is presented in a summary. Figure 3 shows the adapted model for motivation and acceptance of working with e-portfolios in the school practical studies, which represents the relationships between each factor and the motivation and acceptance

Yet it does not allow any statements about causal effect relationships or an overall assessment of the model. Only by using a structural equation analysis (also called „causal analysis“) cause-effect relationships were analysed and interpreted in our model. As a method, a variance-based causal analysis, based on the calculation of partial least squares (PLS) has been used. In contrast to the analysis of covariance-structures it requires no distributional assumptions and can also be carried out using small samples. It includes both formative and reflexive measurement models. With the free software SmartPLS we have found a user-friendly tool that provides extensive calculations for the assessment of the overall model.

For the quality evaluation of structural equation model can be stated that with respect to reliability and validity good results have been achieved and that the operationalization of the latent variables succeeded in the overall model. Much of the relations between the influencing factors and the declared impact could be confirmed. Only the direct relationship of the factors for attitude had to be removed from the model. Furthermore interesting is that the actual use (i.e. the behavioural acceptance) of the e-portfolio still has to depend on other factors that were not considered in this model. One possible factor could be the available time that students were able the students spend.

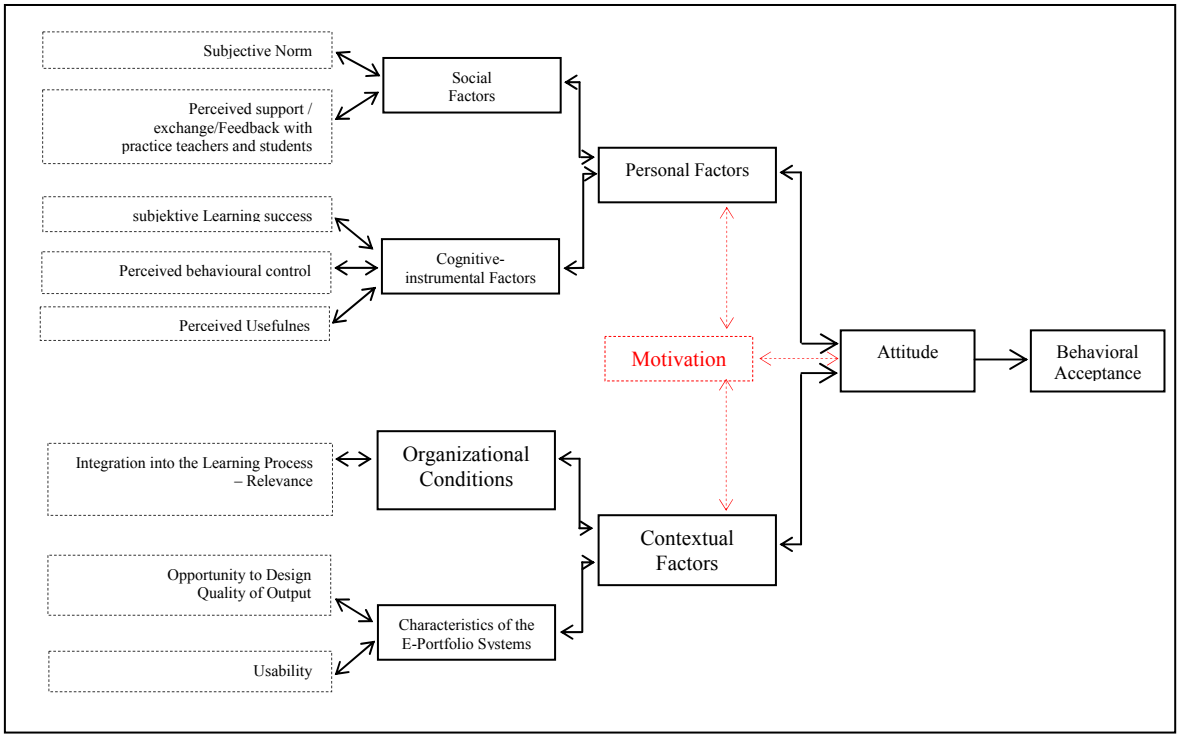

Figure 3. Resulting model of motivation and acceptance of e-portfolios

5. CONCLUSION

In conclusion, it can be stated that motivational and technological factors as well as their impact and relationships were analysed systematically between the proposed latent variables. It has been found that the model used basically provides a valid and reliable assessment of motivational and technological aspects of working with e-portfolios. For the interpretation of the results it must be taken into account that the sample of 64 subjects is a somewhat small and eventually the results and have a limited scope only. In addition, in this study, no effect on the nature and quality of the responses was made to the e-portfolio entries, but only a minimum level of feedback from the process-oriented group has been defined. For future research it would therefore be interesting to set priorities in the field of qualitative feedback here and investigate further development steps. In addition, the results presented here should be reviewed with a representative sample.

In summary, the following five recommendations for the use of e-portfolios in the school of practical studies of teacher can be derived from the empirical study:

1. Create a positive expectation for working with e-portfolios with students.
2. Give good and consistent support during the work phase and appreciative, positive feedback.
3. Focus on relevance and usefulness for future teaching.
4. Offer templates and views but still leave most freedom in the design of e-portfolios.
5. Carefully select the e-portfolio system.

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EFFECTS OF FACEBOOK TUTORING ON LEARNING ENGLISH AS A SECOND LANGUAGE

Chang-hwa Wang[1] and Cheng-ping Chen[2]
[1]*Graphic Arts and Communications, National Taiwan Normal University, Taipei, Taiwan*
162, Heping East Rd. Sec. 1, Taipei, Taiwan
[2]*Information and Learning Technology, National University of Tainan, Tainan, Taiwan*
33, Shu-Lin St., Sec. 2, Tainan, Taiwan

ABSTRACT

Social media use has become increasingly embedded in everyday life. Among various social media, Facebook is a highly interactive virtual social communication tool and it has become increasingly popular on college campuses. Research results have indicated that Facebook could be an effective platform for informal learning. However, most of current studies in the educational use of social media seem to pay more attention on college students or adults. This study, however, explored the effects of Facebook tutoring on learning English as a second language for children. 60 elementary students from a supplementary English tutoring program were evenly divided into Facebook tutoring group and traditional classroom teaching group. Instructional strategies of communication, collaboration, and information sharing were given to both groups. The results indicated that children participated the Facebook tutoring generally exhibited a positive attitude toward this new type of learning experience. The learning achievement for the Facebook group was also significantly higher than the traditional classroom group. It is concluded that providing with proper strategies, both student's learning attitude and learning achievement were positively affected by the Facebook tutoring.

KEYWORDS

Facebook, learning English as a second language, social network, supplementary tutoring

1. INTRODUCTION

Recently, people frequently use the Internet as a social medium to interact with each other and expand their social circles, share information and experiences, and organize communities and activities (Bourlard, Krishnamurthy, Sun, Zhao, & Liu, 2012). Social media provide multiple dimensions for developing creative learning strategies that allow students to connect formal and informal learning settings. Students can find like-minded people and organize informal knowledge exchange for educational purposes (Wodzicki, Schwämmlein & Moskaliuk, 2012). The use of social media applications in teaching and learning has garnered substantial interest among educators (Cain & Policastri, 2011).

Web-based social networking platforms such as Friendster, MySpace, and Facebook offer users communication and interaction channels to link with friends, family, and community. Among them, Facebook has become increasingly popular on college campuses,.Any Facebook user can easily search and view any user's Facebook page through the Facebook network (Mazer, Murphy & Simonds, 2007).

Most current studies in educational use of social media seem to pay more attention on college students or adults. However, many younger children have begun to bring social networks into their daily life. They may be a substantial group with the potential to learn with social networks as children rely on interaction with others who share their interests in new experiences.

Children are curious, active and creative while learning language (Lin, 2008). Blattner & Fiori(2009) indicated that various usages of Facebook can be integrated in foreign language courses. Children could experience authentic language interactions and develop socio-pragmatic awareness (e.g., language use in specific contexts, relationship building…), which are often absence in textbooks. In Taiwan, such notions are particular interest since learning a second language, especially English, is considered to be the most important supplementary work after the regular classes for many school children.

This paper provides a successful example of learning English as a second language via Facebook for Taiwanese children. We believe the promising results found in this study could draw better attention to the issue of learning a second language via social network interactions.

2. EDUCATIONAL USE OF FACEBOOK

In recent years, social networks have been widely accepted as efficient platforms for academic communications, especially on university campuses. According to Blattner & Fiori (2009), Facebook is the largest social network that boasts more than 100 million members, and it is one of the fastest-growing and best-known sites on the Internet. As McLoughlin and Lee (2008) pointed out, Facebook has multiple functions of communications, information sharing, and collaborative construction and modification.

Although early in the Facebook appeared, the main reason for students using Facebook was keeping contact with friends (Ellison, Steinfield, and Lampe, 2007), Wodzicki, Schwammlein and Moskaluik (2012) later discovered that students would be in favor of exchanging informal experiences if a collaborative and sharing environment is embedded in the Facebook. Roblyer, McDaniel, Webb, Herman, and Witty (2010) found that in compare with traditional face-to-face interaction, students prefer to communicate with teachers via Facebook. This may reduce an immediate embarrassment. Cain and Policastri (2011) claimed that Facebook provides an informal learning environment for presenting contemporary topics and the thoughts of guest experts not affiliated with a college or school, thereby exposing students to relevant “real world” issues.

Mazman and Usluel (2010) recognize Facebook has three types of educational functions: communication, collaboration and resource/material sharing. Communication consist of activities such as enabling communication among students and their instructors, facilitating class discussions, delivery of homework and assignments by teachers, informing about resources and links related to courses; consist of activities such as people's joining to academic groups related to their schools, departments or classes and carrying on group works by sharing homework, projects, and ideas; collaboration consists of activities such as exchanging multimedia resources, videos, audio materials, animated videos, resources and documents.

3. SOCIAL NETWORKING SITE AND LANGUAGE LEARNING

Harrison and Thomas (2009) recognized that web 2.0 technologies have been advanced as potentially transformative in the area of foreign language learning. They believed that web 2.0 technologies are presenting new opportunities for developing diverse online learning environments and enhancing interactivity, participation and feedback between students, their peer groups and teachers. They further argued that language learning is not only how learners develop their language skills, but also how the learning process impacts on their overall personal development in terms of cultural values and beliefs, something that has been generally overlooked in computer-assisted language learning research to date.

Blattner and Fiori (2009) indicated that Facebook could be an effective platform for language interactions. Godwin-Jones (2008) also believed that Facebook could benefit interpersonal communications. They believed that unique functions of Facebook provide a constructive learning environment while maintaining a certain degree of privacy and safety.

Some evidences have been established for the fact that Facebook helped language learning. Ajjan & Hartshorne (2008) recognized that active users could improve their communication and writing skills through virtual social interactions with Facebook. Mill (2009) discovered that language learning with Facebook was effective as virtual social activities help students develop better verbal communication competences in the real world. Moreover, Shin (2011) used Facebook as the platform to perform peer evaluation. The result indicated that peer evaluations at Facebook significantly improved student’s learning interest and learning motivation. These positive results all supported that social interactions via Facebook affect the outcomes of language learning.

4. LEARNING ENGLISH AS A SECOND LANGUAGE IN TAIWAN

English is the most popular language in the world. Most countries take English as second language. Private supplementary tutoring of English has a long history in parts of East Asia (including Japan, Hong Kong, South Korea and Taiwan). In Taiwan, many Taiwanese parents send their children to language cram schools to learn English in order to get a competitive educational advantage. Most of the teachers at cram schools use their own teaching materials. Some teachers are emphasized their textbooks are very effective. Many cram schools treated English as a formal learning subject and mainly focusing on reviewing school textbooks therefore students had no time to practice communicating each other with English (Su, 2011). Promising development is that some of the supplementary tutoring program at cram schools have recently employed social network as the communication and teaching platform (Suchiao and Yachin, 2012).

5. METHODS

An experiment was done to examine the effects of Facebook-facilitated English tutoring. The instructional context was a series of home assignments for an after-class remediation program in which activities requiring peer-to-peer and teacher-to-peer communications via Facebook were designed. Experimental subjects were divided into Facebook communication group and traditional classroom group. After the experiment, a learning motivation questionnaire and an achievement test were given to collect data. The research questions were as follows:

1. What are the effects of Facebook-facilitated tutoring on student's learning motivation?
2. What are the effects of Facebook-facilitated tutoring on student's learning achievement?
3. How do the students learn with the Facebook?

5.1 Subjects

Subjects were 60 elementary school children in an English supplementary tutoring program in Taipei City of Taiwan. They were under age from 9 to 12 and were randomly assign to the experimental group (Facebook-facilitated group) and control group (traditional classroom teaching group). Before the experiment, subjects in the experimental group all had Internet connection at home. The experiment lasted for 6 weeks.

5.2 The Instructional Design

A six-week instructional material was designed with two major emphases: vocabulary and grammar. The same material was applied for both experimental group and control group. Each week, an independent topic was taught with a variety of instructional strategies including discussions, explorations, and information searching/sharing. The experimental activities were executed upon the reinforcement section, in which the fallible parts of the material were reviewed. For the experimental group, Facebook was used as the communication platform in which students discussing and collaborating to achieve reinforcement learning tasks, as well as sharing each own resource with other participants. For the control group, traditional drill and practices, group discussions, questions and answers were performed in the classroom. The major difference between the two groups was that for the control group, there was no Internet activity involved. Table 1 describes the experimental process for each group and Figure 1 displays the sample Facebook learning screen.

Table 1. Learning activities

Activity	Experimental group (via Facebook)	Control Group (in classroom)
Communication	Teacher-student dialog Student-student dialog	Teacher's lecture Students raise questions
Collaboration	Teacher announce discussion topics Student online discussions	Teacher announce discussion topics Students discussions in groups
Sharing resource	Student uploading assignment Teacher/student feedback	Teacher hand out remediation material

Figure 1. Sample Facebook learning screen

5.3 The Research Instrument

In order to collect data for statistical analyses, two major instruments- a learning motivation questionnaire and an English achievement test were designed.

5.3.1 Learning Motivation Questionnaire

The questionnaire was developed based on keller's (1983) IMMS (Instructional Material Motivational Survey) and Pintrich's (1989) MSLQ (Motivated Strategies for Learning Questionnaire). It has two factors and six phases. The following table displays these factors and phases in detail.

Table 2. Content of learning motivation questionnaire

Factor	Phase	Sample question
Personal (Internal)	Interest of learning	I feel interest in learning English
	Professional development	I can spell more words and use correct grammar
	Problem-solving	I can solve the problem that teacher raised
Environmental (External)	Social learning	I like to share my information with others
	Web learning	I like to find answers from the Internet
	Self-paced learning	I like to learn with my own pace

The questionnaire was consulted with two elementary school English teachers. Modifications were made as evaluator's suggestions. The revised questionnaire was then given to 30 students who did not attend the experiment to ensure the reliability. The overall reliability for the personal factor was .758 and environmental factor was .761. These reliabilities were considered to be fairly acceptable.

5.3.2 English Learning Achievement Test

According to the instructional design, student's learning achievements on vocabulary and grammar were tested. The test consists of spelling, fill-in-blank, and short-answer type of questions. The test was given to the same 30 students to verify the reliability. The result was that the overall reliability of the test was .729, indicating the test had very good reliability.

6. RESULTS

This study employed a single-test true experiment. Subjects were randomly assigned to experimental and control group. The experimental context was in a cram school in Taipei City of Taiwan in which supplementary tutoring was provided to enhance regular school education. 30 students were assigned to each group. The experimental group utilized Facebook as virtual communication, collaboration, and sharing platform, while the control group performed the similar instructional activities in a traditional classroom. The instructional materials were designed for remediation and practice. A learning motivation questionnaire and an achievement test were given after 6 weeks of experiment. Following sections discuss the results of the data analyses.

6.1 Facebook Effects Regarding Student's Learning Motivation

Motivational data were collected by the learning motivation questionnaire. Learning motivation divided into two categories: personal (internal) motivation and environmental (external) motivation. A dependent t-test was performed to examine the difference between these two categories. A significant difference was found (t=4.53, p<.001) in the experimental group, looking up the descriptive data, we concluded that external motivation was higher than internal motivation for the experimental group**.** Facebook tutoring has more effect for external (environment) motivation. Table 3 displays the result of the t-test.

Table 3. T-test of internal and external motivation

	n	Mean	SD	*t*	*p*
Internal motivation	30	3.87	.35	4.53**	.003
External motivation	30	4.11	.72		

P<0.01**

Pearson product moment correlation coefficient process was performed to examine the relationship between learning motivation and learning achievement. A significant correlation was found between external (environmental) motivation and learning achievement (r=.25, p<.05). However, there was no correlation between internal (personal) motivation and learning achievement. Table 4 displays the result of the correlational test.

Table 4. Correlational test for learning motivation and achievement

	n	Pearson *r*	*p*
Internal motivation	30	,15	.21
External motivation	30	.25*	.04

P<0.05*

6.2 Facebook Effects Regarding Student's Learning Achievement

According to the instructional design, the test was examining student's achievement on vocabulary and grammar. First of all, an independent t-test was performed for the experimental and control group to examine the overall effect of Facebook tutoring, that is, the total score of the two categories (vocabulary and grammar) was employed. The result indicated that there was a significant difference between the two groups (t=2.56, p<.05) in terms of the overall learning achievement. This result indicated that Facebook tutoring had significant effect for overall learning achievement. Table 5 displays the result of the t-test.

Table 5. T-test of learning achievement

	n	Mean	SD	*t*	*p*
Experimental group	30	88.50	7.32	2.46*	.017
Control group	30	83.83	7.36		

P<0.05*

We further looked up the achievement in the two categories. For the category of vocabulary, significant result was also found in the independent test (t=2.91, p<.01). For the category of grammar, however, the effect of Facebook tutoring was not significant (t=.374, p=.71). This finding is interesting. We believe that vocabulary is easier to learn and remember than that of grammar, due to the fact that major difference in lingual expressions between Chinese and English does exist. It is hard to learn English times for most of the children in Taiwan. The specific reasons for the non-significant of the grammar learning may need further investigations. Table 6 and table 7 display the result of the t-tests.

Table 6. T-test of learning achievement on vocabulary

	n	Mean	SD	*t*	*p*
Experimental group	30	36.25	4.55	2.91**	.005
Control group	30	32.16	6.18		

P<0.01*

Table 7. T-test of learning achievement on grammar

	n	Mean	SD	*t*	*p*
Experimental group	30	52.25	6.44	.37	.71
Control group	30	51.66	5.62		

6.3 How did Student Learn with Facebook

During the experiment, the instructor conducted a reflexive log in which his observations and reflections of student's learning conditions were recorded. We summarized the important notions in this reflexive log in the following sections.

6.3.1 Learning Motivation

We found that there was a gain in learning motivation for the experimental group. With compare to the control group, the students learned with Facebook exhibited more positive attitude and performed more peer interactions. Students seemed to prefer more to discuss the questions on Facebook than in the classroom. Some of the "quiet" students in the class demonstrated high interest in replying questions and argue with peers on Facebook. We believe some students who usually hesitate to express their thought face-to-face may have more intention to communicate with others in a virtual environment.

6.3.2 Learning Activities

Multiple activities (communication, collaboration, resource sharing) were designed as the instructional strategies. Students in either groups felt such activities were interesting. The interactions among peers were tremendously increased. We believe that both groups were benefitted from this multiple learning activities, especially for the experimental group, students experienced learning in a virtual environment. The Facebook provided a more private, more flexible, and more adaptive environment that made the students gain better achievement.

6.3.3 Learning Style

Student's learning style was changed for both groups. Students needed to prepare what to discuss and how to answer the questions raised either by teachers or peers. Students felt they were participants during the learning process rather than listeners. For the experimental group, student's messages posted on Facebook could be seem simultaneously by all class members. Therefore they needed to be more careful to avoid possible mistakes. They also experienced how to review instructional information more cautiously.

7. CONCLUSION

This study intended to explore the effect of Facebook tutoring for learning English as a second language. The children participated the Facebook tutoring generally exhibited a positive attitude toward this new type of learning experience. The learning achievement for the Facebook group was also significantly higher than the control group.

Specific findings regarding learning attitude suggest that for Facebook tutoring, student's external (environmental) motivation was higher than internal (personal) motivation. Further exploration on the relationship between learning motivation and learning achievement also showed that external motivation was highly correlated with the learning achievement. These phenomena may represent that Facebook did provide a flexible environment for students to communicate, collaborate, and share. Positive results were also found in learning achievement. There was a significant difference for learning achievement between Facebook tutoring and traditional classroom teaching. However, there was no difference on grammatical achievement. We suspected that with compare to Chinese, English grammar has major differences in lingual expressions. Further investigations are necessary to develop proper strategies that may help learn English grammar on Facebook.

In summary, Facebook provides the unique functions that facilitate teachers to develop activities incorporating communicating, collaborating, and sharing strategies. These strategies are considered to be effective in learning with social network. This study evidenced that providing with proper strategies, both student's learning attitude and learning achievement were positively affected by the Facebook tutoring.

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AN ITALIAN EXPERIENCE OF SOCIAL LEARNING AT HIGH SCHOOL

Michelle Pieri, Davide Diamantini and Germano Paini
Università degli Studi di Milano-Bicocca, Piazza dell'Ateneo Nuovo, 1, 20126 Milano, Italia

ABSTRACT

This work focuses on an experience of social learning realized in six high schools in Bari (a city in southern Italy) in the 2012-2013 Academic year. In this experience we used ThinkTag Smart, a new learning platform, to train 400 students. After an introduction concerning Information and Communication Technologies in the Italian school, this contribution will describe the ThinkTag Smart platform and will also focus on the experience in Bari, underlining special aspects connected to social construction of knowledge.

KEYWORDS

Social learning, Web 2.0, Platform, Italy, High School, Case Study.

1. INTRODUCTION

One of the most prominent features of contemporary schools is that students are born and raised within a context which takes the existence of Information and Communication Technologies (ICTs) and the Internet for granted and considers them as "natural". They have been diversely labeled: iGeneration, Generation Y, native speakers, digital natives (the opposite to digital immigrants), Generation Me (Twenge, 2006), Millennial Generation (Howe and Strauss, 2003) and Net Generation or Net Gens (Oblinger and Oblinger, 2005). Regardless of the name, this generation is composed of students born between approximately 1980 through 2000 (Sutherland and Thompson, 2001; Howe and Strauss, 2003). As Diana and Jim Oblinger (2005) point out, "as long as they've been alive, the world has been a connected place, and more than any preceding generation they have seized on the potential of networked media".

In Italy despite the programs implemented by the Ministry of Education, ICTs are coming very slowly into the school. Italy is clearly a "two speed" country: from one side widespread computer illiteracy and on the other side a country with the second place in Europe for the possession of mobile phones, with children, the Net Gens, who govern and control the technological tools better than their parents and teachers, who are not always able to exercise adequate control for their proper use (Movimento Difesa del Cittadino, 2007; Pieri, 2008; Pieri and Diamantini, 2010) or to use them in the learning process (Pieri, 2012). In the national study on Digital Schooling (Avvisati et al., 2013) presented to the Ministry of Education in Rome it clearly emerges that regarding the use of technology in schools we are "late compared to most other countries: in 2011 only 30% of Italian students in their third year of middle school used ICTs as a learning tool during science lessons, compared to an average of 48% in other countries of the OCSE". In elementary schools on average there is one computer for every 15 children: approximately one per class. There is one PC for every 11 students in middle school and one for every 8 students in high school. One classroom out of five in Italian schools has an interactive multimedia blackboard, Lim. Eight schools out of ten have internet connections, but only have of the classrooms have access to the web. According to OCSE, the Italian project for the Digital School which was launched by the MIUR (Ministry of Education, University and Research) in 2007 had too few resources "that limited the effectiveness of its initiatives. Above all, the report shows that the lack of resources, more than a lack of interest on the part of schools and teachers, is the reason why the presence of technology is still very low in the classroom." OCSE reports that for multimedia and ICT "30 million Euro per year for four years was allocated for the project or less than 0.1% of public expenditure for education, which is less than 5 Euros a year per student in primary and secondary schools".

In this contribution we will present an experience of social learning, as the last frontier of learning supported by ICTs, in an Italian high school realized in the 2012/2013 academic year. With the term e-learning 2.0 we refer to a type of computer-supported collaborative learning (CSCL) (Stahl and Hesse, 2009) system that developed with the advent of the Web 2.0 (Kerrer, 2006). From an e-learning 2.0 perspective, conventional e-learning systems were based on instructional packets, which were delivered to students using assignments. Assignments were evaluated by the teacher. In contrast, the new e-learning places increased emphasis on social learning and the use of social software such as blogs, wikis, podcasts and virtual worlds (Redecker, 2009). Social learning, assumes that knowledge (as meaning and understanding) is socially constructed. Learning takes place through conversations about content and grounded interaction about problems and actions (Brown and Adler, 2008). In addition to virtual classroom environments, social networks have become an important part of e-learning 2.0. As underlined by Sie (2012) “e-Learning 2.0, is social learning through and through”. One of the most important features of e-learning 2.0 is social learning, which assumes that the best way to learn something is to teach it to the others (Bonfils, Pieri and Dumas, 2010; Pieri, Diamantini and Bonfils, 2011). The prosperity of social networking sites has met this demand. Open source social networking software has made it possible to create social networking sites with only a little effort (Ben and Chi, 2011).

2. THINKTAG SMART: A SOCIAL LEARNING TOOL AND METHODOLOGY

ThinkTag Smart, the learning platform focus of this paper, was designed to aggregate the power of Web 2.0 with those of the social networks.

The ThinkTag Smart platform, created in 2005 by the Goaling enterprise, is a quick and simple way to archive, organize, link and discuss information such as websites, articles, documents, books, movies and music. This platform mixes the learning opportunities offered by the Web 2.0 with the learning opportunities offered by social networks. This platform is a tool to support users to combine the requirements of knowledge management and the opportunities of social networks to share, build and spread knowledge and information. ThinkTag Smart is a place for sharing knowledge, organizing contents, comparing different kinds of knowledge and supporting collaborative work.

The main characteristic of ThinkTag Smart is the “hyperpertinence”, different from the “ipertinence” coined by sociologist Derrick de Kerckhove to signify the particular property of the search engines of the latest generation to be able to return, in the face of a question (query), multiple answers that pertain to it, at different levels, both of language (i.e. texts, images, videos) and content, in short, whatever has been uploaded to the network and entertains a relationship with that query. The hyperpertinence makes this platform different from social networks and search engines. The main social networks in fact, focus on the relationship between people, do not have systems for structuring and organizing contents with one or a few materials, thus they are irrelevant with respect to our needs for managing information. The search engines are able to reconstruct the networks of citations, but they are nothing more than the result of mere algorithmic processing. In fact, the results we get from search engines like Google are the result of an algorithm that can attribute more importance to the more "linked" pages, which in this way acquire a high ranking.

The ThinkTag Smart platform is able to aggregate the richness of the network with the social construction of meaning. This is possible because each resource present on the platform must be necessarily accompanied by at least a title and one or more tags. The network environment is in fact “hyper”, meaning that the amount of resources that can be identified through it is beyond our means of fruition/management. At the same time the net is approximate, uncoordinated and often irrelevant and brings to an "information overload". This indicates that the more information you have, the more information you must have in order to manage. To avoid “information overload” and “confusion”, every resource in the platform must have a title and one or more “tags”. These tags are carried by all the users. In ThinkTag Smart the construction of meaning and the organization of resources is self-determined and bottom up.

As time goes by, the resource cumulates the tags of all the users; this means that the more ideas exchanged on a subject the more tags we will have on that subject. This artifact is used by other social networks, and is named "tag cloud". The tag cloud is used to reconstruct a visual map of the tags used by users or the main tags used. In the tag cloud each tag is a link to the resources that use that word and appears in different sizes depending on the frequency of use, so the tags displayed in large characters are among the ones most used by users.

In addition to the standard tag cloud, ThinkTag Smart has developed an innovative feature called “hyperpertinent tag cloud” that provides users with a graphical output that can display not only the occurrence of the different tags but also the relationships between the different tags. Starting from an initial tag (identified through the search engine or by clicking on a tag of a resource) the user gets a new cloud that shows (with different sizes) all the tags used by the users along with the initial tag. With the hyperpertinent tag cloud, it is possible to reconstruct the network of relationships emerging between the resources reported by users on a particular subject.

It is important to underline that the tag will not be made by leaders or by experts, but by all the users. The construction of meaning and the organization of resources are then from below; it is self-determined and follows the bottom up logic. This is certainly a source of added value, in that it allows to read the same resource from different points of view; in this way knowledge is not flat, but is a prism.

The main elements of ThinkTag Smart are:

- RESOURCES: any type of document or material produced by users or derived from the productivity of others, which users decide to share (ThinkTag Smart can handle more than fifty different types of resources).
- SHELVES: containers can be used as a virtual file. The shelves allow to bring together a range of resources that are considered relevant or related to a unique concept. The shelf is born as individual/personal and only the person who created it can modify it and add content to it, even if everyone can see it.
- COLLECTIONS: follow the same logic of the shelf, but they are not personal but of the group, all members of the group can add and edit content.
- CONNECTIONS: tie a content to another content without putting them in the same "container".
- GROUPS: group of people, collaborative community with a common goal to work on. Administrators have the possibility to edit the group settings, manage members and in general to change several aspects of the group, the members however, participate in the "life of the group," but without having the possibility to handle it.

All in all, we can compare ThinkTag Smart to a bottom-up process, where the initiatives, the materials, the creation of groups and the sharing of knowledge are derived from the spontaneous initiative of users surfing the web following their own personal interests. The main objective of this approach is to make explicit, and therefore more accessible, the tacit and implicit knowledge that every user has. The users sharing opinions and knowledge enrich their own personal baggage, automatically helping to enrich and update the knowledge of the network of users connected to them.

Thanks to the tags and the connections between resources, users can organize the knowledge collected, interpreting, refining and assembling it in an appropriate way for re-use. The platform instantly processes a map that graphically depicts the connections created between resources related to the same topic, in order to provide an overall clear and immediate picture of the network. The set of resources, with their labels, in this way becomes a dynamic and ever-changing system of relationships between objects.

With the use of tags we are witnessing a change in the classification of documents: the "taxonomies" (the so-called "folksonomies"): users can assign semantic labels to documents to facilitate classification and research. To assign labels users must put themselves in the shoes of others, thinking about the words that other people would use to find the resources connected to the specific topic.

Another important aspect of knowledge management is the ability to use the knowledge generated to create new knowledge. The premise of this activity is the internalization of exchanged knowledge, to take possession of new thought patterns that are applicable to daily and professional life. Even wikis support collaborative learning by allowing users to create shared documents so that everyone can intervene by modifying and adding parts quickly and easily. In conclusion, this kind of platform offers tools and opportunities for the kind of activities (school, work and personal) which require a broadening of perspectives in a social perspective. The users, by sharing and comparing, will evolve while enriching themselves (creating new knowledge) and others (sharing).

Regarding the safety of the platform, this platform is dedicated only to schools, and though it is available on the internet it does not provide access to users who are not part of the project. All students were able to have only one account corresponding to their first and last name. Users with different nicknames were not accepted, when different nicknames were created by some students they were canceled without informing the user. Constant monitoring of the platform identified some (few) enrollments made by external users (in some cases teachers who were accepted, in other cases unknown users who were blocked/refused). Apart from the

enrollments to the platform, the main issue is the access to groups and the possibility to add resources for the groups. The task of managing the groups was entrusted to teachers and students who wanted to take on this responsibility. The author of the resource assumes responsibility for what he publishes, while the administrators of the group in addition to deciding who joins the group can also decide whether resources to be published should be subjected to a preliminary assessment within the group. Following the issue of crowdsourced content validation, the contents developed and proposed were consistently evaluated by the community. The platform was continuously monitored, and there were no cases of problematic content. Just a few cases of generally offensive comments were reported, but thanks to the incisive and rapid intervention of some users, we decided not to remove the comments.

3. CASE STUDY: "SOCIAL LEARNING LABS FOR SMART LEARNING COMMUNITIES"

This experience, realized in the 2012/2013 academic year in six high schools of Bari (a city in southern Italy), involved 18 classes, 400 students and 50 teachers. In December 2012 we held the training of teachers (about the methodological aspects and about the use of the platform); in January 2013 we started the activities with the students.

The project applied the methodologies and instruments of the web 2.0, directly involving the students and teachers in the creation, search, management and organization of suitable contents in order to structure 18 learning areas (i.e. "The theatre: the spaces, the words, the experiences over time"; "The revolutions of the 1700s"; "Adolescents and alcohol").

The activities began in January 2013 and continued until the end of April, involving teachers and students in the construction of contents for the various subjects – literature, social sciences, history, geography, art, math, natural science, foreign languages and literature (English, French, Spanish and German), artistic and creative arguments – as part of the project in the creation of 54 groups using over 3,800 resources, more than 800 shelves and 100 collections, with countless connections among resources in a constant and significant activity of interaction.

During the learning path the creation of resources had a constant progression over time with the development of the didactic activity (Figure 1). Regarding the creation of the shelves there is a regular trend, with an increment corresponding to the need to organize contents and information that was acquired and used in the project during the last three weeks (Figure 2). Regarding the collections, which are an instrument for organization shared inside groups, their use was seen after the first month of work and constantly grew, which confirms the acquisition of a shared and active work style inside the groups (Figure 3). Regarding the connections, which represent the organization of the contents in a network, it became more intense in the last month of the project (Figure 4). This confirms the acquisition of the value of this tool for handling the multiplicity and variety of the contents. Finally, regarding the groups, after an intense development in the first phase (in the first week) to create project communities, the situation stabilized with the creation of a few communities focused on specific topics which emerged during the project (Figure 5).

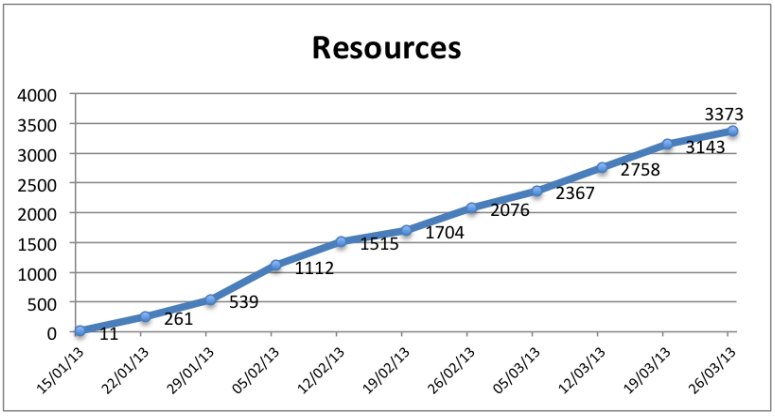

Figure 1. Resources

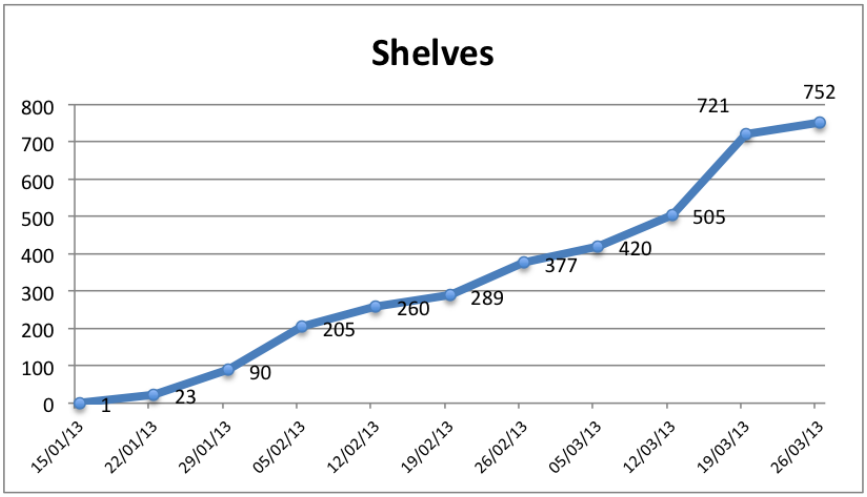

Figure 2. Shelves

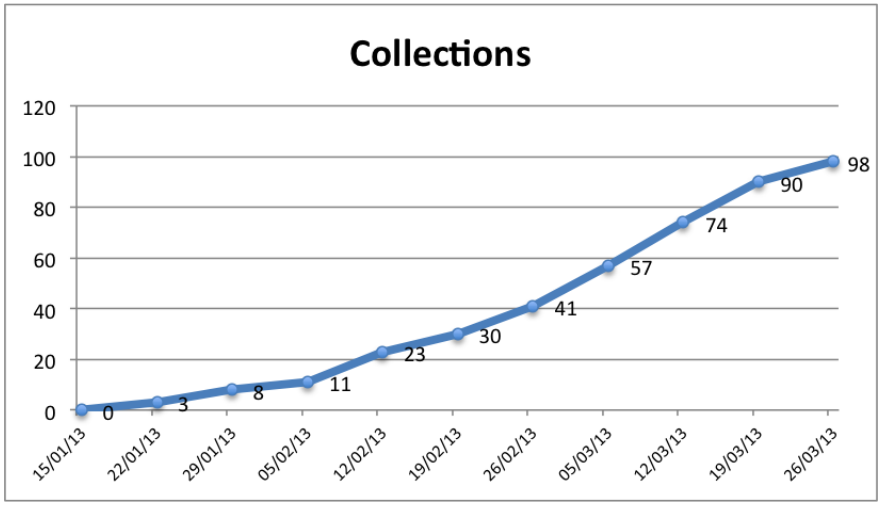

Figure 3. Collections

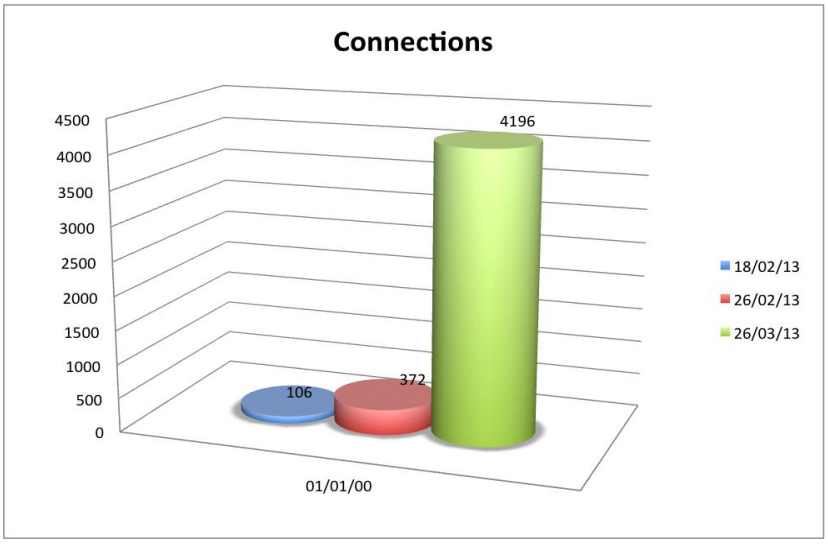

Figure 4. Number of connections

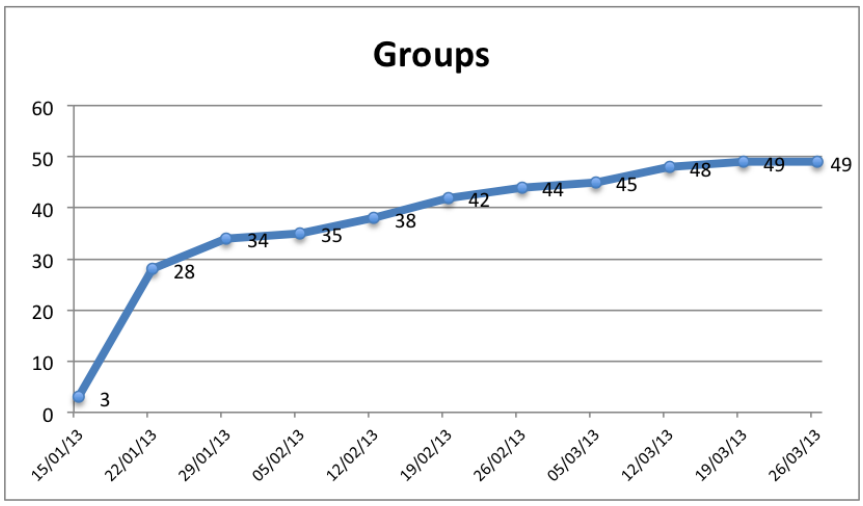

Figure 5. Groups

A distinguishing feature of the learning process was the identification of a tutor among the members of the "project group" of the community. The tutor is a student, who gives advice and indicates corrections that need to be made.

The specific modality given by the platform, which is the real method of social learning, has helped some students to overcome difficulties in their social relationships and in communications, taking on a new role with the possibility to construct new relationships inside the group they belong to.

The use of "comments" was transversal and involved most of the users:

- the teachers used it to support activities, to offer suggestions, work strategies, corrections or areas to focus on
- the students used it to indicate how they used the platform, to suggest ideas to work on and for their opinions on contents.

A distinguishing and particular feature Smart platform to evaluate contents negatively or positively. As can be seen in the chart "Reputation score", 55.1% of the participants significantly increased their reputation (from 10 to 100 or more points, specifically 34% of the experience was the use that was made of the possibility given by the ThinkTag Smart with more than 200 points) (Figure 6).

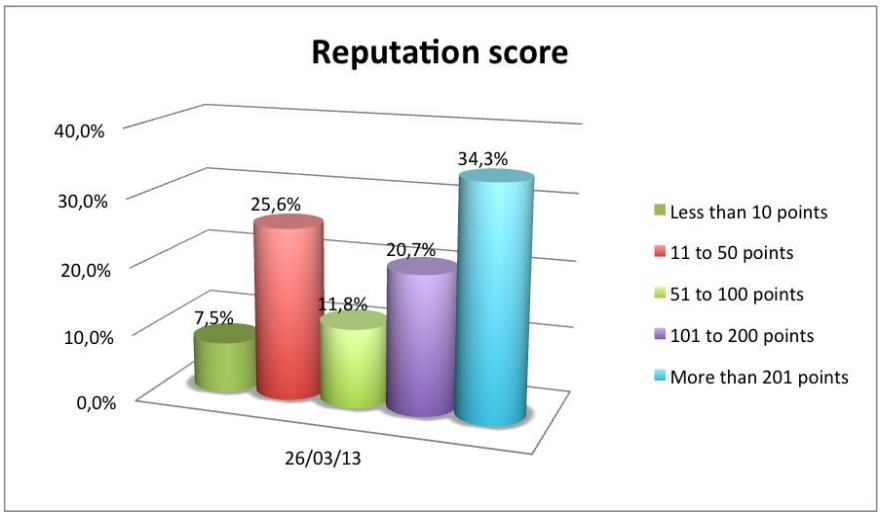

Figure 6. Reputation score

4. CONCLUSIONS

In this experience students were guided to: actively participate in the different communities; not search only for learning models that were delivered; construct together the course contents and materials based on the lessons and follow up activities; organize their own learning path; participate in the shared assessment of the contents and materials; organize their own materials in a useful way during the whole learning process; identify their approach to the complexity of the knowledge and of the learning. The project obtained the following results: activation and involvement of the students in the "construction" of their learning path, availability of an explicit body of knowledge to use in the different courses and availability of a network of knowledge for the development of interdisciplinary approaches to educational fields.

As reported by a student "When I enrolled on this platform, honestly I was not very enthusiastic, but then during the course, learning new things, being together with friends and teachers, I liked it a lot. I believe that by working on the computer, using the technology we learn better, and it is much more fun and easier. The great thing about this platform is that you can also add different resources, such as: images, texts, pictures etc. ... I mean, maybe even in the future we will use this method, because it's really helpful". Another student underlines that "This platform proved to be especially useful for my work, my reports, my comments, and my careful selection of resources on the network, none of this has remained confined within the four walls of my classroom, but in fact it was appreciated and judged by other people, so that maybe my resources have proved useful for the study of some of the content or for a more in-depth review of the assignment. In a certain sense, through ThinkTag Smart I also able to express myself more". In conclusion, with the words of one of the teachers who participated in the experience, <<a student, who really worked hard said: "Professor, I have worked on many projects in this school: I took a course on Public Law at the Faculty of Law in Bari with a final exam, I went to Rome to present a project to the BCE, but this project has been the most difficult one." I asked him to explain why and he answered: "it was very complex; there were too many connections to remember which then needed to be clarified and then carried over into our work in a simpler format in order to make them clear for the students using the e-book. It was a real brain-teaser." I asked him: "But in the end you did it, right?" He answered simply: "Yes." "Then", I told him, "you reached the objectives that this activity aimed to have you reach: learn how to manage the complexity of the knowledge of the overall picture and to see the connections in order to make critically aware choices. Outside school there isn't the reality of math, business economics, or law. There is reality and stop, knowing how to discern the various aspects and how to work in a relevant way is a competence which is acquired with hard work that you yourself experienced." Your smile of satisfaction that you gave us coming out of the lab made up for the immense work that we did all together in order to reach this small result, a drop in an immense sea of things to do in school.>>.

In the Italian context, and not only, experiences of this kind can contribute in an important way to:

- sustain the switch to digital in schools, trying to bridge the digital divide which is still strong among teachers and students, the Net Gens
- update schools to the ongoing transformations
- support the "educational reconversion" of the new social media and social networking
- reconnect the break between the cognitive experience of students and the school
- overcome the current logic of schools
- directly involve students in the creation, management and organization of contents to create greater awareness and administration of what is learned
- give value to interaction and collaboration
- give methodologies and instruments to administer informal learning integrated with formal learning
- produce digital contents using a bottom up process.

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DISTANCE EDUCATION: EDUCATIONAL TRAJECTORY CONTROL

Andrey Isaev, Alla Kravets, Ludmila Isaeva and Sergey Fomenkov
Volgograd State Technical University,
Volgograd, Russia

ABSTRACT

Distance education has become a rather popular form of education recently. The advantages of this form are obvious and well-known. They include asynchronous learning, individualized learning trajectories and convenient case technologies. However, the distance form of education is not able to form the trainee's hands-on experience, especially concerning the complicated technological equipment. Besides, it cannot form one's personal communication skills of working in the team. That's why many distance teaching programs include synchronous teaching elements. The difference in the students' achievements creates a lot of problems in the organization of educational groups. The principle of dynamic study group forming for a short-term synchronous teaching is proposed by the author as a way of solving such problems.

KEYWORDS

Distance learning, individualized educational trajectory, educational process control.

1. INTRODUCTION

The development of modern e-learning platforms (Cecilia Rossignoli et al, 2013; Margot McNeill et al, 2010) and electronic search and processing marked the highest priority of distance learning. The problem of new effective pedagogical technologies development has been paid a lot of attention to recently. Researchers (Dr. Ajay Kumar Attri, 2012; Said Hadjerrouit, 2013) propose methods, strategies and technologies of the distance learning. Further research into course development techniques will help educational institutions understand which methods work best in the distance teaching.

2. DISTANCE EDUCATION: EDUCATIONAL TRAJECTORY INDIVIDUALIZATION

Extra-mural education is the closest in its form to distance education in the Russian higher education system. The peculiarity of this education form is the integration of asynchronous teaching and synchronous final control. The curriculum is formed in the following way (Fig. 1): the first one or two weeks are dedicated to the students' starting acquaintance with the curriculum contents, the study, as a rule, being organized in the mode of synchronous teaching. The future student's training is realized in asynchronous teaching form and presupposes the student's individual work with the published sources, recommended Internet resources and the information of the case provided. At the end of the course the student is to fulfill practical tasks and laboratory practice in synchronous teaching mode. The course is completed with final examination (Titova O.V. and Kravets A.G., 2013).

Such organization of educational process is realized in Eurasian Open Institute, London School of Business and Finance (LSBF), National University (USA), National University – UNED (Spain) and other systems of open education. Nevertheless, it should be taken into consideration that the efficiency of students' achievements in the distance teaching mode depends on their self-organizational ability and effective system of inner motivation to a great extent [1].

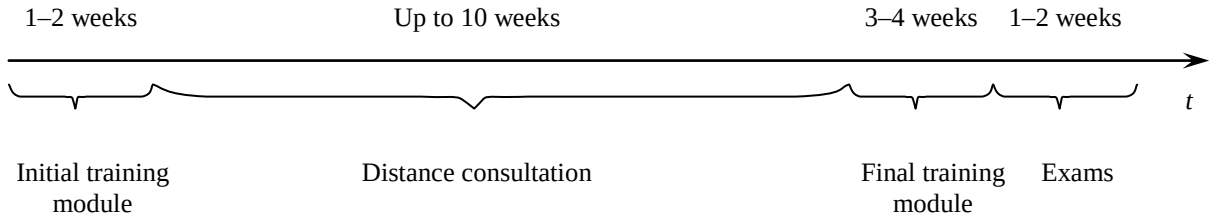

Figure 1. Time portrait (initial) of the distance education process structure

According to the inertial subject concept, proposed by us, the process of mastering the curriculum by the student is nonlinear (Fig. 2) and consists of the parts represented one after another [2, 3]:

AB – student's interest development (mastering the means used in the particular field of knowledge);

BC – information component widening (the set of tasks solved with the mastered means);

CD – elaborating the techniques and methods of specialized information processing;

DE – optimizing the ways of information storage (knowledge transformation onto personal level);

EF – new specialized means development.

On the diagram (Fig. 2) the value of *Z* characterizes the student's real achievements level, quantitatively determined as

$$Z = \sum_{i=1}^{n} k_i R_i ,$$

where k_i is the vector of the weight coefficients determining the significance of this or that competence in the professional portrait of the graduate, R_i is the rating grades vector determining the level of mastering the competence.

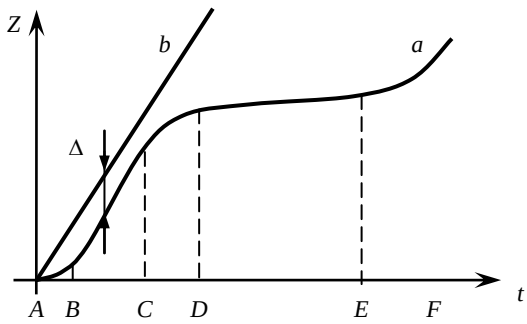

Figure 2. Individualized educational trajectory

In a number of works we substantiate that the necessary condition of forming the student's stable motivation is creating the range of acceptable deviations Δ_Z of one's real educational trajectory (Fig. 2 line *a*) from the defined one (Fig. 2 curve *b*). Δ_Z range narrowing to the level lower than acceptable one results in student's overestimated self-appraisal forming and, therefore, lowering the level of further studies motivation. Vice versa, Δ_Z range widening forms the feeling of apathy because the student understands his or her inability to achieve the result.

On the basis of these developments the distance education management system was created by the author, its pilot project being realized in Svetly Yar branch of Moscow State University of Technologies and Management named after K.G. Razumovsky. Its main characteristic feature is distributing the time resource for synchronous teaching realization inside the interval of students' distance consulting. As the educational process is inertial, this distribution is nonlinear: the greatest intensity of synchronous education periods is displaced to the beginning of teaching. Such educational process structure allows the students to master the means used in the educational course in the most effective way. These means include terminology (concepts and definitions), methods and algorithms of data processing and work with specialized IT contents.

The following algorithm serves as the basis of this system:

1. Developing the individualized task according to the curriculum. The task consists of a number of smaller tasks to be solved by the student one after another, the results being the source data for the final task according to the curriculum.

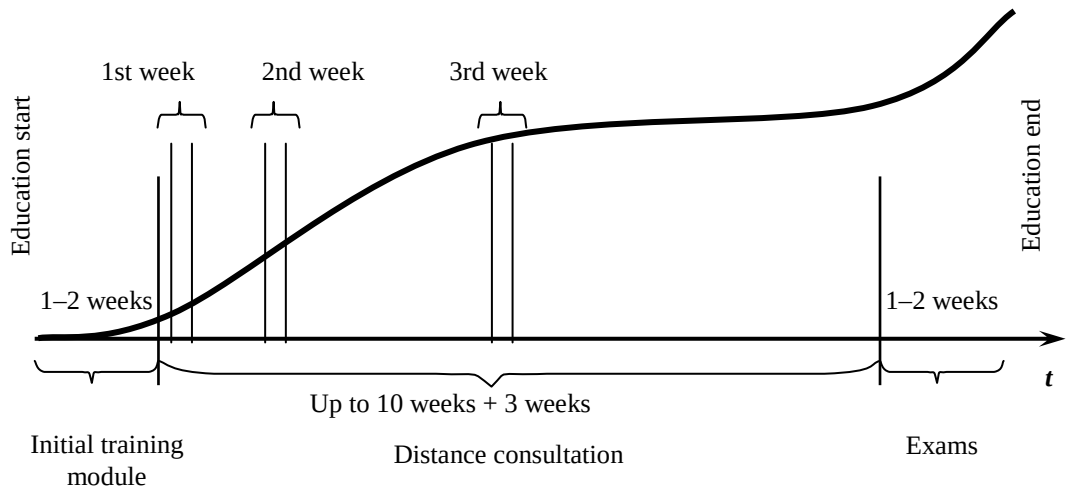

Figure 3. Time portrait of the distance education process structure proposed

2. The whole time interval that the student has for individual work is divided into small time parts with control reports. Such reports are carried out either in the off-line/on-line mode of testing or on-line interview.
3. According to testing results it is decided if additional consultations are necessary, the subject, volume and form being taken into consideration.
4. Study groups are formed for short-term synchronous teaching. The aim of this teaching is developing students' professional competences necessary when operating real equipment.
5. The organization of students' final control.

It should be stressed that the study groups' structure was not strictly defined and the groups were formed according to the intermediate control of all the students in parallel groups.

3. TESTING THE PROPOSED EDUCATIONAL PROCESS STRUCTURE

To check the efficiency of the proposed teaching process two groups were formed: the students' experimental group *A* (36 people) and control group *B* (38 people). The groups consisted of the extra-mural students in Svetly Yar branch of Moscow State University of Technologies and Management named after K.G. Razumovsky.

The analysis of group participants' competence level is represented in two stages, fixing and transformational ones. On the first fixing stage the comparability analysis of two students' groups (*A* and *B*) was carried out as for the difference of their starting level achievements. According to the results of the starting testing, students were divided into three subgroups characterized by low, intermediate and advanced levels of students' starting achievements.

Table 1. Groups qualitative analysis according to academic achievements (according to the starting control results)

No.	Number	Formula	Assessment criterion		
			Low level	Intermediate level	Advanced level
For group A (experimental)					
1	Students total, people	N	36		
2	Absolute number, people	N_A	20	11	5
3	Relative number, %	$\delta = \frac{N_A}{N} \cdot 100\%$	55.6	30.6	13.9
For group B (control)					
1	Students total, people	N	38		
2	Absolute number, people	N_B	25	10	3
3	Relative number, %	$\delta = \frac{N_B}{N} \cdot 100\%$	65.8	26.3	7.9

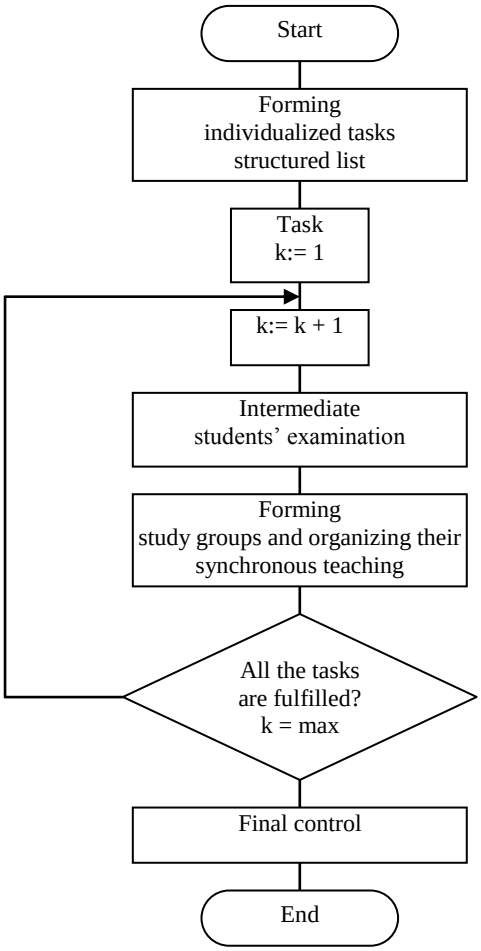

Figure 4. Teaching process algorithm in distance education

Let us establish the characteristics matching or difference in the experimental and control groups. For this purpose let us propose statistical hypotheses:

– the hypothesis of differences absence (a null hypothesis);
– the hypothesis of differences significance (an alternative hypothesis).

Statistical tests are used to decide which hypothesis should be accepted. In our research Welch's *t*-test is used for testing the hypothesis concerning the characteristics matching in two groups [4]. The value, which is called the observed test value, is calculated on the basis of observation results. This value is compared with the known reference value specified in the tables, which is called the critical test value. In pedagogical researches the value of 0.05 is usually the limit that means the possibility of an acceptable mistake being less than 5%.

If the observed test value obtained proves to be less than the critical one or equal to it, the null hypothesis is accepted: the control and experimental groups' characteristics match. Alternatively, if the observed test value proves to be strictly higher than the critical one, the null hypothesis is declined and the alternative hypothesis is accepted: experimental and control groups' characteristics are considered different, the difference validity being 0.95 or 95%.

The observed value of Welch's *t*-test is calculated according to the following formula $T = \frac{\sqrt{M \cdot N} \quad \left|\bar{x} - \bar{y}\right|}{\sqrt{M \cdot D_x + N \cdot D_y}}$, where N, M – sample sizes of x and y, $\bar{x}, \bar{y}$ – sample means, D_x, D_y – sample variances.

To calculate the main characteristics the following formulae were used:

$\bar{x}(\bar{y}) = \frac{1}{N}(k_1 x_1 + k_2 x_2 + \ldots + k_N x_N)$, where k_i – weight significance coefficients,

$D_x(D_y) = \frac{1}{N-1}\sum_{i=1}^{N}(x_i - \bar{x})^2$.

Students' experimental group *A*

Sample mean: $\bar{x} = \frac{1}{36}(20 \cdot 1 + 11 \cdot 2 + 5 \cdot 3) = 1.58 \cdot$

Sample variance: $D_x = \frac{1}{36-1}\left[20(1-1.58)^2 + 11(2-1.58)^2 + 5(3-1.58)^2\right] = 0.54 \cdot$

Students' control group *B*

Sample mean: $\bar{y} = \frac{1}{38}(25 \cdot 1 + 10 \cdot 2 + 3 \cdot 3) = 1.42 \cdot$

Sample variance: $D_y = \frac{1}{38-1}\left[25(1-1.58)^2 + 10(2-1.58)^2 + 3(3-1.58)^2\right] = 0.41 \cdot$

The observed value of Welch's *t*-test: $T = \frac{\sqrt{36 \cdot 38}\left|1.58 - 1.42\right|}{\sqrt{36 \cdot 0.54 + 38 \cdot 0.41}} = 1.02 \cdot$

Hence $T = 1.02 \quad < 1.96$. Therefore, the hypothesis of control and experimental groups' characteristics matching before the beginning of the experiment is accepted on the significance level of 95%.

4. THE EXPERIMENT RESULTS EVALUATION

The educational process for control group *B* did not undergo any changes either in the teaching course structure or in the principle of study groups' forming.

For group *A* the time resource at the end of the educational course for synchronous teaching realization was divided into smaller time intervals that were evenly distributed in the time range for individual work. Subgroups of group *A* students were formed for carrying out short-term teaching in each such interval. The main choice criterion was the student's achievements fixed level that was evaluated on the basis of current control in the form of on-line testing.

The following results (Table 2) were obtained at the final examination of both groups' students.

Table 2. Groups qualitative analysis according to academic achievements (according to the final control results)

No.	Number	Formula	Assessment criterion		
			Low level	Intermediate level	Advanced level
For group A (experimental)					
1	Students total, people	N	36		
2	Absolute number, people	N_A	9	21	6
3	Relative number, %	$\delta = \frac{N_A}{N} \cdot 100\%$	25.0	58.3	16.7
For group B (control)					
1	Students total, people	N	38		
2	Absolute number, people	N_B	21	14	3
3	Relative number, %	$\delta = \frac{N_B}{N} \cdot 100\%$	55.3	36.8	7.9

To evaluate the comparability of the two study groups, control and experimental ones, the above mentioned method was used. The obtained Welch's *t*-test value was T = 2.59.

As $T = 2.59 > 1.96$, the hypothesis concerning the difference in characteristics of control and experimental groups after the teaching process is true on the significance level of 95%.

The qualitative structure of experimental group *A* and control group *B* according to the starting and final testing is represented graphically in Figures 5 and 6.

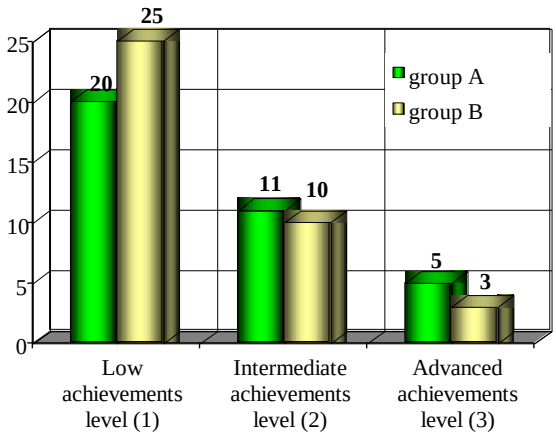

Figure 5. Comparative diagram of the starting testing results for experimental (*A*) and control (*B*) groups

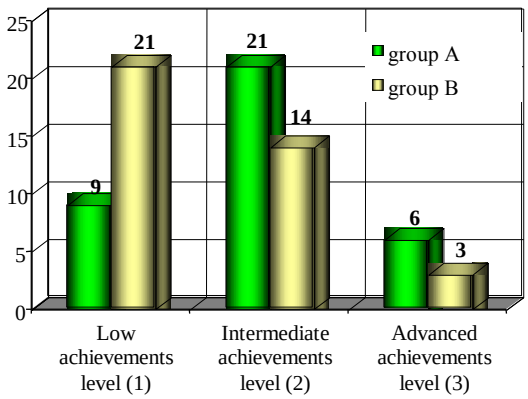

Figure 6. Comparative diagram of the final testing results for experimental (*A*) and control (*B*) groups

According to the academic achievements, the qualitative structure of experimental group (*A*) has changed: the number of students with intermediate and advanced achievements level (Table 3) has increased. Welch's *t*-test value was 3.5 when academic achievements level in group *A* before and after teaching were compared. It proves substantial differences in the academic achievements levels in this group in the beginning and at the end of teaching.

Table 3. Experimental group A qualitative structure analysis according to the academic achievements (in the starting and final testing)

No.	Number	Formula	Assessment criterion		
			Low level	**Intermediate level**	**Advanced level**
		Starting testing			
1	Absolute number (students total: 36), people	N_A	20	11	5
2	Relative number, %	$\delta = \frac{N_A}{N} \cdot 100\%$	55.6	30.6	13.9
		Final testing			
1	Absolute number, people	N_A	9	21	6
2	Relative number, %	$\delta = \frac{N_A}{N} \cdot 100\%$	25.0	58.3	16.7
		Relative number change:	**30.6 ↓**	**27.7 ↑**	**2.8 ↑**

Some changes of group qualitative structure according to the academic achievements level (Table 4) have also taken place in control group (*B*). Nevertheless, Welch's *t*-test value compared before and after teaching in this group was 0.7 (<1.96). It proves the fact of the group qualitative structure to be unchanged up to 95%.

Table 4. Control group B qualitative structure analysis according to the academic achievements (in the starting and final testing)

No.	Number	Formula	Assessment criterion		
			Low level	**Intermediate level**	**Advanced level**
		Starting testing			
1	Absolute number (students total: 38), people	N_B	25	10	3
2	Relative number, %	$\delta = \frac{N_B}{N} \cdot 100\%$	65.8	26.3	7.9
		Final testing			
1	Absolute number, people	N_B	21	14	3
2	Relative number, %	$\delta = \frac{N_B}{N} \cdot 100\%$	55.3	36.8	7.9
		Relative number change:	**10.5 ↓**	**10.5 ↑**	**0**

5. CONCLUSIONS

In the pilot project of managing the extra-mural students' educational process in Svetly Yar branch of Moscow State University of Technologies and Management named after K.G. Razumovsky the following work was carried out:

– starting testing technology to determine real level of students' achievements was developed and introduced;

– intermediate control technology for the current level of students' achievements was developed and introduced;

– the main principles of reorganizing the teaching course to actualize the motivation system taking into consideration the students' individual characteristics were developed;

– the main principles of the teaching course to allow integrating the advantages of synchronous education into the extra-mural form according to the students' individual characteristics were developed.

The following results were obtained:

– objective assessment:

  – changing the qualitative structure of the study group according to the academic achievements (Table 3): the number of students with low academic achievements level has decreased;

  – the level of general achievements in experimental group *A* is higher than in control group *B*;

– subjective assessment:

  – students' interest to their learning has increased;

  – students' perception level of the curriculum has increased;

  – positive basis for educational process perception by the students has been formed.

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LEADERSHIP FOR SUSTAINING PEDAGOGICAL INNOVATIONS IN ICT IMPLEMENTATION: A CASE STUDY OF A TAIWANESE VOCATIONAL HIGH SCHOOL

Yih-Shyuan Chen[1], Yu-Horng Chen[2], Shun-Jyh Wu[1] and Fang-Kai Tang[3]
[1]*St. John's University, Taiwan*
[2]*Chungyu Institute of Technology, Taiwan*
[3]*Kao Yuan University, Taiwan*

ABSTRACT

This paper is a case study of a vocational high school in Taiwan. The main purpose of the present study is to investigate the key determinants of a school's success in initiating and sustaining pedagogical innovations in Information and Communications Technology (ICT) implementation, with a specific focus on the effect of leadership approaches in the change process. Centring on a particular vocational high school, this study examined the way in which the entire staff succeeded in transforming a traditional school into an acknowledged ICT-capable school. Questionnaires and interviews served as the main research methods within this study. The results confirmed that, first, collaborative leadership was at the core of successfully managing changes of ICT integration. Second, the findings highlight the importance of fostering the future leaders for sustaining good practices of ICT implementation. Finally, the findings reflect upon the potential impact of the leadership approaches on teachers' engagement in the change process of ICT implementation. Currently, there is still limited research focusing on schools' sustainability of ICT implementation. The present research could serve as a reference for further research in this regard.

KEYWORDS

Collaborative leadership, sustainability, pedagogical innovations, ICT integration.

1. INTRODUCTION

The introduction and extension of the use of Information and Communications Technology (ICT) has been of concern in the educational field over recent years, as can be evidenced by studies of change management and ICT integration in schools internationally (e.g. Wong & Li 2006; Owston 2007). It is evident that the aim of implementing educational change of introducing and extending the use of ICT in classes is to improve the existing teaching practices. However, the processes of managing pedagogical innovations involving ICT in a school context are usually fraught with difficulties in practice in many other countries (Owston 2007). That is, whilst the significance of ICT in education is acknowledged, practical challenges of successfully integrating ICT into the curriculum in school settings also arise. More specifically, the studies concerning successful ICT implementation in schools identify that the key and shared attribute of these schools lies in the joint lead and active involvement of the headteacher and other staff members in leadership positions in the change process of ICT development (Tearle 2003; Sheppard 2003) Notably, however, even though new teaching approaches are adopted in classroom practices at the initial stage of the change process, very few are able to become sustainable and institutionalised (Hargreaves & Fink 2006). Furthermore, it is generally accepted that making pedagogical innovations concerning ICT is more complicated than managing changes in many other subject areas (Fox 2003).

Given the above context, the main purpose of the present study is to examine the key determinants of a school's success in managing and sustaining pedagogical innovations in ICT implementation, with a specific focus on the effect of leadership approaches in the change process. Centring on a specific vocational high school in Taiwan, this study examined the way in which the entire staff succeeded in transforming a traditional school into an acknowledged ICT-capable school. Thus, the findings can show the patterns of the leadership processes of managing pedagogical innovations in ICT integration in school settings in Taiwan.

2. LITERATURE REVIEW

2.1 Sustainability of Educational Change

Sustainability of educational change typically refers not only to the durability of reform movements in school settings, but also to the fact that whether these movements can be scaled up or spread from a few schools to the entire educational system (Combs 2007; Fullan 2006; Hargreaves & Fink 2006). Therefore, these authors perceive sustaining changes and innovations in education as a much tougher and more complicated undertaking than simply maintaining educational shifts over time. For Hargreaves and Fink (2003), sustainable educational change in schools has five critical and interrelated features below: (1) its processes and effects are deep, broad and durable; (2) it supports continuous learning and knowledge sharing for benefiting everyone in the educational context, and thus, it does not profit simply a few individuals by means of partial changes and improvements; (3) it is upheld by accessible human and material resources, and it develops and renews its resource base; (4) it does not result in any negative impact on its surrounding environments; and (5) it promotes diversity and emphasises the importance of learning from differences through collective efforts for constructive debate and reflective evaluation.

From the perspective of systemic transformation, Fullan conceptualises sustainability of educational change as 'the capacity of a system to engage in the complexities of continuous improvement consistent with deep values of human purpose' (Fullan 2005, p. ix). Based on the above conceptualisation, capacity-building for educational change should focus not merely on the school/community level, but on the district level and the state/central government level as well (Fullan 2005). Apart from the above advocacy of large-scale and deep reforms at all levels, the remaining interconnected elements which Fullan considers fundamental for sustainable educational change are as follows: (1) starting educational change with moral purpose; (2) enhancing whole-school capacity for educational change by developing learning networks and communities across different schools; (3) developing systemic accountability both by building vertical relationships between the central government and school districts, and by enhancing cross-level communicative avenues; (4) forming a prevailing culture of deep learning for coping with endless challenges in the processes of educational change; (5) pursuing both short-term and long-term results for achieving system-wide and lasting changes; (6) a cyclical mode of two counterbalancing forces – activity and rest – is the component for stepping into successful systemic change in education; and (7) sustaining educational change requires continuation of adequate leadership capacity which is built throughout the organisation at all levels of the system. Notably however, while stressing the importance of deep and large-scale reform of the holistic educational system, Fullan (2005) views successful leadership at the school level as the primary and essential bedrock of integrating the above requirements for sustaining educational change into school contexts. Indeed, although noting the potential impact of a school's surrounding environments on the sustainability of educational change, Hargreaves and Fink (2006) still highlight the fact that leadership capacity within a school is the radical determinant of continuity or discontinuity of educational change.

It is evident that Fullan, Hargreaves and Fink argue sustainability of educational change from different perspectives; however, they reach a consensus that the ways in which schools react to reform agendas generally decide whether or not educational innovations are able to continue and become system-wide. Their common opinion raises the question of the way in which schools develop their capacities for acting positively and effectively on continuous reform movements. Like Fullan, Hargreaves and Fink, other researchers' shared response to the above question is that schools must become learning organisations which cultivate staff collaboration and continuous professional development (Combs 2007; Leithwood 2005). These researchers' arguments also echo the advocacies by Fullan, Hargreaves and Fink that effective school leadership is the core of building school capacity for coping with changes, and that developing sustainable school leadership is the fundamental and key strategy for sustaining educational change and improvement.

2.2 School Leadership for Sustaining Good Practices

'Setting directions, redesigning the organisation and developing people' are identified by Leithwood and Riehl (2003) as the crucial principles of successful school leadership. In his later international studies, Leithwood (2005) goes further, verifying 'developing people' as the key determinant of making good practices durable and wide-spreading in the educational context. For Leithwood and Riehl, the principle of developing people concerns the following areas: (1) providing intellectual stimulation; (2) emphasising individualised needs and professional learning; and (3) setting appropriate models which are consistent with the school's values and goals. The successful headteacher supplies professional training to enhance teachers' skills, and created a school culture which nourishes the constructive debate and open evaluation among staff.

The initiation of school change usually requires teachers' sufficient competency for adapting themselves to reform and their aspiration for educational improvement (Fullan 2001). Importantly, the encouragement and support from the headteacher could be the main force for driving teachers to participate in continuous professional learning. In their case studies across different schools in England, Leithwood and his colleagues found that all headteachers had a strong and positive impact on the staff's motivation, commitment and beliefs about the supportiveness of their working conditions (Leithwood et al. 2006). They concluded that the headteacher is the crucial supporter for staff to develop their personal mastery in embarking on school change. More specifically, successful headteachers are able to lead staff in considering the values and reflecting upon the action for new educational agendas in a critical and constructive way (Leithwood et al. 2006).

The studies of sustaining educational change in schools address that the value of teachers' collaborative learning lies in showing their respect for and learning from individuals' diversity (Fullan 2006; Hargreaves & Fink 2006). It is for these reasons that the headteacher's and other senior leaders' prompt mediation of turning conflicts among staff members into productive discourse and discussions is particularly imperative in the organisational processes. That is, without the competent headteacher and other senior leaders to manage the conflicting tensions among staff members, individuals' diverse opinions and critical dialogue cannot be beneficial, but fragmented or even harmful for people who work together in pursuit of school change and improvement (Fullan 2006). Moreover, educational policies are usually overload and fragmented, and this can result in disturbance as schools are asked to carry out educational change (Fullan 2001; Hargreaves 2002). Even so, teachers' resistance to implementing and sustaining educational change can be diminished, when the headteacher enlarges the school's capacity by supporting teachers in both rational and emotional ways (Fullan 2001). It would appear that the problems with educational policies can cause teachers to struggle with managing school change. However, compared with external factors, the internal factor – the way in which the headteacher shapes the common values among teachers – tends to be more influential to educational reform within the school context.

It was also worth noting that continuation of developing leadership talent on the staff and collaborative leadership are usually treated as the critical components of successfully initiating and persisting in good practices (Fullan 2006; Hargreaves & Fink 2006). As with these authors' work, the studies of school leadership for change management consistently reinforce the powerful impact of leadership distribution to teachers on continuous improvements in teaching practices (Spillane 2006). More recent international research of ICT integration in school settings also verified staff collaboration in the leadership processes as the key to a school's sustainability of implementing ICT (Owston 2007). Corresponding to Owston's research, the studies concerning school change of ICT implementation in Canada (Sheppard 2003), England (Tearle 2003) and Hong Kong (Wong & Li 2006) revealed that the tasks of pedagogical innovations in ICT integration should not be put on the shoulders of one particular school leader, but be appropriately distributed to the staff at different levels if educational change of ICT integration is to be successful and sustainable.

All the above studies could be summarised as saying that if school-wide pedagogical innovations are to be successful and sustainable, school leaders are required to take the responsibilities for nurturing the potential leaders on school staff and for making a wholesale shift in teachers' attitudes towards the reform movement. In other words, not only the formal leaders' high commitment to ICT development, but other staff members' joint contribution to the leadership processes of implementing ICT is also fundamental for managing wholes-school and endurable pedagogical innovations in ICT adoption.

3. METHODOLOGY

In the methodological literature, many authors have made similar comments that mixing quantitative and qualitative approaches in the same research design is feasible (Robson 2002). Moreover, incorporating quantitative and qualitative research approaches and methods into a single study is particularly instrumental for further exploration of social phenomena (Denscombe 2003). Owing to the usefulness and feasibility of combining both quantitative and qualitative approaches in one study, a mixed-method approach was used within the present study for investigating the target school's leadership approaches to pedagogical innovations in ICT integration. Purposeful sampling was applied to ensure that the school selected for this research was an information-rich site. The target school was a publicly acknowledged ICT-capable vocational high school and evaluated by the government as being qualified for continuing running the change project concerning pedagogical innovations of ICT integration. Findings presented in this paper were collected through questionnaires and semi-structured interviews. The questionnaires were distributed to 30 teaching staff and a total of 25 returns were achieved; the return rate was 83%. All the respondents to the questionnaires were asked to give their answers by registering on a six-point bipolar scale ranging from 'very strongly agree' to 'very strongly disagree'. The levels of 'very strongly agree', 'strongly agree', 'agree', 'disagree', 'strongly disagree' and 'very strongly disagree' were translated, respectively, into the scores 6, 5, 4, 3, 2 and 1 in the process of data analysis. As regards the follow-up interviews, data was gathered from a total of 19 school staff, including the headteacher, the director of academic affairs, the ICT coordinator and 16 teachers.

4. FINDINGS

4.1 Findings from the Questionnaires

Statements presented in the questionnaires were designed for examining the staff opinions on their leadership approaches to managing school-wide pedagogical innovations in ICT adoption in the existing teaching practices. Totalling all questionnaire responses to the statements, nearly all (97%) fell within three levels from 'agree' to 'very strongly agree', with an overall mean of 4.52 (at the level of 'strongly agree').

In analysing all answers in detail, two statements were rated particularly highly. One of the statements was 'there is coordinated action across the staff at all levels in the leadership processes of pedagogical innovations in ICT integration'. The other statement was 'there is a good approach to developing teachers' leadership potential for managing school changes and improvements in ICT integration'. According to the findings, general overviews of all responses to the two statements were classed as the level of 'strongly agree'. The former statement attracted 100% positive responses, over half (52%) of which fell within two levels from 'very strongly agree' to 'strongly agree'. In addition, this statement received the top individual mean of 4.56. On this basis, there seemed to exist collegiate work patterns in leadership practices of undertaking pedagogical innovations in ICT integration. As regards the latter statement, nearly all responses (96%) were positive and around half (48%) fell within two levels from 'very strongly agree' to 'strongly agree'. This statement was ranked the second highest in the list of individual means. This result reflected that most staff agreed with their in-house mechanisms for cultivating the talented individuals as their future leaders in the domain of ICT developments. Compared with the above statements, the statement concerning teachers' satisfaction with the overall approach to school leadership for pedagogical innovations in ICT integration was ranked slightly lower. Even so, the general overview of the responses to this statement was still relatively positive, with a 96% approval rating. Therefore, it can be said that nearly all staff subscribed to the shared views that their overall approach to school leadership was satisfactory, in terms of undertaking pedagogical innovations in ICT integration.

Based on these figures, there was a strong tendency reflecting that the teachers' opinions on their leadership approaches to implementing ICT across the curriculum were positive. Furthermore, it can be assumed that school leadership for pedagogical innovations in ICT adoption was not restricted to a limited staff in leadership positions or with specifically strong skills in ICT at the implementation stage of ICT development.

4.2 Findings from the Interviews

4.2.1 Collaborative Leadership Approach

Corresponding to the questionnaire results, a particularly strong theme which emerged in the interview phase was that the teachers generally felt pleased with working together and getting involved in leadership practices of implementing pedagogical innovations in ICT integration. All teachers who were interviewed expressed the same views, arguing that their school leadership was not treated as the prerogative of any individual staff. In the interviews with the teachers from outside the leadership team, their common opinions were that they were becoming increasingly comfortable with taking the leadership role in the processes of school-wide pedagogical innovations in ICT integration. An inexperienced teacher, for example, appreciated that:

> *This school is like a family and the morale is very high…Although I was not in the leadership team, many teachers, including formal leaders like the ICT coordinator and directors, invited me to join their team discussion and decision-making processes…It was really heart-warming that everyone here tried making me feel accepted.*

In the interviews with the headteacher, he claimed that:

> *Without the continuous and joint efforts of the director of academic affairs, the ICT coordinator and other teachers in carrying out school-wide pedagogical innovations, it would have been almost impossible to allow our school to have today's outcomes.*

Speaking of the key drivers for the staff collaboration and active engagement in school leadership for pedagogical innovations in ICT integration, all teachers in the interview phase claimed that the headteacher was in the central role in shaping a school culture within which individual staff became used to coordinating with each other in undertaking the leadership tasks of promoting ICT integration. More specifically, the responses from all teachers reached the similar comments, highlighting the fact that shouldering the leadership tasks offered them more opportunities of working closely with senior and middle leaders in proposing and revising the strategies for making new practices fit well with the existing classroom practices. The teachers, therefore, felt that getting involved in the leadership activities strengthened their confidence in conducting new teaching practices of ICT adoption.

4.2.2 Development of Future Leaders

In the interview phase, the staff expressed their positive views on the question about their in-house mechanisms for developing teachers' leadership potential to implement ICT. For all teachers in the interviews, the school's initial and current achievements in ICT implementation lay in the headteacher's good appointment of the suitable teachers as the key leaders for whole-school development in the field of ICT education and its application. All teachers made the similar comments, stating that their ICT coordinator was very ICT-focused, highly-committed and had sufficient interpersonal skills. For example:

> *Our ICT coordinator is very enthusiastic about helping us out whenever we have trouble with the computer. He is like our total guide with ICT.*

> *Our headteacher is quite visionary and has well-targeted development plans for managing human resources…He selected 'the right person' as the ICT coordinator. I think this is the important base for our school's outcomes of ICT implementation.*

In addition to good designation of the key staff in the very beginning of the change process, the headteacher's investment in fostering the future leaders for sustaining ICT implementation was the crucial issue which was raised frequently and positively in the interview phase. Apart from this, it was worth noting that the strong support from another formal leader – the director of academic affairs – in the overall course of developing individuals' potential to manage school changes in ICT adoption. This is because when praising the headteacher's efforts to cultivate leadership abilities of individual staff, the teachers also highlighted the director of academic affairs' hands-on approaches to leading others by examples. As can be seen in the teachers' replies:

> *The director of academic affairs eased our nerves by showing us the practical strategies for leading others and managing the project…I think that he is really competent for "leading us to understand how to lead"*
>
> *I think both the headteacher and the director of academic affairs are very supportive for what we do…The headteacher allows us to exert leadership in the field which we are familiar with…The director he coaches us by showing how to do and how to make things better. I think he is an excellent, a very approachable leader.*

In the interview with the director of academic director, he said that:

> *I've never seen making whole-school pedagogical innovations as an easy job…Of course, making effective change is even more challenging…However, being a leader, you need to do your best to comfort teachers' nerves…It is my belief that you need to show them the way how to embark on new projects and share some experiences with them in advance.*

Based on the above interviewees' responses, it was evident that in order to construct the supportive conditions of implementing and sustaining pedagogical innovations in ICT integration, the headteacher invested much energy in identifying the competent individuals as the core leaders at the very start of the change process. Apart from this, the headteacher and the director of academic affairs both provided adequate support for the ICT coordinator in the aspect of nurturing and renewing human resources within the school throughout the change process. Moreover, it was encouraging to note that for those from outside the leadership team, getting involved in leadership practices was perceived to be beneficial for future career plans. The positive feelings about exercising leadership in the change process seemed to motivate the staff to become more willing to participate in leadership activity involving ICT implementation.

4.2.3 Perceived Values in Pedagogical Innovations

In analysing the interview data, 94% of the teachers approved their school leadership for managing changes of ICT integration without dissent. When further explaining why they felt satisfied with the overall approach to school leadership for pedagogical innovations in ICT integration, the interviewees' responses can be divided into two key points. First, the success in gaining official recognition of initiating and continuing the change project allowed the staff to receive more support from the government to develop and improve the ICT-integrated instructional modes. This, in turn, yielded the benefits for the teaching and learning processes. Second, the school's image and competitive capabilities improved throughout the course of whole-school developments in new practices of ICT application. In the interviews, the teachers claimed that:

> *We felt exhausted at the very beginning of undertaking the change project of ICT integration, but now we're at a point that we are proud of being part of the staff here…Our neighbouring schools know that integrating ICT into the curriculum has become the key feature of our school. We enjoy a good image within our school community.*

The overwhelming majority of the teachers (94%) also considered their leadership approaches to be successful in nearly every aspect of handling pedagogical innovations and developments, not simply in the aspect of implementing ICT across the curriculum. Moreover, the interview results showed that, when noting the things which the school could change and improve, the teaching staff were keen on giving their voice in the staff meeting or even proposed their ideas directly to the headteacher or other formal leaders.

5. DISCUSSION

With respect to the leadership approach to managing changes of ICT implementation, it was evident that leadership tasks of maximising the use of ICT for teaching purposes were fulfilled through considerable synergies and interactions of many staff members, irrespective of post or ICT expertise. That is, there seemed to exist a distributed form of leadership approaches to implementing ICT in the target school. The evidence reinforced the conclusions of the related studies (Wong & Li 2006) that teachers' coordinated actions and active engagement in the leadership processes were at the heart of making school-wide pedagogical innovations in ICT integration successful and durable. The findings also resonate with Tearle's case studies

(2003) that teachers' collaboration in shouldering leadership responsibility in the change process was at the core of enlarging their school's leadership capacity for continuing pedagogical innovations in ICT implementation. The findings also support Leithwood's (2005) international multi-case studies that teachers' intense involvement and close collaboration in leadership activities were found to be essential for effective leadership which brought about successful changes and improvements in school settings in nearly all educational contexts. Importantly, teachers in the target schools generally accepted their collaboration and collegiality in the leadership processes of implementing ICT as a natural and an important part of their work routine. To a certain degree, the findings echoed Sheppard's multi-case studies (2003) that the predominant determinant of the schools' success in continuing new teaching practices of ICT integration was teachers' awareness of the necessity and value of their collaboration in leadership practices.

In the aspect of developing school staff for sustaining ICT implementation, the findings showed that the headteacher's comprehension of the staff's quality, together with good designation of the key leaders, seemed to be essential for success in planning and initiating whole-school ICT developments. The evidence gathered here was parallel to the related studies focusing on implementing school-wide changes in pedagogical innovations regarding ICT adoption in Canada (Sheppard 2003), England (Tearle 2003) and Hong Kong (Wong & Li 2006). Despite differences in their educational contexts, these studies subscribed to the same views, arguing that identifying and developing the competent teacher as the ICT coordinator (or the 'technology teacher' in Sheppard's terms) was the foremost requirement for bringing about the initial success in the change process of school-wide ICT adoption. Notably, both the headteacher and another senior leader (e.g. the director of academic affairs) continued nurturing the potential staff as lead teachers in the ICT field. Moreover, echoing the literature on sustainable leadership and school change, the results from this study reflected that the headteacher's competence in identifying and continuing fostering individuals' leadership potential may function as the primary base for making the initial success in school change become durable (Fullan 2006; Hargreaves & Fink 2006). In a sense, it would appear that only with the long-term plans and systemic strategies for enhancing leadership capacities of many staff members can a school have sufficient capacity for moving the change and improvement efforts beyond the initial success to the continuation phase.

As for teachers' perception of pedagogical innovations, it was encouraging to note that the interviewees generally approved their school leadership for managing changes of ICT integration without dissent. Apart from this, the teachers considered their leadership approaches to be successful in nearly every aspect of handling pedagogical innovations and developments, not simply in the aspect of implementing ICT across the curriculum. More specifically, when noting things which the school could change and improve for better, the teachers were keen on giving their voice in the staff meeting or even proposed their ideas directly to their formal leaders. On this basis, an overarching message which emerged in the school was that the rationale for the teachers' high praise for their school leadership lay in their strong awareness of the ongoing and whole-school progression throughout the change process. Based on the findings, it could be inferred that one of the radical impulses for school staff to continue moving the existing success in ICT implementation forward was that the school fostered a dominant culture within which people held a high-level commitment to striving for excellence. That is, teachers' awareness of the necessity for school change underpinned their intentions to keep improving in ICT implementation even when challenges occurred. The findings correspond to the literature that school staff are usually willing to undertake change and development when feeling a critical need for doing so (Fullan 2001).

6. CONCLUSION

Despite a small number of research participants in the present study, the combination of quantitative and qualitative approaches provides insights into school leadership for managing pedagogical innovations in ICT implementation. The factors which affected the school's sustainability of pedagogical innovations in ICT implementation are inter-related rather than discrete. Yet, it would appear that collaborative leadership is at the core of supporting whole-school change and improvement in this regard. In addition, the results show that a school's capacity for sustaining ICT implementation entails not only good designation of the suitable staff as the key leaders at a very start, but also ongoing development of the potential teachers' leadership abilities. The findings also identify the impact of school leadership on teachers' perceived values in pedagogical innovations which, in turn, affects their participation in change management concerning ICT implementation.

It is inevitable that the findings from one case-study school limit the possibilities for generalisation. However, little research is undertaken to examine the change process focusing exclusively on school leadership for sustaining good practices of ICT integration. It is anticipated that the findings from this study can shed light on the approaches to managing and sustaining pedagogical innovations in ICT integration. Thus, it is expected that the result of the present research, on the one hand, contributes to illuminating the potential factors which facilitate sustainability of school change and improvements involving ICT adoption. On the other hand, it can extend knowledge in the field of school leadership for change management regarding ICT implementation.

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TOWARDS TO A VERSATILE TELE-EDUCATION PLATFORM FOR COMPUTER SCIENCE EDUCATORS BASED ON THE GREEK SCHOOL NETWORK

Michael Paraskevas[1,2], Thomas Zarouchas[1], Panagiotis Angelopoulos[1] and Isidoros Perikos[1]
[1]*Computer Technology Institute and Press "Diophantus", N. Kazantzaki str, GR-26504, Patras, GREECE*
[2]*Dept. of Telecommunications Systems and Networks, TEI of Messolonghi, GREECE*

ABSTRACT

Now days the growing need for highly qualified computer science educators in modern educational environments is commonplace. This study examines the potential use of Greek School Network (GSN) to provide a robust and comprehensive e-training course for computer science educators in order to efficiently exploit advanced IT services and establish a modern and versatile education environment in the Greek Society. Furthermore, a preliminary questionnaire survey was performed in order to validate the adoption of GSN and also to formulate a realistic training course customized to specific and future needs of computer science educators in primary and secondary education, thus enabling them to immerse in real-world situations (i.e., school computer laboratory). Findings from this preliminary survey are also presented.

KEYWORDS

tele-education, Greek School Network (GSN), training, computer science educators

1. INTRODUCTION

The Ministry of Education[1] (MoE) has established the strategic plan for the "Digital School", in order to modernize the education system through the use of the ICTs. In the context of the "Digital School", on-going and near future actions in both primary and secondary education evolve the wide use of innovative technologies (i.e., Web 2.0 applications tools), in order to enhance the traditional and lecture-dominant teaching methods and provide a flexible and attractive learning environment. Related actions include:

- Initiation of "Bring You Own Device" (BYOD) methodology to primary and secondary schools.
- Installation of mobile computer laboratories with enhanced functionalities (i.e., broadband wireless access, multimedia equipment) and integration of advanced devices such as interactive whiteboards.
- Schools interconnection to municipal optical metropolitan area networks, enabling high-speed optical access to GSN.
- Interactive and experimental learning environment considering the use of (a) tablets or e-book readers, (b) low cost electronic prototyping platforms (i.e., Arduino kit, Raspberry Pi), (c) 3D printers and (d) programmable robotic and artificial intelligent systems.
- 3D visualization and interaction [1].

In order the above activities to achieve their potential goals, an updated and targeted training course should be provided to computer science educators. This will establish a flexible framework that will further promote the utilization of information and communication technology infrastructure in schools. The initial design and the conceptual framework of the training course was based on well-established practices [2], while further adjustments and improvements will be performed taking account the findings of an electronic questionnaire survey appropriate formulated [3]. The e-training course will be realized using the Greek School Network (GSN) [4]. This was an optimal solution since GSN delivers high quality and a wide range of network and telematics services to its end users [4-6].

[1] http://www.minedu.gov.gr

This paper is organized as follows: In Section 2 an overview of GSN core and advanced services is presented. In Section 3 the basic scheme and functionality of the information system for management and monitoring the tele-education progress is briefly described. In Section 4 the conceptual framework of the training course is analyzed, while in Section 5 the evaluation of the electronic questionnaire survey is presented. Finally, conclusions are drawn in Section 6.

2. GSN CORE AND ADVANCED SERVICES OVERVIEW

The Greek School Network[2] (GSN) was founded in 1998 and constitutes the educational intranet of the Ministry of Education [4]. GSN interconnects all Greek schools, educational administration offices and organizations and also provides advanced e-services to students, teachers, and school administrator communities [5]. It was funded by the second and third Community Support Framework of the European Union and is currently maintained and supported by a group of twelve research centers and universities, under the management of Computer Technology Institute and Press "Diophantus" (CTIP)[3] [6]. It is the biggest national public network according to the number of users, and has been recognized internationally as a remarkable educational network that promotes the introduction and exploitation of Information and Communication Technologies (ICT) in the Greek educational system. Furthermore, due to its innovative role the GSN fulfills the scientific and research goals for the diffusion of Internet access and the promotion and establishment of contemporary educational models.

The GSN services [4] can be divided into the following categories: (i) Basic services: network connectivity, user authentication and authorization, GSN and students portal, automatic user's registration, (ii) Communication services: email (with anti-virus and anti-spam protection), electronic lists, instant messaging, video-teleconference, (iii) Web hosting and blogging: teacher and school pages hosting, authoring tools for web pages, dynamic pages hosting, database service, blogs, (iv) Advanced services: Video on Demand (VoD), live casting, synchronous and asynchronous e-learning, e-portfolios, social networking, (v) Complementary services: electronic cards, school magazines and newspapers, team calendars, file sharing, (vi) Central infrastructure services: naming service (DNS), directory service (LDAP), distributed helpdesk, online statistics, asset management and (vii) Management services: users management service, network monitoring, network security, remote router administration, CERT, statistics, etc..

The aforementioned services have been designed to appeal to all GSN users offering a versatile environment suitable for the implementation of modern educational methodologies and the introduction of modern practices. Traditional teacher centered, lecture-dominant and text-based teaching methods can be enriched and become more attractive using GSN services. It has to be mentioned that the role of GSN is not to define the teaching methods, but to support a coherent set of well-established educational tools that can enhance and accommodate modern digital education methodologies. This implies that GSN efficiently provides a robust information and communication technology framework (i.e., high quality networking services) allowing large scale and long-term e-learning and training activities, as is described in the following sections, to be successfully realized.

As described below, feedback information extracted from an electronic questionnaire survey indicates a high adoption of the GSN services from the school community (i.e., teachers). There is particularly high utilization of electronic services, such as email, emailing lists, websites, blogs, VoD as well as of social networking and synchronous and asynchronous e-learning services. Some overall statistics (recorded February 2013) validating the broad use of GSN services are depicted in Table 1.

[2] http://www.sch.gr
[3] http://www.cti.gr

Table 1. Statistical data of GSN

GSN services	16
Educational websites	12.747 (based on PHP, Joomla, Wordpress or ASP/.NET technology)
Educational blogs	19.223 (February 2013)
Educational communities	318
Digital Courses (current year)	4.786 courses from 891 schools of Secondary Education
GSN portal	>340.000 unique visitors per month
Personal accounts	82.120 (teachers), 63.554 (students)
Active mailboxes	>133.000
Helpdesk tickets	>30.000/year

GSN maintains a thorough tested, reliable set of services that exhibit high level of availability and scalability and its flexible architecture [4] allows the integration of the tele-education platform described below, in terms of management, authentication and authorization.

3. TIME SCHEDULING AND TELE-EDUCATION PLATFORM

A time Scheduling and Tele-Education Platform (t-STEP) was designed and implemented by Greek School Network and Networking Technologies Directorate[4] in order to provide a high quality and flexible training course and potentially compensate the growing needs on information and communication technologies. Currently, t-STEP is in pilot operation and is evaluated by the group of universities and research institutes that operate and maintain the GSN. As it is expected, production service will be available in March 2013 at http://training.sch.gr. Considering the initial design framework, t-STEP comprises the following:

- **Frontend module (see Figure 1):** Upon successful login (i.e., valid GSN account) time scheduling (i.e., registration in forthcoming e-lecture) and basic administration (i.e., update users' profile) operations can be efficiently performed. Also, some statistical data can be extracted (i.e., total hours of successfully attended e-lectures) and thoroughly presented to the user. Furthermore, a questionnaire survey is provided in order to evaluate, upon completion, the overall e-training process. Additionally, a link to a test-room (virtual class) is provided to verify software and hardware compatibility, in order to successfully participate in the real-time e-learning environment described below.

Figure 2. Front-end web-page of the training platform

- **Administration (backend) module (see Figure 2):** The backend environment provides the main administration interface of the t-STEP, which is only accessible by the operators of the GSN and the

[4] http://www.cti.gr/nts

registered instructors (with different administrative privileges). Also, a super user account (i.e., supervisor) is provided with enhanced administrative functionalities enabled. Basic operations such as monitoring the overall progress of the training course (i.e., successfully completed training sessions), schedule or postpone a training task, track trainees who successfully registered and participated in a training session, extract statistical data etc. are efficiently performed through the backend module.

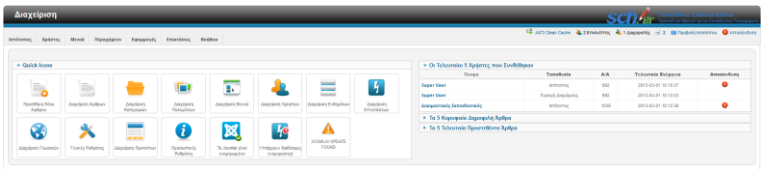

Figure 2. Administration module of the training platform

- **Real-time tele-education environment (see Figure 3):** The realization of each training session is based on the BigBlueButton[5] open-source software, which is transparently integrated with the time-scheduling module described above. In principle, the administration of the real-time session is performed by the instructor (i.e., moderator), who potentially can interact with the participants (i.e., mute/unmute or eject user), upload slides to the presentation area and efficiently coordinate the related learning activities.

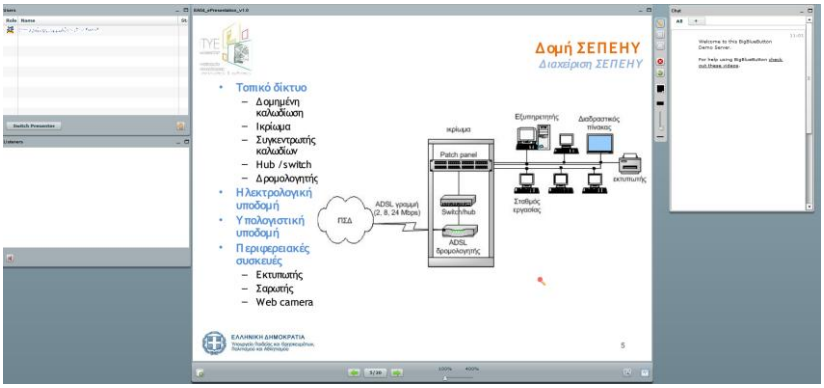

Figure 3. Typical BigBlueButton session.

Following the initial design restrictions, t-STEP is strongly oriented to the Greek educational system (i.e., primary and secondary education). Large scale deployment of the training course described below will provide critical hints for potential use (considering appropriate adjustments) in related training and life-long activities and also for advanced educational services (i.e., university post-graduate courses).

4. CONCEPTUAL FRAMEWORK OF THE TRAINING COURSE

The proposed framework of the training course defines 24 educational topics (ETs) organized under four categories shown in Table 2. The outline of the proposed training framework was based on the extensive and fruitful collaboration between the administrators of the GSN [4-6] and the hints that were provided by the Users Support Service (Help-Desk)[6]. Furthermore, useful information was also extracted from the ticketing system[7] utilized by the Help-Desk.

For the realization of the intended training courses and the in-depth and detailed analysis of the topics depicted in Table 2, well-documented resources designed, taking into account the adult education aspects [7], including (a) lecture notes, complemented by practical examples and case studies, (b) instructor's

[5] http://www.bigbluebutton.org/
[6] http://www.sch.gr/helpdesk
[7] http://helpdesk.sch.gr

presentation slides, (c) research topics and set of activities meriting further investigation and practice, (d) self-assignments and (e) instructor's notes. Typically selecting the correct mixture of available resources is a challenging task, however the motivation for defining the logical structure of the resources (i.e., reference material) described above, was to fulfill at least the following criteria [2]:

- Addressing the challenges of life wide and lifelong learning
- Maximize the impact of distant learning providing in-depth training
- Assessment of learning and the provision of feedback
- Enhance learning experience and learning outcome
- Expand "educational bandwidth" limiting time constraints
- Facilitate collaborative work and online discussion
- Effective content and course delivery
- Efficiently address both technical oriented tasks and pedagogical issues
- Potentially accommodate growing students enrollment in digital technologies
- Address the growing emphasis on technological issues
- Potentially augment central support services considering long-term support challenges
- Strengthen incentives for fostering digital technologies and encourage innovation

Table 2. Conceptual framework of the proposed training course

Categories	**Topics**
Organizational	**ET1** - The role of computer science educator in the context of "Digital School" **ET2** - Users support service (helpdesk)
Ministry of Education systems' support	**ET3** - E-school application
School Computer Laboratories	**ET4** - Administration and maintenance of school computer laboratories **ET5** - Support and management of MS-Windows based operating systems **ET6** - Windows 2003 Server administration **ET7** - Windows 2008 Server administration **ET8** - ISA server 2000 and 2004 administration **ET9** - Squid proxy/caching server administration **ET10** - Ubuntu installation and configuration in school laboratories **ET11** - Open source educational OS **ET12** - Advanced IT devices (i.e., interactive whiteboards)
Greek School Network Services	**ET13** - Email service utilizing enhanced security, communication & collaboration features **ET14** - Students services **ET15** - Open source educational services **ET16** - Web hosting **ET17** - Publishing web content using Joomla CMS **ET18** - Wordpress configuration and management **ET19** - Blogs and communities **ET20** - E-class and e-learning services **ET21** - Moodle Learning Management System **ET22** - Internet safety **ET23** -Video on demand **ET24** - Advanced services (i.e., School RSM)

The potential interest of computer science educators to excel their technical proficiency in the aforementioned topics was examined through a questionnaire survey described in Section 5.

5. QUESTIONNARIE SURVEY EVALUATION

The final version of the questionnaire, which was structured after fruitful consultation with the operators of the Greek School Network, comprises two distinct parts. The first part examines: (i) the degree of awareness of the educational community for the electronic services provided by the GSN, (ii) the ICT school infrastructure and (iii) the Users Support Services (Help Desk) for the direct support regarding the connectivity to GSN or its electronic services. The related evaluation tasks are listed below:

- Q1 - Are you familiar with the Greek School Network?
- Q2 - How well informed are you on the network feasibility (networking access) and network bandwidth provided by the GSN in schools and administrative units?
- Q3 - Are you familiar with the electronic services provided by the Greek School Network?
- Q4 - Are you taking advantage of the electronic services provided by the Greek School Network?
- Q5 - Do you know where you can access documentation and official guidelines for the electronic services provided by the Greek School Network?
- Q6 - How well informed are you about the school PC laboratories and their IT infrastructure?
- Q7 - Do you know where you can access technical documentation for school PC laboratories and their IT infrastructure?
- Q8 - How well informed are you about technical support services for troubleshooting common and advanced IT failures at school PC laboratories?

The second part of the questionnaire records the potential interest of the computer science educators to be trained, in the near future, in a well-defined set of technical and educational topics, as was described in Section 4. Its organizational structure was formally based on the conceptual framework shown in Table 2.

For the realization of the survey a three-grade scale was employed [3], depicted in Table 3, while statistical data was collected by means of an electronic questionnaire administered from January 9th until February 3rd 2013.

Table 3. Comparison scale for evaluation process

Characterization		
None	Sufficiently	Considerably

The questionnaire was hosted on a GSN's web-server and posted online at http://www.sch.gr/training. The development of the electronic questionnaire was based on open source software LimeSurvey[8] v2.00+, whereas the installation and configuration was performed by the Greek School Network and Networking Technologies Directorate. In order to successfully login to the above link a valid GSN account was prerequisite, while the estimated time for the questionnaire completion was ten minutes. The questionnaire was pretested, before being widely distributed, through a pilot study which helped to identify and address possible ambiguities. Thus, suggestions and feedback from respondents improved the final structure of the survey. A total of 1469 educators participated to the questionnaire survey which corresponds to 19.13% of the overall computer science educators officially registered to the Ministry of Education. Fifty-eight participants gave incomplete answers, thus their results were excluded from the statistical analysis. Typical results of the questionnaire evaluation considering the distinct parts described above are shown respectively in Figures 4 and 5. Furthermore, a sorted list (in descending order) of the e-training topics considering the characterization "Considerably" (see Table 3) is shown in Table 4.

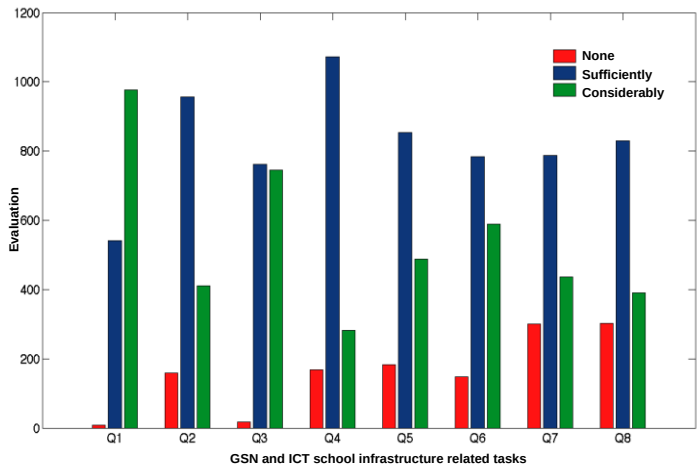

Figure 4. Survey quantitative results considering GSN, support and technical-oriented tasks

[8] http://www.limesurvey.org

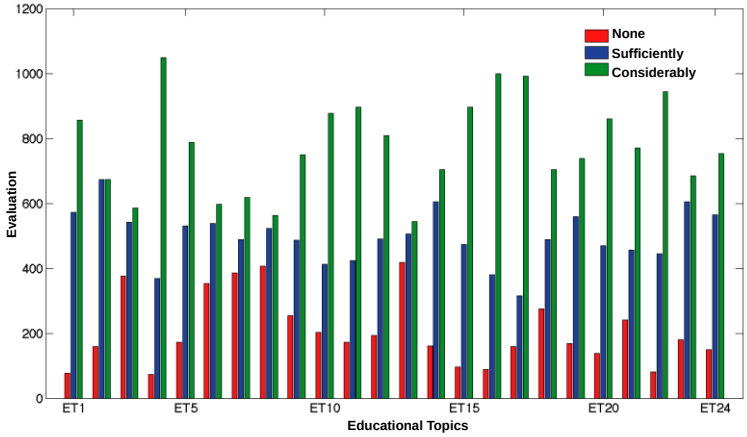

Figure 5. Survey quantitative results considering technical and educational topics shown in Table 2

Table 4. A sorted list of the e-training topics considering the characterization "Considerably"

Topics	Considerably (%)
ET4 - Administration and maintenance of school computer laboratories	70.31
ET16 - Web hosting	68.10
ET17 - Publishing web content using Joomla CMS	67.55
ET22 - Internet safety	64.24
ET15 - Open source educational services	61.10
ET11 - Open source educational OS	60.05
ET10 - Ubuntu installation and configuration in school laboratories	58.78
ET20 - E-class and e-learning services	58.58
ET1 - The role of computer science educator in the context of "Digital School"	56.87
ET12 - Advanced IT devices (i.e., interactive whiteboards)	54.22
ET5 - Support and management of MS-Windows based operating systems	52.85
ET21 - Moodle Learning Management System	52.45
ET24 - Advanced services (i.e., School RSM)	51.36
ET19 - Blogs and communities	50.37
ET9 - Squid proxy/caching server administration	50.23
ET14 - Student services	47.89
ET18 - Wordpress configuration and management	47.89
ET23 -Video on demand	46.59
ET2 - Users support service (helpdesk)	44.66
ET7 - Windows 2008 Server administration	41.45
ET6 - Windows 2003 Server administration	40.11
ET3 - E-school application	38.96
ET8 - ISA server 2000 and 2004 administration	37.69
ET13 - Email service utilizing enhanced security, communication and collaboration features	36.99

The results shown in Table 4 (as extracted from Figure 5) indicate a systematic preference for education topics related to efficient administration of school computer labs (ET4), web hosting and web content publishing using well-established CMS software (ET16 and ET17), best practices for Internet safety (ET22) and open source educational applications (ET15). Furthermore, a considerable preference for innovative educational services (ET20) and advanced IT devices (ET12) was also declared. On the other hand, lower preference was recorded for potential training in relative obsolete software (ET6 and ET7) and widely used and thoroughly tested services provided by GSN, such as the email service (ET13). Accordingly, Figure 4 indicates that GSN users are aware of the advanced electronic services offered and that are highly utilized in educational purposes. Also, a noticeable portion of the participants is able to look for documentation and official guidelines for the electronic services provided by the GSN. However, a considerable portion of the participants is unaware where can efficiently access technical documentation for school computer laboratories and their IT infrastructure and also not properly informed considering the technical support services for troubleshooting IT failures at school PC laboratories.

6. CONCLUSIONS

The present work introduces a time Scheduling and tele-Education Platform (t-STEP) based on the Greek School Network (GSN) and defines the conceptual framework for a technical-oriented training. A questionnaire survey was performed in order to investigate the potential technological needs of computer science educators in Greek schools (primary and secondary education) to improve their technical proficiency. Additionally, typical issues considering the GSN services and ICT school infrastructure were also examined. Preliminary results indicate a systematic preference trend in specific administrative, web-related and advanced IT training topics and furthermore validate the broad use and acceptance of GSN services. In future work a more detailed and sophisticated statistical analysis will be undertaken in order to formally describe and assess the impact and the effectiveness of the training course and potentially enhance it.

ACKNOWLEDGEMENT

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ADAPTIVE FEEDBACK IMPROVING LEARNINGFUL CONVERSATIONS AT WORKPLACE

Matteo Gaeta*, Giuseppina Rita Mangione[+], Sergio Miranda* and Francesco Orciuoli *
**DIEM, University of Salerno, Via Giovanni Paolo II, 132, 84084 Fisciano (SA), Italy*
[+]CRMPA c/o DIEM, University of Salerno, Via Giovanni Paolo II, 132, 84084 Fisciano (SA), Italy

ABSTRACT

This work proposes the definition of an Adaptive Conversation-based Learning System (ACLS) able to foster computer-mediated tutorial dialogues at the workplace in order to increase the probability to generate meaningful learning during conversations. ACLS provides a virtual assistant selecting the best partner to involve in the conversation and generating adaptive feedbacks for the dialog. Adaptive feedbacks are triggered by the concepts automatically extracted from the conversation texts, while their content is generated by querying the organizational knowledge represented by means of Semantic Web technologies. Lastly, Fuzzy Formal Concept Analysis is exploited to conceptualize domain knowledge.

KEYWORDS

Workplace Learning, Knowledge Extraction, Adaptive Educational System, Semantic Web, Fuzzy Formal Concept Analysis.

1. INTRODUCTION AND MOTIVATIONS

Workplace Learning represents the field of studies and researches related to effective and efficient solutions supporting learning and training processes within the work context and aiming at enhancing individual and organization performances.

Workplace Learning principles are described in several works. Among them, the authors of (M. Wang, et al., 2010) assert that Workplace Learning is *adult learning, organizational learning and knowledge management*. The related theories emphasize personal reflection, problem orientation and knowledge construction by means of social processes, models representing how organizations learn, approaches and practices exploited in order to identify, create, represent, and distribute knowledge for reuse, awareness and learning. Furthermore, in (P. Tynjälä and P. Häkkinen, 2005), the authors describe the main features of the Workplace Learning. First of all, it is mostly informal or non-formal (both intentional and incidental). Secondly, it is strongly contextualized in the sense that learning occurs in the environment in which skills and knowledge, that are object of learning itself, will be applied. In this scenario, conversation is considered an important tool to share, construct, create knowledge and learn as emphasized in (A. Soller, 2007). The authors of (I. Nonaka and H. Takeuchi, 1995) underline the importance of conversations in order to transform individual processes into organizational processes.

Moreover, conversations foster personal reflection and are typically driven by a well-defined learning objective. In this context, *technology enhanced learning* solutions are effective not only to support conversations (dialogues, discussions, etc.) but also to store knowledge, ideas and shared decisions. They can serve, at the same time, as a tool to support individual learning, sustain knowledge creation and construction, manage the organizational memory, share knowledge and develop mutual understanding (M. Wang et al., 2010). Generally, these systems are able to catch the knowledge of the domain experts to support learning and peer collaboration but they need methodical approaches for knowledge representation (W. Chen, 2006), otherwise they are focused, as *Adaptive and Intelligent Systems for Collaborative Learning Support (AICLS)*, on adapting the collaboration processes (I. Magnisalis et al., 2011).

With respect to the aforementioned systems, this paper proposes a novel approach to exploit organizational resources (kept *up-to-date* by the collective intelligence and represented by means of semantic models) in order to enhance and adapt peer learning activities.

Taking in consideration the relevant role of conversation at workplace for both individual and organizational learning and for knowledge management, this paper proposes a workplace learning system, based on semantic technologies, that implements the conversation-based learning approach. The main faced problems are: i) empowering conversations in order to facilitate the occurrence of learning by providing a mechanism to stimulate meaningful learning, and ii) exploiting conversations as a tool to link individual and organizational learning by tracing and reusing learningful conversations.

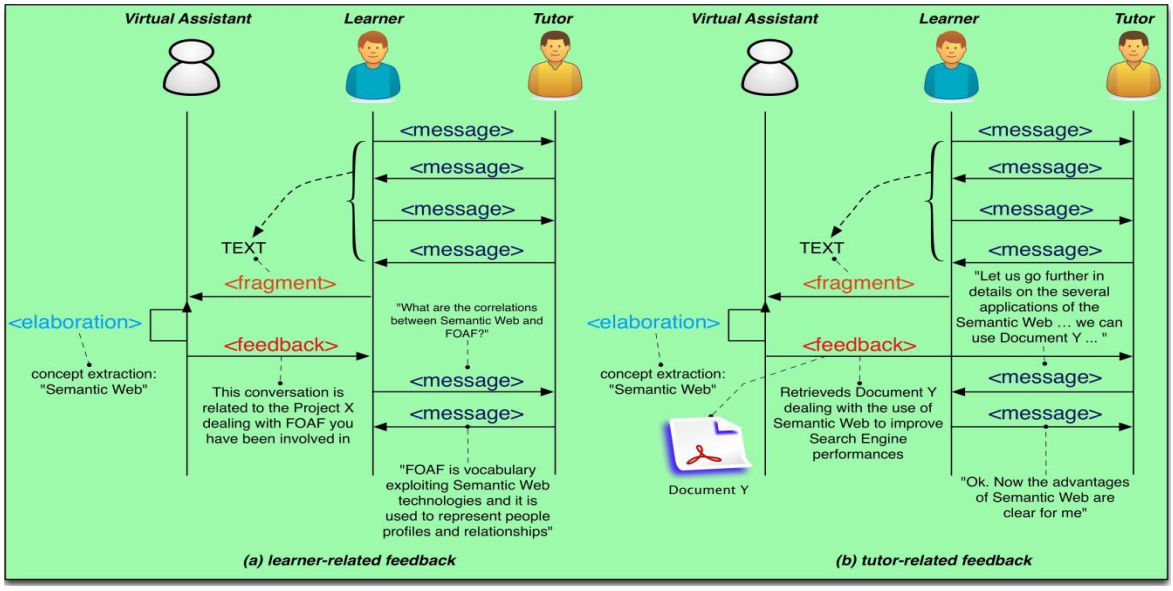

Figure 1. Learner-related and tutor-related feedback

The structure of this work is the following: section II provides an overview of the defined approach and a description of the adaptation strategy. Section III describes the general view and the most important details of the ACLS. Lastly, Section IV provides details about the evaluation of the proposed approach and some final remarks.

2. OVERALL APPROACH

The proposed approach lays on three pillars mainly enabling a virtual assistant that exploits the organizational knowledge in order to foster conversations by means of the provision of feedbacks for both learner and conversation partner.

The first pillar is represented by **computer-mediated conversations**. In our approach, conversations are dialogues between two participants, the tutor and the learner, who exchange messages through an instant messaging tools. A model for learningful conversations is defined in (D. Laurillard, 2009), where the author provides a framework for a conversational learning approach. This framework is conceptually structured into two levels, the lower and the upper. In the lower one, the learner masters the topics of learning while the conversation partner provides the experiential environment (e.g. delivery of learning resources) where the learning process is executed. In the upper level, the learner and the conversation partner are engaged in a dialogue by exchanging messages containing their understanding and representations of the topics obtained through the experience performed at the lower level and adapting their behaviours. Reflection occurs when the learner and the partner talk about what they are doing at the lower level. Adaptation occurs when they modify what they are doing at the lower label on the basis of their talk. Several types of dialogues (e.g. argumentation-based dialogues, tutoring dialogues, peer dialogues, and so on) can be instantiated, but this work, in particular, focuses on tutoring dialogues. The virtual assistant is committed to help the conversation partner in playing his/her tutor role.

The second pillar is represented by **the capability to generate adaptive feedbacks** able to foster conversations in order to increase the probability that meaningful learning occurs during dialogues. We adopt the definition of feedback reported in (V. J. Shute, 2008): *[...] feedback is defined in this review as information communicated to the learner that is intended to modify his or her thinking or behavior for the purpose of improving learning. And although the teacher may also receive student-related information and use it as the basis for altering instruction [...]*. In our proposal, feedbacks are generated by the virtual assistant that analyses a specific conversation fragment and queries the organizational knowledge for content that could foster the dialogue and help the learner to improve development of domain-specific knowledge and skills. Feedbacks are *adaptive*, in the sense that they are generated by considering the concepts that really emerge from the conversation fragment and *personalized*, in the sense that they take care of both learner and tutor roles and are tailored to prior knowledge and previous work experience of the learner. For the sake of simplicity, we divide feedbacks in two types: learner-related and tutor-related. The first ones are topic contingent feedbacks suggesting correlations among the topics to master and the learner's prior knowledge (V. J. Shute, 2008). The second ones are hints/cues/prompts about worked examples provided by the tutor (conversation partner) in response to automatic suggestions, produced by the system, concerning the existence (in the organizational knowledge) of documents, user-generated content, etc. that are related to the topics to master. The main idea is to build these feedbacks in the form of dialogue moves by exploiting classifications provided by the authors of (S. D'Mello et al., 2010) and (X. Lu et al., 2007). In this way, even if indirectly, the dialogue is adapted maintaining a common tutorial dialogue scheme.

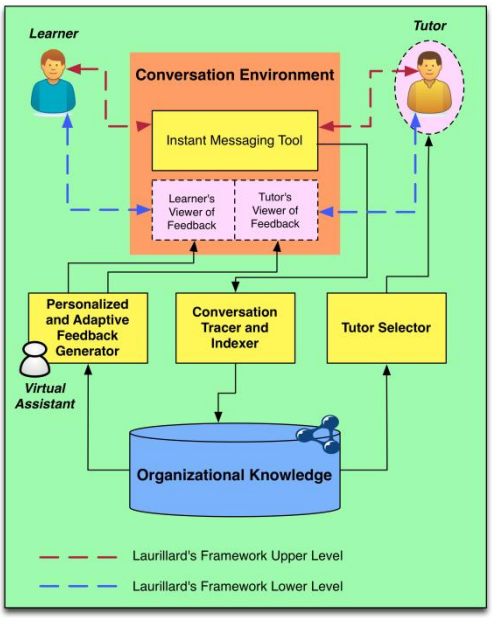

Figure 2. Learner-related and tutor-related feedback

The third pillar is represented by **the exploitation of the organizational knowledge** in order to support computer-mediated conversations as well as other processes. In this paper we refer to the organizational knowledge as the set of all types of knowledge existing in a specific organization, for instance, tacit knowledge in the minds of workers, embedded knowledge in procedures, explicit knowledge recorded in artefacts (e.g. documents, etc.) and in information systems (e.g. information about the competences of each workers (N. Capuano et al., 2011), etc.), and so on. In our approach the organizational knowledge is represented by means of a model (see section III-A for further details) exploiting the Semantic Web stack[1].

The so represented organizational knowledge is mainly useful to accomplish three objectives. The first one is to enable search for suitable conversation partners among all the available human resources in the organization. The second one is to enable search for resources (e.g. documents, user generated content, task

[1] http://www.w3.org/2001/sw/

and project information, and so on) useful to generate personalized and adaptive feedbacks fostering learningful conversations (in this case the virtual assistant, once extracted the concepts from the conversation fragment, uses SPARQL1.1[2] to query the organizational knowledge and provide content to construct feedbacks). The third one is to enable storage and correlation of learningful conversations with the existing knowledge in organization in order to foster reuse. For a further description of the overall approach, Fig. 1 shows the two types of feedbacks and how they support adaptation of the conversation by providing suggestions to the learner (Fig. 1a) and to the tutor (Fig. 1b).

3. ADAPTIVE CONVERSATION-BASED LEARNING SYSTEM

Our ACLS implements the approach described in II. The high level architecture of it is presented in fig. 2.

3.1 Structuring the Organizational Knowledge

Modelling and representing the organizational knowledge are two of the most important tasks related to the definition of the ACLS architecture.

In particular, the technologies adopted to represent the organizational knowledge come directly from the W3C Semantic Web vision. This choice guarantees a layer of interoperability and cooperation among applications (or apps), the fundamentals to build knowledge-based applications, the chance to use a standard query language like SPARQL1.1, the possibility to integrate and reuse existing ontologies, vocabularies and metadata to model several aspects of the organisational knowledge, the capability to support reasoning, inference and so on.

If the Semantic Web provides us with a set of methodologies, languages and technologies useful to represent the organizational knowledge, an effective and efficient organizational knowledge model is needed. The solution for the aforementioned issue is provided by the ARISTOTELE Project[3], where the organizational knowledge is presented as Organization Linked Data structured in three layers as depicted in 3 that provides only a fragment of the whole model. Firstly, the upper layer consists of several linked ontologies (described by using RDFS/OWL/OWL2[4]) used to model the organization key concepts (ontology classes). Secondly, the lower layer consists of the instances of the classes we can find in the upper layer. Lastly, the middle layer is made of a set of lightweight ontologies used to classify and organize the lower layer elements. Lightweight ontologies (described by using SKOS[5]) can be connected each other in order to correlate concepts (at the same layer) and instances (at the lower level).

More in details, the ontologies at the upper layer describes the semantics of domain-independent concepts in organization like Task, Competence, Worker, Content, Document, BlogPost, etc. that are implemented as OWL classes. Whilst, the middle layer defines conceptualizations for domain-dependent knowledge in a specific organization. For instance, the main research topics the organization deals with are modelled as instances of skos : concept and organized in semantic structures like taxonomies or conceptual maps.

It is clear that the middle layer is more dynamic than the upper layer, in the sense that the lightweight ontologies (as we have defined them) can evolve in the time if, for instance, a new research field is activated or new project artefacts are indexed in the Document Management System (DMS) of the organization. Instead, the probability that a concept (like, for example, Document or Task) changes in the upper layer is very low. The construction of the lightweight ontologies implementing the middle layer is a critical and difficult task.

The idea is to generate the aforementioned ontologies by exploiting textual data embedded in documents (M. Gaeta et al., 2011) that are representative for the organizational knowledge. For this aim we exploit the framework described in (C. De Maio et al., 2012) that is based on a fuzzy extension of the Formal Concept Analysis (Q. T. Tho et al., 2006). The objective of the above mentioned framework is building a taxonomical conceptual structure starting from a collection of text documents. The framework defines an ontology generation workflow consisting of three main steps: **text processing**, **fuzzy data analysis** and **ontology building**.

[2] http://www.w3.org/TR/sparql11-query/
[3] http://www.aristotele-ip.eu/en/project/svc/entry/0/196/4/aristoteleproject.html
[4] http://www.w3.org/TR/owl2-overview/
[5] http://www.w3.org/2004/02/skos/

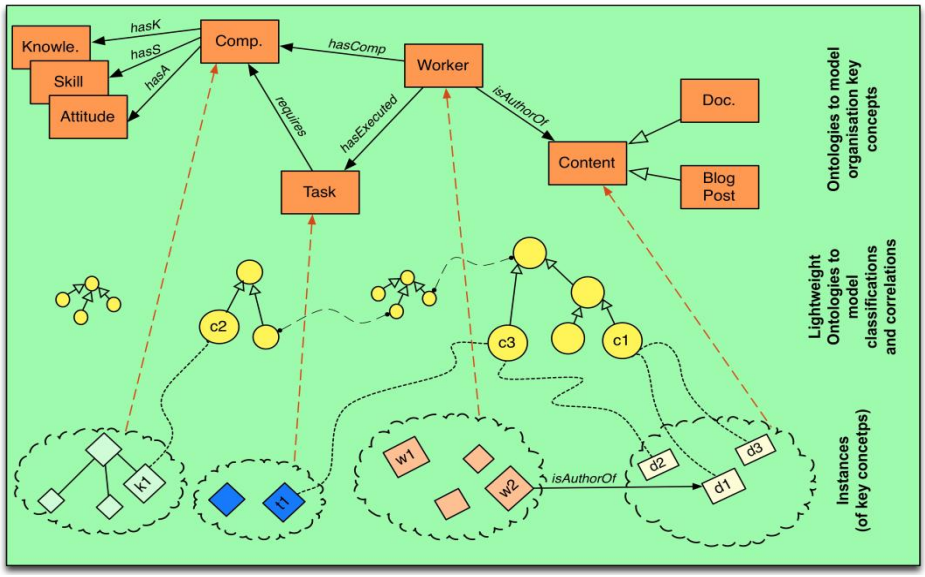

Figure 3. Three layers of structured Organisational Knowledge (Organisational Linked Data)

The goal of the first step is to construct a *Fuzzy Formal Context*, i.e. a matrix showing the relationships between the keywords extracted from the input documents and the documents.

The set of keywords is extracted from the documents, filtered (by eliminating non-informative words by using stopword lists), normalized (by means of stemming and POS tagging) and enriched by inserting the synonyms of all words in the set. The relationship value (in the range [*0,1*]) in a matrix cell (*g,m*) (*g* is one of the input documents and *m* one of the keyword in the enriched set) is calculated by using the TD-IDF technique (term frequency inverse document frequency) and represents an evaluation of the measure of strength of the relationship. The goal of the second step is to analyse the *Fuzzy Formal Context* by means of *Fuzzy Formal Concept Analysis* (*FFCA*) and transform the matrix into a *Fuzzy Concept Lattice* (nodes in the lattice are called *Fuzzy Formal Concepts*) that is a mathematical modelling of the knowledge embedded in the input documents and, moreover, it can be considered an alternative and more informative representation of the matrix. Lastly, the goal of the third step is to transform the Fuzzy Concept Lattice into a taxonomy structure by executing some rules. In our approach we use a SKOS-based representation of the final taxonomy instead of the OWL-based representation adopted in (C. De Maio et al., 2012). SKOS is more suitable than OWL when the objective is to organize large collections of objects and provide a lightweight intuitive conceptual modelling. At the end of the process, the obtained SKOS structures represent the aforementioned lightweight ontologies. It's important to underline that the documents, used as input of the ontology construction process, are already related to their respective concepts in the SKOS structures.

New documents, as well as other artefacts, can be subsequently classified (by manual and/or automatic operations) by the lightweight ontologies.

Definitely, the lightweight ontologies can evolve by exploiting a similar process based again on *FFCA*.

3.2 Activation of a Context-Steered Conversation and Selection of a Suitable Tutor

First of all, it is important to remark the role of the context in which the conversation is activated. The learning scenario we consider in this work is the context-steered learning (A. Schmidt and S. Braun, 2006) where a worker has been committed to execute a specific task (an instance of the *Task* class) that requires a specific competence (an instance of the *Competence* class) that must be developed (fully or partially) by means of the execution of a tutorial conversation. Now, the context is defined as the set of all concepts (nodes of the lightweight ontologies) that are directly linked to the needed competence or to its parts (knowledge, skills or attitudes).

The so defined context is useful to select a suitable conversation partner. This selection is one of the most important operations enabled by the Organizational Linked Data and is realized by using SPARQL queries. In order to find suitable partners (peers, experts, tutors) among all the workers in the organization our approach takes into account, their competences (see classes *Competence*, *Knowledge*, *Skill* and *Attitude*), work experiences (see *Task* class) and produced artefacts (see *Content*, *Document* and *BlogPost* classes).

For instance, it is possible to write a query to find all the workers with *Software Engineering* and *Tutoring* competences in order to reinforce the tutor role. Moreover, it is also possible to relax the constraint on *Tutoring* competence and search only for *Software Engineering* competence to have a peer-based conversation. With respect to the architecture presented in Fig. 2, the module responsible for finding a suitable tutor is the **Tutor Selector**.

3.3 Feedback Generation

Once the lightweight ontologies are generated and deployed, we have two types of elements linked to them: the set $D(c)$ of all documents and the set $E(c)$ of all elements that are instances of classes *Content* (or its subclasses) and *Task*. The main idea is using a search engine like Lucene[6] to index all the elements in the set $D(c)$ and finding matches among a conversation fragment T (extracted by means of the Instant Messaging Tool presented in Fig. 2 by exploiting the *MoreLikeThis* function provided by the Lucene API).

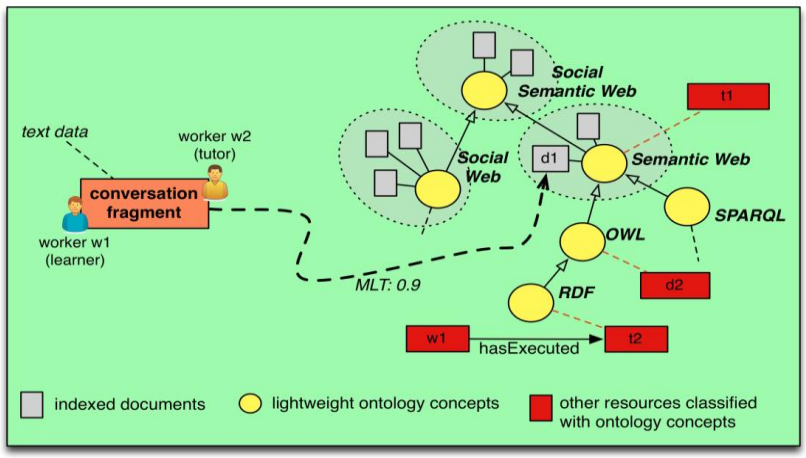

Figure 4. Matching example

The virtual assistant invites the tutor to provide prompts, hints or cues by using worked examples retrieved from the documents, blog posts, wiki articles, task/project information and so on. The idea is that the tutor has the competence to mediate the aforementioned artefacts and use them as learning content. Furthermore, the virtual assistant suggests the learner to reflect on (or to ask the tutor for details about) the correlation among his/her previous work experience, represented by the retrieved elements and his/her understanding of the current conversation fragment.

With respect to the architecture presented in Fig. 2, the module responsible for finding a suitable tutor is the **Personalized and Adaptive Feedback Generator**. Feedbacks for the learner and the tutor are provided by means, respectively, of the **Learner's Viewer of Feedback** and the **Tutor's Viewer of Feedback** shown in the high-level architecture. Table 1 provides a mapping between the generated feedbacks and the interaction patterns in tutorial dialogues (X. Lu et al., 2007) (S. D'Mello et al., 2010).

[6] http://lucene.apache.org/core/

Table 1. Mapping feedbacks on dialogue patterns

Feedback	*Pattern*	*Content*
Suggesting *personal reflection* on integration among conversation topics and learner's prior knowledge.	Student-tutor.	Set A.
Suggesting *questions* (to the tutor) about integration among conversation topic and learners' prior knowledge.	Student-tutor.	Set A.
Suggesting *specific prompting* by instructing with worked examples coming from real and concrete work experiences.	Tutor-student.	Set B.

3.4 Knowledge Reuse

In ACLS, conversation threads are traced and indexed to satisfy a possible need to reuse them in informal or non-formal learning experience. In order to foster reuse, conversation threads are represented by using SIOC[7]. SIOC may be easily integrated with the upper layer ontologies of the Organizational Linked Data because they share the same Semantic Web stack. In particular, we use some extensions of SIOC (e.g. *sioct:ChatChannel* and *sioct:InstantMessage* that are sub-classes of *sioc:Forum* and *sioc:Post*) to model a conversation session and individual messages. With respect to our work, the most important properties of the *sioct:InstantMessage* class are topic and content.

The first one enables to link a conversation message with a *SKOS:Concept*. This is, de facto, a way to index messages and threads by means of lightweight ontologies at the middle layer of the Organizational Linked Data. The second one stores textual data of a message. Thus, a Social Semantic Web process is deployed: conversations produces messages and threads represented in SIOC that are classified with respect to the concepts in the lightweight ontologies and become retrievable through SPARQL queries. The quality of the conversation messages and threads can be evaluated by means of social rating or by assessing learners after the conversations.

4. EVALUATION AND FINAL REMARKS

In order to emphasize the rationale of the feedback generated by the ACLS with respect to the objective of improving the meaningfullness of learning during tutorial dialogues, Fig. 5 provides the rules used to define the feedbacks.

Table 2. Rules used to generate the feedbacks and their rationale

Rule	Description	Rationale
1	Connecting learner's prior knowledge with new one	People learn better when unfamiliar material is related to familiar knowledge and when they ask questions
2	Connecting learner's prior experience with new knowledge	People learn better when they organize and connect new concepts with already acquired ones
3	Enriching explanation with expert's concrete work experiences	People learn better when worked examples are presented in the context of a familiar situation
4	Exploiting organisational resources as learning content	People learn better with guidance rather than by pure discovery

In brief, according to (R. E. Mayer, 2008), the generated feedbacks try to stimulate *generative processes* (e.g. organizing and integrating knowledge) which are those, among the cognitive processes, able to produce meaningful learning. Furthermore, generative processes are sustained also by the defined Organizational Linked Data in the sense that the Semantic Web structures, and in particular the explicit use of the lightweight ontologies, help the learner to organize the knowledge and integrate the new one with the prior

[7] http://rdfs.org/sioc/spec/

one. Unlike what the other systems usually do, the proposed approach pays attention to both the domain knowledge and the cognitive processes raised from the partners' interactions but it doesn't need any expensive modelling activity. Both the approach and the ACLS will be experimented in the next months in the ARISTOTELE Project activities.

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TEACHERS LITTLE HELPER: MULTI-MATH-COACH

Martin Ebner[1], Martin Schön[2], Behnam Taraghi[1] and Michael Steyre[1]
[1]*Social Learning, Steyrergasse 30, 8010 Graz*
[2]*Life Long Learning, Mandellstraße 13/II, 8010 Graz*

ABSTRACT

Individual learning is out of sync with the elements of a curricula and the daily program of a teacher. At a time when multidigit multiplication methods are taught, many children are not perfectly performing the basic multiplication table. Teachers organize settings for learning and they usually have no time to give an individual feedback to every single student. Furthermore they have no physiological capacity to produce statistics and to investigate the probable causes of errors. Our goal is to give teachers a tool to help them to review and train some typical requirements for written multiplying. We use the ubiquity of the Internet and provide on different devices free applications with written multiplication problems. All data are collected centrally and are used to determine typical errors. These data could also be used to answer further new questions and test new hypothesis. This is one aspect of Learning Analytics. The given tasks are automatically adapted to the skill level of a student. Teachers can see every detail of the solution process of every task. But really useful is that teachers can see the typical problems of each student as well as of the whole class every time at a glance. They need just a connection to the database with a web browser – anywhere, anytime.

KEYWORDS

Written multiplication, feedback, learning analytics, degree of competence, algorithm, school children

1. INTRODUCTION

Even before the advent of the first personal computers (PC) in classrooms, educational researchers attempted to realize an intelligent tutoring system (ITS) [13]. Early attempts to model student knowledge were based on a "failure" model for subtraction with more than 100 typical problems described by Brown and Vanlehn [2]. This is based on the idea that computers can “perceive” and evaluate much faster and more detailed information about some aspects of the behavior and the learning process of each individual student in a class as a teacher. Even teachers have always too little time. Therefore in the past the extensive listings of results and protocols have been ignored or rejected by the teachers. The PC with restricted capacity brought some simple drill & practice programs into the classrooms. For our subject “multidigit multiplication” there are actual applications referred in [1] [9] [11] for example. Computer power today is often used for the delivery of content and for the administration. Adaptive skill tests are often used to efficiently estimate a global performance value.

We at the TU Graz are developing some applications (little helpers) which realize the idea to check up and train only a special curricular area. This is based on the experience that teachers refuse any innovations when they tend to intervene heavily in their management of teaching. May be that is a reason that it seems that the ITS-tradition has been forgotten in classrooms. Today, however, we see more and more a confrontation between the general requirements for greater individualization, for more and more precise feedback [8], and this denial of the teacher towards the support of technology.

We agree with Phil Long and George Siemens who stated [10] that “the most dramatic factor shaping the future of (higher) education is something that we can’t actually touch or see: big data and analytics”, the founders of the research field Learning Analytics. And on of the main issues is the question what exactly must be measured to get a deeper understanding of learning processes [4]. Furthermore nowadays a technological shift is happening to more flexible and ubiquitous applications. They are to be used in browsers or even as applications on mobile devices. This new technological environment and a new understanding of Learning Analytics at Graz University of Technology (TU Graz) are realized in applications that can be used by students on many occasions and that could contribute to an automation of basic mathematical operations

[12]. Basic multiplication facts based on an automatic level of proficiency are considered to be foundational for further progress in mathematics [7]. Using this software the arithmetic technique should already be practiced in traditional ways. The program is not primarily intended to use to teach. It is a diagnostic and training tool and gives feedback about typical problems in the domain. It can be used with no further guidance or explanation. The program is intended to relieve the teacher, who usually does not have enough time and concentration to look very carefully for the causes of the mistakes. We had a look to the analog episode in the program TutorIT [11] and we interpret its intrusive help in small steps rather as a blockade than an encouragement. Our applications checks in particular, whether the solution is correct, and then we try to investigate the approach. Of course, if we get only an incorrect result, no carries, no partial calculations, we cannot go on with an analysis.

The main idea of our approach is to collect every student's data in a central database. Tasks are given by a browser based program and by apps for iOS and Android. If a student has completed a multidigit multiplication, the program analyzes different aspects. For example if the solution is not correct, the program looks for evidence on typical failures. Is there a problem with basics, with simple multiplication facts? Is there a lack of overall competence? Are there problems with the correct placement and alignment of the carries or when writing down the partial results? Many individual data are compressed into one compact statement. This application can give teachers a powerful hint for the further promotion of each individual student. We know, that "the mathematicians were variable and versatile in their strategy use, as shown most strikingly by the fact that when 18 of the mathematicians were retested after a few months, they used different strategies on the two occasions for most of the same problems" [3, p.20]. Considering this aspect the correct solution must be recognized in any case and learners should not be forced to specific solution steps.

Finally, it is a major goal, that the results and the evaluation should not overburden teachers with details. Based on the collected data it is possible to generate detailed analyses, almost broken down to the single multiplications which has been shown to solve the task. But we said it already, it must be taken into account that teachers have only a limited time budget for their interpretation. Therefore normally the teachers were "alarmed" for doing some urgent interventions only in a few cases. It can be summarized that our approach is to develop a small web-based application where each single pupil does not get only a random selection of multidigit multiplication tasks. The program estimates a competence level and generates a hierarchy of adequate new problems. The teacher can see just in time the results and analysis of each single task just after the student has finished it.

2. GENERAL CONCEPT

First of all, the program targets school children in classes 4 and 5 - starting from an age of about 10 years. The name and layout of the web-based program was chosen with regard to children: easy and playful; it is called "Multi-Math-Coach" Learning by playing is an important concept in this respect. Knowledge of the basic multiplication tables and the ability of working with an Internet browser are the prerequisites for using the learning application. It is suggested that teachers should always give an initial introduction and overview to children of how to use and deal with the program before using it. For displaying multiplications in the front-end, the standard school method for written multiplications is used [5].

The crucial goals of our application are:

1. An overall learning algorithm that sets the difficulty for multiplications adaptively and independently for each user,
2. The generation of multiplications of a specific category (of difficulty),
3. The analysis/evaluation of the results of the generated and displayed multiplications (= user inputs), typification of the detailed results (multiplication, addition alignment).

It has already been mentioned that the learning application should adapt to the current user's expertise in multidigit multiplication knowledge. To do so, in the very first beginning categories of multiplications that differ in difficulty must be defined. Another main objective of the multiplication generation algorithm is to stay universal and to offer a large variety of examples at the same time. On the basis of [6] eight different problem groups of multidigit multiplication are distinguished. The overall domain of definition includes multiplicands (left factor) with 2 to 4 digits and multipliers (right factor) starting from 1 up to 3 digits in size. All combinations of such factors result in a total of eight problem groups, which are listed in Table 1. A

specific problem group only depends on the size of its both factors. Problem groups 1 to 3, the simplest categories of multidigit multiplication, are summed up to so-called Expertise category I which is formed of multipliers with only one digit in size whereas the multiplicand varies in size. As can be seen in Table 1, a total of three overall Expertise categories are classified like this.

Table 1. The domain of definition for the Multi-Math-Coach.

Expertise	Group	Pattern
I	**1**	nn * n
	2	nnn * n
	3	nnnn * n
II	**4**	nn * nn
	5	nnn * nn
	6	nnnn * nn
III	**7**	nnn * nnn
	8	nnnn * nnn

The outcome of Table 1 now lets us differentiate between three universal categories of examples, each including a more fine-grained classification inside each Expertise class, which allows a universal allocation of multiplications in difficulty. Beside these categories of difficulty the concept of written addition and multiplication includes another dimension: the carry. In our application simple multiplications without carries and multiplications including a carry are separated. As a whole the program's domain consists of eight problem groups for simple multiplications and the same eight problem groups for multiplications including one or more carries. The ability of the application to adapt to the particular skills of the students is based on generating or providing appropriate test items according to this 16 hierarchy levels.

2.1 Generation of Multiplications

The algorithm for generating multiplications on the described sixteen levels differs from problem group to problem group. After a couple of serious tests it was realized that much of the thinking and strategies for generating the factors randomly was not effective. The simulations showed that factors with the digits 1 and 0 are more frequent than expected. For the first concept (tasks with no carry) it is very difficult to build multidigit multiplications.

One pre-condition for the algorithm is the absence of identical digits in a factor. Furthermore factors must be generated under the condition that no carry is needed to solve the multiplication.

A bunch of test runs carried out specific frequencies for the occurrence of specific digits for particular problem groups. Larger numbers in the multiplicand require smaller numbers at the multiplier, if a carry must be avoided. See Table 2 as an example where the probabilities for digits for multipliers of (the simplest) problem group 1 are shown for multiplications without carry. After generating the multiplier for a specific problem group, the multiplicand is generated. This (left) factor depends completely on the single-digit value(s) of its according factor (multiplier).

Table 2. Probabilities of occurrence of digits for multipliers of problem group 1.

Digit	Probability of appearance
1	**5%**
2	**32%**
3	**32%**
4	**21%**
5-9	**10%**

The algorithm deals with random numbers and probabilities to generate appropriate digit values for the multiplicand factor. See Table 3 for illustration where the beforehand-generated possible values for a multiplier for problem group 1 are shown with its equivalent domain of definition for the multiplicand. It is mentioned that the outermost digit to the left of a multiplicand is always generated randomly without considering the multiplier's value because this special digit can also include a special form of carry. In this case the carry is not considered for the number of successful attempts.

Table 3. Probabilities of occurrence of digits for multipliers of problem group 1.

Digit	Multiplicand (exclusive of left outermost digit)
1	**Random number out of [3, 9]**
2	**Random number out of [3, 4]**
3	**Random number out of [1, 3]**
4	**2**
5-9	**Random number out of [0, 1]**

Multipliers from expertise category II and III are not generated digit by digit. They were drawn at random from a table of all remaining possible factors.Generating factors for the category “multiplications with carry” is easier and the values are more variant but the generation happens in a similar way as explained above.

2.2 Evaluation of Multiplications

In table 4 all positive (OK) states for the different sorts of calculation processes in multidigit multiplications are shown. In the same way table 5 shows all possible error states which the program is able to identify.

Table 4. All determinable OK states and their possible occurrences in the program.

Occurrence	OK state	Description
Examples without a carry	**OK**	OK (failure-free)
Examples including a carry	**OK**	OK (failure-free)
	OK_MENTAL	OK (mental arithmetic)
	OK_NOCARRY	OK (mental arithmetic with succeeding failure)
	OK_ERR	OK (including consequential failure)
Addition	**OK**	OK (failure-free)
	OK_END_ERR	Addition OK (including consequential failure)
Overall state	**OK**	OK (failure-free)
	NO_ERROR	No failure

Immediately after a user responds to a multiplication, the algorithm for evaluation of all detailed user inputs is executed. Beside of saving absolutely all user values of each input cell, the algorithm takes note of specific errors and the so-called positive states of the user input. The main objective of the evaluation process is to find out and classify typical failures done by each learner. The evaluation algorithm for multiplications including carry is much more complex than the one for simple multiplications. This is due to the fact that multiplications with carries offer different input values for different strategies. If the result is near to the correct one, a reconstruction of all steps which has been well done is not always possible. Each “OK”- and “Error” state presented in the table5 is totaled in the profile of each single student. These states are the basis for the statistical presentation and hints. For teachers the hints can be extremely helpful because the teachers have no opportunity for such a close look on a single student under normal circumstances.

Table 5. All determinable errors the program identifies.

Occurrence	Error state	Description
Examples without a carry	**ERR_INPUT**	Input failure
	ERR_1x1	Basics failure
	ERR_REV_IN	Reverse input failure
Examples including a carry	**ERR_INPUT**	Input failure
	ERR_1x1	Basics failure
	ERR_REV_IN	Reverse input failure
	ERR_NOADD	Carry error (correct basics – no addition)
	ERR_ADD	Carry error (despite correct answer)
	ERR_UNKNOWN	Unknown failure
Addition	**ERR_INPUT**	Input failure
	ERR_END_ADD	Addition failure
	ERR_END_OK	Addition failure (despite correct answer)
Overall state	**ERR_MISC**	Multiple failure

2.3 Adaptive Learning Algorithm

When the program starts it is a real challenge to estimate the competency level of the actual user in our hierarchy of 16 categories in order to generate an adequate multiplication task that suits the user's current expertise.

For each user the algorithm sets six so-called expertise attributes in the database. These attributes reflect the current user's knowledge in multidigit multiplication. The six values are divided into two groups of three categories – one table for simple multiplications without carry and the other table for multiplications with a carry. The three categories reflect the three classes of expertise in table 1, respectively.

At the beginning of an assessment the current attribute values of a user are loaded from the database. If it is the first time the user is going to practice, all values are initialized to zero. The learning algorithm now chooses randomly a multiplication of the simplest expertise category (out of problem group 1 to 3), as well randomly without or including a carry. The multiplication is then displayed to the user. After solving the multiplication, the evaluation algorithm computes the state of the user input (the result) and displays the user if his or her answer was correct or incorrect. In the background the expertise attribute matching the expertise category of the generated multiplication is increased with 1, if the user's answer was correct, or decreased with 1, if the answer was incorrect. If the attribute value was zero, no decrease happens. The same happens for a value equal to three – no increase takes place. Next, another example is generated from the lowest expertise category. If an expertise attribute's value is equal to three, this means that the user has practiced three consecutive solutions and it is supposed, he or she is now able to solve multiplications from the reflected expertise category. In the following process, no more examples from this category are generated. If all six attributes are set to value three for a specific user, then this user has successfully solved the training mode. These users have the expertise to solve all multidigit multiplications in this domain. At any time during the training a so-called training example is generated and displayed to the user (10% of occurrences). Such a training example is simply a multiplication chosen from the already solved expertise categories. This serves as a refreshment of knowledge and leads to strengthening the training purpose. If no multiplications were solved correctly and a training example is chosen randomly, then an alert for the teacher is generated.

3. TECHNICAL DETAILS

The web-based bilingual application is programmed in PHP 5 using the Zend Framework. For layout and design purposes Cascading Style Sheets (CSS) and jQuery are used. MySQL was chosen as a relational database management system. All mentioned technologies are Open Source and can be freely adapted and distributed.

4. USER INTERFACE

First of all, there is a start page where users are able to log in with a specific username and password. To be able to log in and to play with the multiplication training program, users have at first to register for free on a separate webpage (http://mathe.tugraz.at). After the login process students enter a welcome-page ("Are you ready?") as a preparation for the training mode. Logged-in teachers will see an additional "Statistics" button at the top of the page. When clicking on the green button ("Let's go"), the training mode starts and according to the described algorithm an appropriate example is presented.

Figure 1 shows a correct result of the overall calculation (user inputs) of a multiplication of expertise category II without add carry. All input cells were checked and marked correctly in the evaluation process. The evaluation algorithm therefore computes a statistic on positive result states, which have been saved in correspondent database tables. Additionally, the learning algorithm increases the user's property for expertise category II (compare the two-digit multiplier) by adding 1 to his/her state.

Figure 1. Correctly solved multidigit multiplications.

Figure 2 demonstrates a wrong answer of a filled-in multiplication calculation of the most difficult problem group (8) including carry. Wrong input cells are marked with a red background to advise users exactly where failures occurred. The evaluation algorithm has computed result states for each input cell, as well as an overall result state. The second row's result-states include, for example, correct calculations (OK), a correct mental calculation (OK_MENTAL) as well as the state OK_NOCARRY and an unknown error (ERR_UNKNOWN). The third result row's outcome states include: OK, ERR_NOADD, ERR_UNKNOWN, OK_ERR (see tables above for an explanation of specific result states).

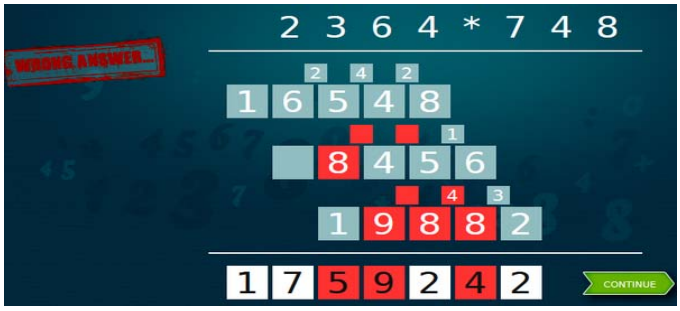

Figure 2. Wrongly answered multidigit multiplications.

Figure 3 points out the statistics of all grades and students belonging to a teacher/class. Each student is listed with its name, total amount of solved examples, total amount of correct solutions, total amount of incorrect solutions, as well as a computed success rate and error burst. A positive success rate (> 70%) is marked with a green background whereas a negative success rate is marked with red background. A link leads to detailed table for a selected student. This figure shows the typically error bursts:

- Basic errors (less competence in handling the multiplication tables)
- Problems with the carry
- Multiple Errors

GRADE saaralt

User name	Overall answers	Correct answers	Incorrect answers	Success rate	Error burst	Details
Basti05 Never	21	14	7	66.67 %	Multiple errors	› HERE ‹
Anton Cary	11	7	4	63.64 %	Carry addition error (correct basics - no addition)	› HERE ‹
no1x1 mining	22	9	13	40.91 %	Basics error	› HERE ‹

Figure 3. List of learners and compressed statistics (Error burst).

3868*48

Basic multiplication	Correct carry to add	Correct Solution	User carry input to add	User answer	New carry	Result status
8*4	OFF	32	OFF	32	3	OK
6*4	3	27	3	27	2	OK
8*4	2	34	2	34	3	OK
3*4	3	15	3	15	OFF	OK

Figure 4. Detailed analysis of one task.

Figure 4 shows the top of the most detailed listing. (This is only optionally shown!) It includes each single input (cell) of a single multiplication problem. It shows exactly the evaluation of the generated problem of figure 2, including the computed positive and erroneous states as explained before.

5. CONCLUSION

The ubiquity of laptops, netbooks, tablet computers, and smartphones among young people led to a complete new way of dealing with learning materials as well as watching learning processes. Research in the field of Learning Analytics seems to be a big task in the future. For example, many teachers express their fears about being replaced or to be less or not necessary anymore. Scandura [11] spread in his article exactly this issue and answered immediately: "What TutorIT can do better than a human and Why: Now and in the Future". Nevertheless, our research team is not sharing this opinion. The role of tomorrow´s teachers is much more like to facilitators and coaches who assist learners according to their individual needs. Many teachers are offering other hints and additional material. Our application should have the role of such an additional content. We don’t dictate the students the individual solution steps. If anyone prefers only mentally computing, the right solution is accepted. If someone does not use the prepared input fields for the carries , this will be reported.

Furthermore our application gathers more details about learning multidigit multiplication. Resulting from many personal discussions with teachers about common failures our team got the impression that teachers almost exclusively see only one cause of problems: multiplication facts. Due to the fact that teachers usually

have no time to take a closer look or to figure out systematically what might have caused each single failure this application should close this gap. The program tests not only for competence in multiplication facts. Additionally it takes also a look on other fundamental skills. Finally, if teachers use the advice of the program, they can try to help the students in targeted manner. In some cases, the students will probably have other physiological and psychological problems which were presented in detail in in Dowker [3].

For the future of the program also the issue “processing time” is a challenge. This is corresponding to the goal of Hasselbring [7]: an “automatic level of proficiency”. This is a category that would be easy to implement in a diagnostic system. In a close cooperation to further interested institutions this issue as well as a huge field study will be carried out in future. It can be concluded that Learning Analytics in combination with the possibilities of innovative technologies and innovative teaching and learning strategies is a powerful field to enhance learning processes of each individual learner.

The apps and the user account for this and other little helpers are available for free on http://mathe.tugraz.at . Choose “Registrieren” and then “English”. With a single e-mail address you can get an account to test the functionality. To get accounts for schools and classes please have contact with martin.ebner@tugraz.at.

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YOUFLOW MICROBLOG: ENCOURAGING DISCUSSIONS FOR LEARNING

Rafael Krejci and Sean W. M. Siqueira
Federal University of the State of Rio de Janeiro (UNIRIO)

ABSTRACT

Microblogs have been used in the educational context. However, differently from following friends' status messages, in the educational scenario it is important to follow the discussions, to understand the flow of messages. YouFlow microblog was developed for that purpose. It is a microblog that provides the main structures of discourse that are available on communication systems as well as messages' categorization according to a lesson plan. An exploratory case study allowed analyzing the use of the structures of discourse on the microblog in an educational context. Then, an explanatory case study showed an increase in the participation on discussions of topics according to a lesson plan.

KEYWORDS

microblogs; discussions; collaborative learning; lesson plan; structure of discourse.

1. INTRODUCTION

As microblogs become more used, some differences are explored on specific domains, such as microblogs for a specific geographic area: i) Frazr (http://www.frazr.com), which is focused on European public that speaks German, Spanish or French, and ii) Sina (http://www.sina.com.cn), focused on the Chinese public; or a specific age group or sex (Sina - http://www.sina.com.cn), common objective, learning (Edmodo - http://www.edmodo.com, and Cirip - http://www.cirip.ro), collectivity and other characteristics.

Similarly, some online social network environments such as Facebook (http://www.facebook.com) and Myspace (http://www.myspace.com) provide microblog functionalities for the participants. An analysis of the 100 main learning systems in 2009 showed the importance of microblogs systems in the educational context as Twitter (http://www.twitter.com), Edmodo and Plurk (http://www.plurk.com) were listed (Holotescu and Grosseck, 2010). In 2011 (http://c4lpt.co.uk/top-100-tools-for-learning-2011/), Twitter is listed as the main system (among the top 100) to support learning.

Microblogs are systems with a high publishing frequency, which makes the conversation interesting for learning. Although they are considered asynchronous conversation tools, usually there is an expectation that the information is consumed in real time because there is a huge amount of users online.

However, this high amount of publications, in addition to the way the messages are organized, may lead to a misunderstanding of the discussion (Lim, 2008). It promotes a search for other microblogs that can organize the content better (Academic Aesthetic, 2008).

As in a microblog the publishing frequency is high (140 million of posts per day in Twitter - 2011 KISSmetrics - http://blog.kissmetrics.com/twitter-statistics/), it is necessary a filtering mechanism for the user to get the relevant content and follow the discussion. When applied to the educational context, the relationships among the messages (posts, comments, replies etc.) is really important because the user needs to understand not only the message content, but also its relationship with the other messages in order to follow the discussion and participate of the collaborative dynamics based on discussions on microblogs. In the future, this kind of dynamics could be supported by models such as those proposed by Atif (2012).

We explored the discourse's structures as well as the categorization of messages in microblogs for teaching and learning. Section 2 presents structures of discourse in microblogs according to the exploratory case study. Section 3 explores how categorization, filtering and search can be used in the educational context in microblogs. Section 4 presents the data analysis of our research according to the use of these functionalities on YouFlow during the second case study. Section 5 provides a deeper analysis on the participation of the students on the second case study. Finally, Section 6 presents some final remarks.

2. STRUCTURES OF DISCOURSE ON MICROBLOGS

We supposed the structure of discourse may influence on how the user can follow the messages in microblogs. Then, this section describes the structures of discourse that are available on collaborative (communication) systems. The structuring of discourse represents the relationship possibilities among the messages. Among the main structures are (Gerosa et al, 2005): list, tree and graph.

In the list structure (or linear) each message is chained sequentially. It may be ordered by the author's name, message's title or posting date. The visualization of the messages follows this order and therefore the possible relationships among the messages are not explicit (although they may happen, for instance a message may be an answer to another one).

In the tree structure (or hierarchical), each message (that comes after the first one) must be associated to another one that is called its parent. A parent message may be associated to more than one child. It allows a divergence on the communication.

In the graph structure (or network), a message may be associated to more than one message at the same time (independently of the hierarchical position). Therefore it is possible to notice when a conversation is getting a consensus. This approach is similar to the one presented at (Camusi and Giovannella, 2010).

The star-graph structure is a specific type of the tree structure where there is a central node (root), which is the parent of all the other messages. The root message is the one that starts the discussion. All the other messages are called leaves. This structure allows a focused discussion (on the starting message) and it is common on blogs (Marques et al, 2013).

YouFlow microblog was developed to support an analysis on the different structures of messages. Therefore one can choose the structure and use it accordingly. Table 1 compares YouFlow and other microblogs used in the educational context according the structuring of messages. Most of them are based on the linear and star-graph structures.

Table 1. Comparing the structuring of discourse on the main microblogs

Microblog	List	Star-Graph	Tree	Graph
Cirip	X			
Edmodo	X	X		
Twiducate	X			
Twitter	X	X		
Plurk	X	X		
Buzz	X	X		
YouFlow	X	X	X	X

Figure 1 shows the Tree structure in YouFlow, while Figure 2 show the Graph structure.

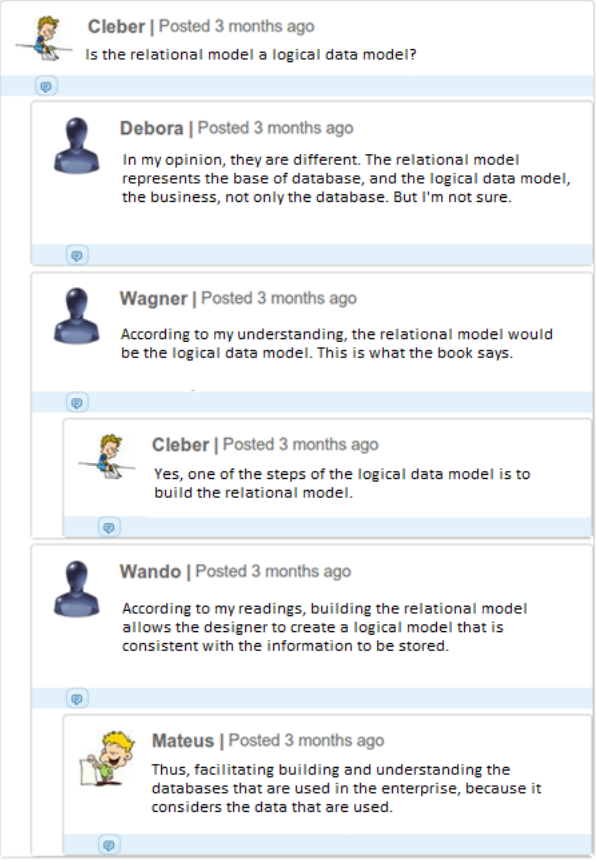

Figure 1. Tree structure in YouFlow.

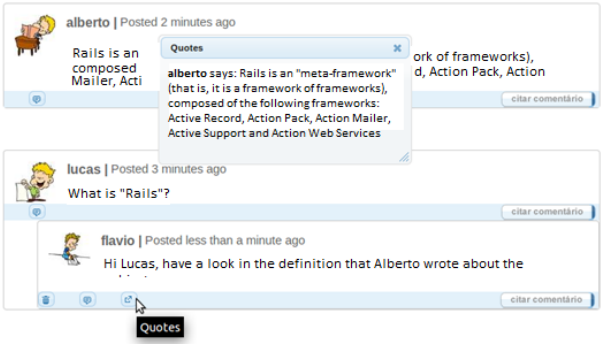

Figure 2. Graph structure in YouFlow.

A case study using YouFlow microblog in an educational context was performed during the first semester of 2011 in the course of Fundamentals of Information Systems. This course is part of the undergraduate curriculum of Information Systems of a university.

From the data analysis it was possible to notice the importance of using microblogs in the educational context. When inquired about the microblog influence in learning (closed question), 82% of the students answered it favors learning and 18% answered it does not influence. In the testimonies (open questions) it was also possible to notice the microblogs' influence on learning. Maria stated "the use of microblogs helps on improving the interaction among the students, directly contributing to increase everyone's participation. It makes the activity delightful.". Lucas said he "liked it because it promotes a good interaction and improves searching online content". John told he "thinks it is good for exchanging information about the course". Finally, Cleber stated "it is interesting because it makes the students leaves the inertia.".

About the use of the microblog, the participants highlighted its simplicity, dynamics, practice and intuitive use as the characteristics they liked most. They answered the open questions with good observations. John: "YouFlow is quite similar to Twitter."; Lucia: "I liked most the messages about the subjects and the possibility of quoting comments of other friends."; Maria: "I liked the fact of everybody participating more since the interaction through the computer decreases the inhibition of the students."; and Cleber: "it is a different (interesting) way of studying.".

Although the participants were used to the environment based on microblog, some had some difficulties. From the participants that answered the questionnaire, 18% of them thought it was very easy to use, 55% almost did not have difficulties and 27% had some difficulties. Through the log analysis it was possible to notice that the quote functionality, which was available in the structuring of discourse based on graph, was not used. John reported he "had some problems with the user interface that confused in some moments." Carla said she "had difficulty on using graph". The other approaches, linear and tree, were commonly used.

Although the graph structure provides more possibilities for relationships among the messages (quotes), it was considered a complex alternative. Perhaps it would be necessary to consider a previous training with the participants in order to have this functionality used.

The linear structuring of discourse promoted the communication through publishing content and definitions. However, when the focus is on discussions, the relationships among the messages are important. This was the case for one participant when making explicit the relationship through the use of "@" sign for answering a message from other participant (this is a really common feature on Twitter). The tree structure was the alternative that best adapted to the dynamics because it allowed the relationship among the messages and promoted the interaction among the participants.

3. CATEGORIZATION, FILTERING AND SEARCH IN MICROBLOGS IN THE EDUCATIONAL CONTEXT

Collaboration requires communication, coordination and cooperation (Gerosa et al, 2005). Individuals must collaborate in order to work or learning in group. They must share ideas (communicate), work in harmony with other participants of the group (coordinate) and perform tasks well (cooperate) (Fuks and Assis, 2001).

Although the discussion of subjects is important to communication systems, when it is not correctly managed it may result on information overload. It can bring out the difficult of assimilating content.

In order to reduce the content provided to the user, predefined criteria can be used to categorize content. We chose the classification based on topics of a class plan (programmatic content) because the domain specialist (the teacher) defines the topics to be discussed. It promotes thinking on the students' messages and provides a classification that is better or equal to the free classification. The classification based on the topics of the programmatic content of a class plan also provides different mechanisms for retrieving information as well as it has a good potential to support teaching and learning.

The classification of the messages can support search and retrieving information through filters that helps understanding what is under discussion or through textual searches.

Therefore, the message categorization in the microblog YouFlow is based on the topics of a class plan. When registering a new topic, information about the topic (such as the description of the topic) can also be added. Then, textual searches can use these pieces of information to improve and expand their results.

For instance, a class plan could be organized in topics such as Technology-Enhanced Learning, Web-Based Education, and Microblogs for Learning. Then, these topics should be registered in YouFlow and when posting a message, the user could choose one of these topics to categorize its message. Therefore, it would be possible to filter the messages related to each specific topic.

The textual search is based on keywords, which allows retrieving the categories that has in their description the searched term. Then, users may have access to microblog messages that do not explicitly mention the searched term, but that were classified in a category that has this term in its description. The keyword search may be executed through a free textual search or through categories that were predefined according to the class plan.

The search by related messages is executed in three steps: i) retrieving information from tracks that have the searched term, ii) recognition of each node of the track that corresponds to the search, and iii) exhibition of the sub-track that is built from the previous step.

Therefore, YouFlow microblog has categorization, filtering and search.

4. SECOND CASE STUDY

A second case study was performed aiming at analyzing if in a microblog with tree structuring of messages, in addition to the classification of its messages in topics of a class plan, would provide a better following of the discussion as well as better participation of the students.

The case study was performed in the second semester of 2011. It started in a classroom of Fundamentals of Information Systems, of the undergraduate program of Information Systems in a university. The characteristics of the students and the class are the same of the first case study. In this class, YouFlow microblog was introduced to the students as well as the instructions for the class activity.

It was possible to notice from the application log that the amount of messages by day was bigger when considering categorization of the messages than the approach with no categorization of messages. Fig. 3 shows the diagram of discussions per day and the amount of messages in each approach.

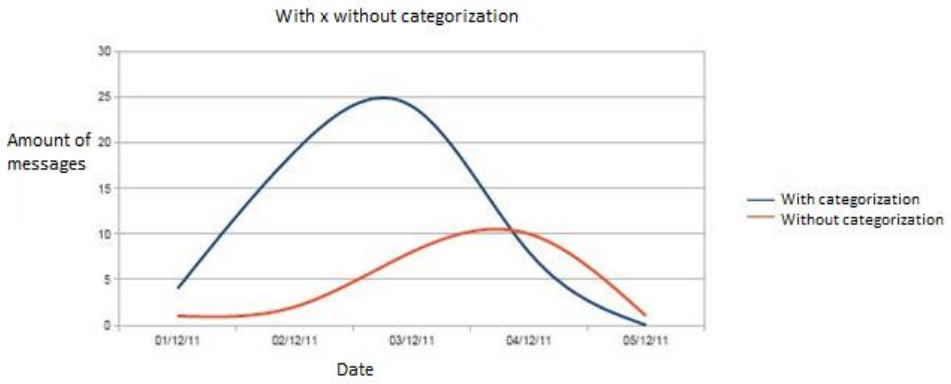

Figure 3. Messages per day.

In addition to the amount of messages with categorization being bigger than the amount without categorization of the messages, the students confirmed the preference to the categorization approach through the online questionnaire with open and closed questions. When inquired about the approach that benefits the education, 80% of the students selected the categorization while 20% chose the approach without categorization. When inquired about the approach that improves the discussion, the result was similar to the education question: 70% selected the categorization approach while 30% chose the approach with no categorization.

The categorization is available at two stages: i) publishing and ii) reading. When inquired about publishing messages, 30% of the users preferred to publish without classification while 70% preferred to publish the message classifying it. When inquired about reading, 90% of the users preferred to use the filter to understand the discussion, while 10% preferred not to use the filter and see everything. John argues about the importance of using the filter especially when reading: "It is easier than in other blogs. I always got lost on the blogs because we are in a discussion and someone sends a message that is not related to the discussion. Then, another person answers that and sometimes the previous subject gets lost. The filter organizes the messages and solves this problem.".

The open questions of the questionnaire allowed collecting data about the educational dynamics. When inquired about the experience of using YouFlow microblog on the course, the results show the use of microblog improved learning. Some answers were: "It showed a usage that I hadn't thought about to discuss the subjects in a faster way.", "It was an interesting experience because I already use microblogs, but in a different goal from the activity in YouFlow.", "It was an excellent experience of sharing information and learning that should be used since the beginning of the courses because it really helps the students.", "It is interesting because the course has lots of subjects and plenty of content material. The subjects lead to discussions and the microblog helped the discussion outside the classroom, online.".

The project of the case study consisted of using YouFlow in three stages: there were two different subjects (stages one and two) to be discussed and the third stage used a subject that encompassed the previous two. Therefore, in the third stage the students could use the search functionality available on the microblog to access the previous content. In the stage one, the groups of students were organized on those who would discuss the subject using the categorization of messages and those who would discuss the subject without categorizing the messages. Then, in the stage two, the group exchanged the approach (i.e., the one who used categorization of the messages in stage 1 could not categorize the messages in stage 2 and vice-versa).

The students were at the beginning of the course and therefore they were in at the same level. They were motivated to participate on the discussion of the group and the results presented at (Stepanyan et al, 2010) for student interaction at Twitter does not directly apply to this study.

Through the analysis of the application log, it was possible to notice that the search functionality was not used as much as expected. There were only a few searches. However, when inquired about the search results,

50% of the users preferred the categorization of the messages (topics), 50% preferred related messages and 0% preferred the loose messages when the focus was on the discussion. Considering the learning aspect, 80% of the users preferred the categorization (topics), 20% preferred the related messages and 0% preferred the loose messages. Although preliminaries, the search results show a possible evidence that the search results grouped by categories and related messages are more relevant (or better) to discussion and education purposes.

5. ANALYSIS ON THE IMPROVEMENT OF THE DISCUSSIONS

Be β = {A, B, C, D, E, F} the graph (tree) showed in Fig. 4. The tree's depth is the depth of the leave of highest hierarchy, i.e., leaves E and F. For the tree β, the depth is equal to 2.

For the data triangulation, two groups were analyzed: with and without categorization. Considering the tree depth concept, the depth of a discussion with and without categorization was calculated through the sum of each tree of the forest, divided by the amount of trees. Fig. 5 shows the formula for calculating the average depth according to each approach (with and without categorization), where Pm is the average depth of each approach, and Pi is the depth of each discussion on each approach, varying from i=1 to n, where n is the maximum amount of tracks of the approach.

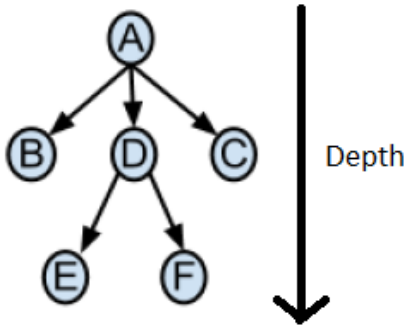

Figure 4. Depth of a tree.

$$Pm = \frac{\sum_{i=1}^{n} Pi}{n}$$

Figure 5. Formula for calculating the average depth.

We analyzed the data from the application log and applied the formula for calculating the average depth by approach. The discussions based on the tree structure with categorization of messages had a higher average depth than the one without categorization. Table 2 shows the results of average depth, where in the categorization we found 2,12 messages while without categorization we found 1,43 messages. The categorization approach had 53 messages in a forest of 17 trees. The approach without categorization had 17 messages in a forest of 7 trees.

Table 2. Average depth by approach

Approach	Average depth	Amount of messages	Amount of trees
With categorization	2,12	53	17
Without categorization	1,43	17	7

Analyzing the 17 discussions (trees) from the categorization approach, the maximum depth was 5 (first and fifth discussions), while the minimum depth was 0 (second discussion). The depth zero means a message was published, but had no answer.

Analyzing the 7 discussions (trees) from the approach without categorization, the maximum depth was 2 (third, fifth and seventh discussions) while the minimum was 1 (all the other discussions).

Fig. 6 and Fig. 7 show the probability by depth for each approach (respectively, with categorization and without categorization).

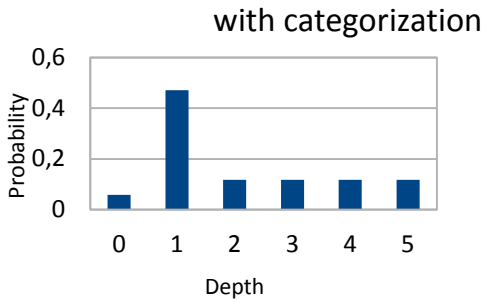

Figure 6. Probability of occurences of discussions by depth (with categorization).

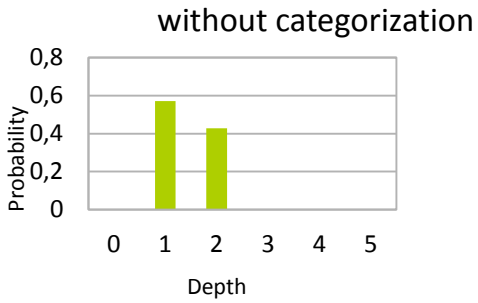

Figure 7. Probability of occurences of discussions by depth (without categorization).

In this research we considered the messages that are related to the root node in each discussion. Therefore, the amount of messages for each track (or discussion) per approach (with categorization and without categorization) was calculated. Table 3 shows the average amount of messages per track. When the categorization of messages was available, the amount of messages was higher than when the discussions did not consider the categorization of messages.

Table 3. Average of messages by approach

Approach	Average of messages
With categorization	1,9
Without categorization	1,4

6. CONCLUSION

In this work we explored the use of different structures of discourse as well as the categorization of messages in microblogs when considering the educational context. Although other works discuss the influence of microblogs in the academic environment, e.g., (Ebner, 2013) and present the importance of discourse structuring in microblogs, e.g., (Mühlpfordt and Wessner, 2005), we developed a microblog that allowed not only structuring the discourse according to different approaches, but also characterizing the discussions according to a lesson plan. The objective was to provide a better understanding of the discussions, allowing the participants to follow the messages and their relationships in collaborative dynamics based on discussions. The results were: i) the categorization of messages according to the class plan allowed deeper discussions; ii) the amount of messages and preference of the students for the categorization approach are directly related; iii) the filtering of messages (categorization on the reading time) was used as a facilitator of the discussion understanding; iv) the students prefer search results organized by the categories and related messages; and v) the students were able to follow the discussions supported by the tree structure of discourse, categorization of messages according to the class plan and searches or filtering of messages.

Some approaches for messages' visualization were considered in this work, such as discourse structuring (linear, tree, graph and star-graph), categorization of messages and search. However, other approaches could be explored, such as i) recommendation of messages in microblogs; and ii) groupings of messages according to date, priority and subject. These approaches are alternatives for reducing the amount of information to be explored and therefore they consist of possibilities for showing the messages that are more relevant to the user, which in an educational context can provide better understanding of the content and discussions.

Although the focus of our work is on helping the participants of the conversations to follow the discussions, we could also provide easier feedback to the teacher in an approach similar to the MIRA (Akbari et al, 2010), but based on message structuring and filtering.

The search presented by YouFlow has a good potential to be explored in microblogs used for learning, especially considering the results by topics of a class plan and related messages. If the domain semantics is also considered, then we believe that even better results could be provided. It would be possible to provide search results based on synonyms, meanings or related subjects or even other categorizations schemes (e.g., user-based categorization). In addition, automatic classification procedures such as an adaptation of the

approach used for classifying learning objects presented in (Mendoza and Becerra, 2010), (Lama et al, 2011) or (Lau and Lee, 2012) could be considered. We are also studying if YouFlow can be considered a new communication mechanism: the micro-forum.

ACKNOWLEDGEMENT

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INTERACTION PROBLEMS ACCESSING E-LEARNING ENVIRONMENTS IN MULTI-TOUCH MOBILE DEVICES: A CASE STUDY IN TELEDUC

André Constantino da Silva[1], Fernanda Maria Pereira Freire[2], Alan Victor Pereira de Arruda[3] and Heloísa Vieira da Rocha[4]

[1]*Institute of Computing (PPG)/UNICAMP, IFSP, Campinas, Brazil / Hortolândia, Brazil*
[2]*NIED/UNICAMP, Campinas, Brazil*
[3]*ProFIS/UNICAMP, Campinas, Brazil*
[4]*Institute of Computing/UNICAMP, Campinas, Brazil*

ABSTRACT

e-Learning environments offer content, such text, audio, video, animations, using the Web infrastructure and they are designed to users interacting with keyboard, mouse and a medium-sized screen. Mobile devices, such as smartphones and tablets, have enough computation power to render Web pages, allowing browsing the Internet and access e-Learning environments. But, their main interaction style is touching, bringing some problems, cosmetics or severe ones. To identify these problems and correct them to allow mobile users access the TelEduc, an e-Learning environment, we planned a user test case with four volunteers using smartphones for access it. The collected data was analyzed and some problems were identified, giving some insights about the problems and barriers multi-touch mobile users dealt and can be easily corrected to give them a better interaction experience. To have an e-Learning environment with good usability in mobile devices is a first step to have a virtual learning environment for sharing data between desktop and mobile devices and understand the behavior of mobile users in this context.

KEYWORDS

Mobile devices and services; Interfaces, interactions and systems for distance education; Interface evaluation; Usability testing and evaluation.

1. INTRODUCTION

e-Learning environments, as Moodle (2013), SAKAI (2013) and TelEduc (2013), are Web applications with tools to support teaching and learning activities though the Web, taking advantages of the Web structure to offer content with text, images, audios and videos in a hypertext document. The environment´s tools allow users to create content, communicate with other users and manage the virtual space, so tools like chat, forums, portfolios, repositories are widely used, and tools that explore the audio and video resource to communication, such as instant messenger and video-conferences, are becoming common among the environments.

Mobile devices, such as smartphones and tablets, are becoming increasingly popular; most of them have touch screen displays, are easy to carry, have autonomy for hours, Internet access and enough computing power to process Web pages. So, Web sites and Web applications, initially developed to be used with keyboard, mouse and a medium-sized display, are been accessed by small touch screen devices. The e-learning environments fit in this context. Three kind of solution to allow mobile users access e-Learning environment are emerging: specific device application, Web site specific for mobile devices, and improvement of the environment for mobile and desktop access. Each solution had vantages and disadvantages. But, in the case of virtual teaching and learning environments, we need ask: is it fundamental have a specific environment for only mobile users? Since Web technology has a power to integrate different technologies, we believe in a virtual teaching and learning environment that allow any device accesses.

Maurer *et al.* (2007) did some usability studies using touchscreen mobile devices and desktop for browsing in Web sites, shows that "more and more people prefer using original content instead of the mobile version, especially for users of new generation mobile devices like iPhone and Android phones". Another result of this work was the users prefer to use the standard Web site instead of tailored mobile versions of Web site. But Schmiedl *et al.* (2009) have a different opinion; in their research they conclude most of the users still prefer tailored versions. Kaikkonen (2008) shows that the standard and the tailored Web sites are both used but for slightly reasons.

Since there is not a clearly opinion in the researches about the users preference in using tailored mobile version or the standard interface, it is important to find and destroy barriers that mobile users meet when uses standard Web interface. In e-Learning context, which are the barriers or the problems the user dealt? To identify them in TelEduc environment we did user tests. Through this work we identified important design issues to allow mobile users access e-Learning environments and Web applications. Section 2 presents related work, Section 3 presents the TelEduc environment. The materials and method are described in Section 4. The identified problems are presented in Section 5, and Section 6 discusses some solutions. Section 7 presents the conclusion and future work.

2. RELATED WORK

The e-Learning environments´ development teams are building solutions to provide access on mobile devices. Three kind of solution are emerging: specific device application; Web site specific for mobile devices; and improve the Web site for mobile and desktop access.

Building specific device application allows designing a suitable user interface for the device and taking advantages of smartphone´s features, such as touchscreen and camera, but needs develop an application for each mobile platform, so to be developed needs specific knowledge programming team and increases the code lines number to maintain. Moodle community offers the Moodle App (2013) and Moodbile (2012), two native mobile applications with versions for the most popular smartphone´s platforms.

Moodle, since version 2.1, offers a Web site specific to mobile devices, an example for the second type of solutions for access e-Learning environments in mobile devices. Building a specific Web site to mobile device allows designing a suitable user interface for mobile devices taking account some common characteristics, such small touchscreen, but depends of the browser to access some platform features, such GPS, and increases the code lines number to maintain too.

The latter solution considers that smartphones and tablets have enough computational power to render Web pages and to do some adaptation if it is necessary, and offer the same user interface for any device. To design this kind of user interface it is necessary to do some usability studies to found barriers or user interaction problems. Disadvantages of this solution are to depend of browsers to use the mobile features and the difficult of consider many interaction styles in the same user interface.

This solution can start from a user interface design model for desktop and be improved to consider mobile devices. So in the initial design was designed thinking the user will interact by keyboard, mouse and medium size display and, allowing users accessed these applications on mobile devices, there is an increasing of interaction styles number, such touchscreen. With the interaction hardware changing the user deals with new interaction problems. Shrestha (2012) did user tests with volunteers using mobile devices equipped with joystick and a small screen and points out some problems when the users try to use mobile devices to do specific tasks into Web sites designed to desktop, so the mobile Web browsing experience needs to be improved to a more mobile friendly Web site and some mobile browser improvement (here we consider browser as one platform characteristic).

Considering only the e-Learning environment context, we agree to Maurer *et al.* (2010) when they argue the user prefer to use the standard version instead of mobile version of Web site, and this is one of the motivations of our work to study the third kind of solution: to access e-Learning environment using mobile devices. Shrestha (2012) studied the use of joystick and a small screen to browsing into some Web sites, while Maurer *et al.* (2010) considers touchscreen devices. All these researches point out some interaction problems, but the context was not e-Learning environments. In this work, we identified, through users test, problems when users use touchscreen mobile devices to access the TelEduc e-Learning environment.

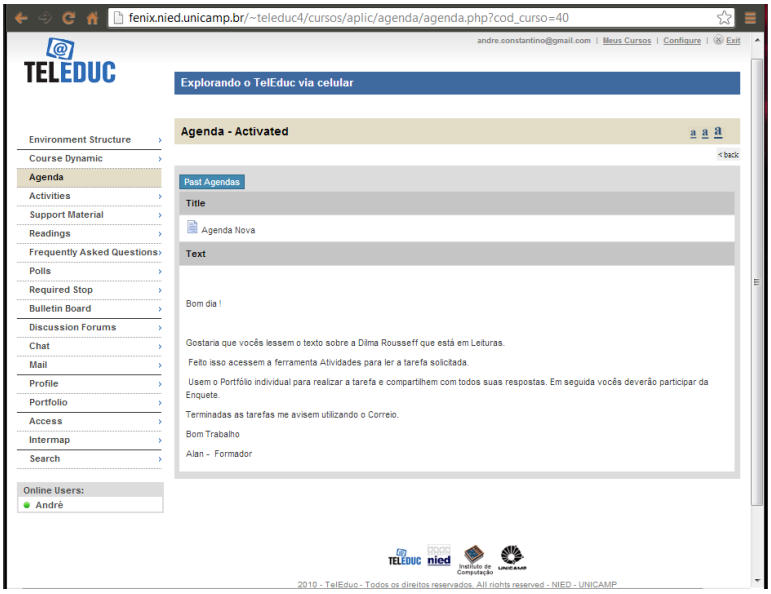
3. THE TELEDUC E-LEARNING ENVIRONMENT

The TelEduc is a teaching and learning environment developed by the Nucleus of Applied Informatics in Education (NIED) and the Institute of Computing (IC), State University of Campinas (UNICAMP), and adopted in several public and private institutions, like UNICAMP through Ensino Aberto project (Franco *et al.*, 2003).

The TelEduc environment was conceited in the end of 90, born with the Cerceau´s Master dissertation (1998), with professor Heloísa Vieira da Rocha as advisor, applying constructivism theory (Papert, 1986)(Valente, 1993) in situated learning (Lave and Wenger, 1991) or in contextualized learning (Valente, 1999) for teacher´s continuance formation. In 2001 February, the first free version was released over GNU General Public License (GPL), an unprecedented fact in the Brazilian Educational Software scenario. Many public and private institutions adopted the TelEduc as platform, increasing the TelEduc user's community, and consequently, the development demand. This fact culminated in the release of TelEduc version 3.0 in March 2002. The version 3.0 was completely redesigned and optimized, reason for TelEduc project was awarded by ABED (Brazilian Association for Distance Education) in the "Research and Development about Distance Learning" category. In August 2011, TelEduc version 4.3 was released, with its user interface redesigned to improve user tasks and be more similar than popular Web sites.

TelEduc is a system that aggregate administration, management and communication tools designed to support teaching and learning activities. Some tools allow users to create content, other ones allow synchronous or asynchronous communication among users, and manage participants and courses. The course page of TelEduc 4.3 is structured in two parts: the left one (Fig. 1a) has a list of all tools available and in the right one (Fig. 1b) the content of the selected tool.

In the course showed at Fig. 1a, a print screen of the course made for our user tests (the content is in Portuguese), the teacher dispose the Course Dynamic, Agenda, Activities, Support Material, Readings, Frequently Asked Questions, Polls, Required Stop, Bulletin Board, Discussion Forums, Chat, Mail, Profile, Portfolio, Access, Intermap and Search tools. Agenda is the ongoing course home page and shows the course´s program for a given period (daily, weekly, etc.). Agenda is an important tool because organize the activities that must be done in a specific period, similar teachers do in the beginning of a presence class. Fig. 1b shows the Agenda tool visualized by a student, where the student can read the agenda content and access the previous agendas.



(a) (b)

Figure 1. A desktop print screen of TelEduc course page (a) tool menu and (b) tool content.

The Readings, Activities, Frequently Asked Questions and Support Material tools have similar features and user interface, but different purposes. Readings tool is used to publish relevant documents, like books, magazines, news and articles. The Activities tool is an area to publish activities to the accomplished during the course, like home work descriptions. The Frequently Asked Questions tool contains a list of the most frequently questions done by the participants during the course and their respective answers. Support Material offers a virtual space for teachers publish useful information about the course and the proposed activities.

Tools like Discussion Forums and Mail are used to participant communication, supporting text message exchange in asynchronous mode. To synchronous communication, there is the Chat tool, its features is similar to Web chat sites.

The Portfolio is a communication tool that aims to promote the collaboration among participants through the sharing of "items" (documents, presentations, programs, links, etc.). So the Portfolio tool provides an area to item storage and sharing for each participant (user or group of users) within a course. The Bulletin Board tool is a dedicated space where all the participants can post information considered relevant to the course content.

To provide content, TelEduc uses the Web infrastructure, more specifically, hypertext with images, links, audios and videos. All these media can be published as content in tools like Agenda, Support Material and Readings. To create text content, the user interacts with a rich text editor, the CKEditor (2013). CKEditor is a third-party WYSIWYG text editor to be used inside Web pages, bringing to the Web application common editing features found on desktop editing text applications, but CKEditor version 3.3 does not work on mobile devices. In previous work (Da Silva, & da Rocha, 2012), we studied some problems in use of third-party software on TelEduc to create and to visualize documents, describing that mobile compatibility needs to be considered to not prejudice mobile users.

The Agenda, Activities, Support Materials, Readings, Mail and Portfolio tools allow attaching files into them items in similar way: the user clicks in the "Attach File" button, select the file to be attached using a dialog and, after the click on the save button, the file is uploaded.

Since the e-Learning environments need to be easy to use for users with different levels of Web experience, the usability is an important nonfunctional requirement. TelEduc was designed in an iterative design-evaluation process to have good usability and the user interface does not impair teaching and learning activities, so many usability evaluations were done. The accessibility is another nonfunctional requirement desired for TelEduc, to allow impaired people to use the environment without meet barriers or obstacles.

TelEduc was designed to use a mouse and keyboard as input devices, and a medium screen size as output device. TelEduc is better visualized into 1024x200 pixels screen resolution. Visualize it into a lower screen resolution cause some user interface problems like dispose interface components in wrong position. Beside the problems happen due the resolution changing, which problems and barriers the mobile users met when interact with TelEduc? To answer this question, we developed a user test case described in the next section.

4. MATERIALS AND METHOD

To identify interaction problems when an e-Learning environment is accessed by a mobile device we planned a study case composes with four users tests. The main activities to do the study case were: (i) tools to be investigated and tasks definition; (ii) hardware to be used; (iii) questionnaires planning; (iv) preparation of the course.

The following sub-sections explain briefly each activity. We started choosing the tools to be evaluated and defined the tasks for user test sessions using the smartphones available, an Android-based and an iPhone.

Based on our experience in using e-Learning environments, we chose the tools: Agenda, Activities, Readings, Polls, Mail and Portfolio. For each tool was defined one task, considering the most important feature of the tool. All tools were used considering the student´s view. The defined tasks were: 1. Login in TelEduc; 2. Read the Agenda; 3. Read the Reading and do it; 4. Read the Activity; 5. Post her activity in her portfolio; 6. Answer a poll; 7. Send e-mail to the teacher; 8. Logout of TelEduc.

To do the task 5, the volunteers need to search into the Web for an article. The purposeful activity is to allow us identify interaction problems when the users need to navigate in two web pages, visualizing one page and going to another. In the tasks planning we found some interaction problems that impair the user to

conclude the tasks, so we shaped the defined activities such a way the user does not meet the identified problems with the goal to find new interaction problems. The problems identified on task planning are discussed in Section 5.1.

We used a Motorola Milestone smartphone (Motorola Mobility, 2013) and an Apple iPhone 3GS (Apple, 2013). The Motorola Milestone has a 3.7 inches multi-touch display with 133MB internal storage memory expansive up to 32 GB with a memory card, 600 MHz Cortex-A8 processor and 256 MB RAM, a 5MP camera, GPS and wireless connection by Wi-Fi 802.11 b/g and bluetooth. Android 4.0.3 (Google, 2013) was used as operation system (OS). Motorola Milestone has a proximity sensor, an ambient light sensor, a 3-axis accelerometer and a geomagnetism sensor to provide orientation with respect to Earth´s magnetic field. To browse in the Web application, the volunteers use the Android stock Web browser.

The Apple iPhone 3GS (Apple, 2013a) has a 3.5 inches multi-touch display with 32 Gb internal storage memory, 600 MHz Cortex-A8 processor and 256 MB eRAM, a 3MP camera, GPS and wireless connection by Wi-Fi 802.11 b/g and bluetooth. The installed operation system is iOS version 5 (Apple, 2013b). iPhone has too a proximity sensor, an ambient light sensor, a 3-axis accelerometer and a geomagnetism sensor. To browse in the Web application, the volunteers use the Safari browser. In both devices, the proximity sensor and the accelerometer can be used to interact with applications, but the browsers do not use these features as input. Only the touchscreen was used as input device.

To collect information about the volunteers and them opinion we elaborated two questionnaires. The first one was to collect data about user age, genre, internet usage and mobile skills. The second one was to get personal satisfaction in do the tasks. Due we did an experiment involving people, we prepared a consent form to be signed by the volunteers informing her about the study purposes, the anonymity of the volunteer, and allowing recording the interaction to further analysis.

After the task planning, we prepared a course in the TelEduc installed in our server with the agenda content, the activity description, an article published on Readings tool, and the poll to be answered. This preparation is to simulate a course in the environment with chained activities. Since the user tests laboratory and the server share the same local network, we did not worry about Internet lacks or fail.

We invited four undergraduate students to participate, one man and three women, whom filled the profile questionnaire before the participation. All volunteers have 20 years old, three of them have smartphone and is mobile users for more than six month, the last one does not have a smartphone and her consider not be a mobile user.

5. DATA ANALYSIS

In this section we discuss about the found problems when mobile users access the TelEduc Environment. We found one problem during the tasks definition, and discuss it here since impose a barrier and do not allow mobile users conclude their goal. Analyzing the user tests data, we found 5 relevant problems for mobile users and other usability problems that is device independently. We focused here in the mobile problems and in the end of the section we present solutions.

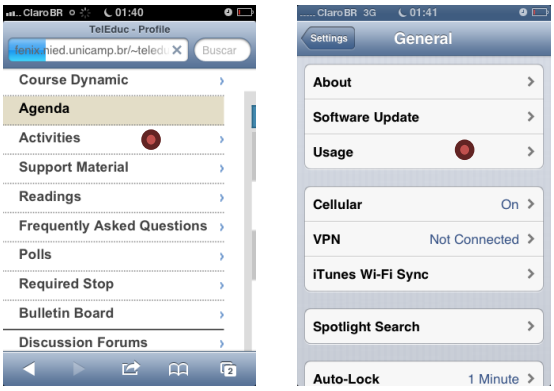
5.1 Problem found in the Task Planning

TelEduc uses CKEditor to allow users write rich text instead of simple plain text, but CKEditor does not work in iPhone and in Android-based devices, bringing a barrier to user write rich text. For example, it is not possible put content in a Portfolio item because the content field does not appear (*Problem 1*). Looking in the environment for others barriers caused by CKEditor, we found that it is possible to write message in Mail tool and post Bulletin Board posts, but the content field appears to write simple text since CKEditor is not displayed. In the other environment tools the barrier was found.

Focused on discovery new interaction problems we planned the tasks such a way the users do not match this problem. The next sub-section presents the problems discovery through the user tests.

5.2 Problems found in the User Tests

The first identified problem in user tests (*Problem 2*) is related with the web site does not follow the smartphone interface standard. The first time the user 2 tried to go to another tool, she touched in the space between the wanted menu item the symbol '>' (Fig. 2a shows the point tapped by the user in the interface), since no action was triggered, she tried a lot of times again in the same place. Asked about the unexpected system response, the user touched in the tool label and the system shows the tool content. Maybe the user thought the TelEduc interface follows the smartphones standard, which is possible to trigger an action touching in the space nearby the menu item label (Fig. 2b). In desktops it is softened due to change the mouse cursor from an arrow to a pointing hand, giving a visual clue that it does not have in touchscreen mobile.



(a) (b)

Figure 2. Print screens marked with the place tapped by the user in (a) TelEduc tool menu and no action was triggered and (b) in iPhone menu settings, where an action was triggered.

Another problem observed during the user tests was related with the selection function (*Problem 3*). Three users needed help to select the desirable URL to perform the copy and paste functions. Maybe due the users are familiar with desktops, they were expected for a menu or a toolbar with options. Asked about how they interact with the device, they realized about the touch interface and they tried to tap the desirable text, and, in a second try, tapped the text and hold the finger over the text, and the interface responses with the options. The problem is about the visibility and discoverability of the actions. We do not realize that we will meet this problem, since the all volunteers are the generation who use mobile devices since childhood, but they have a mental model more related with the desktop computers than mobile devices.

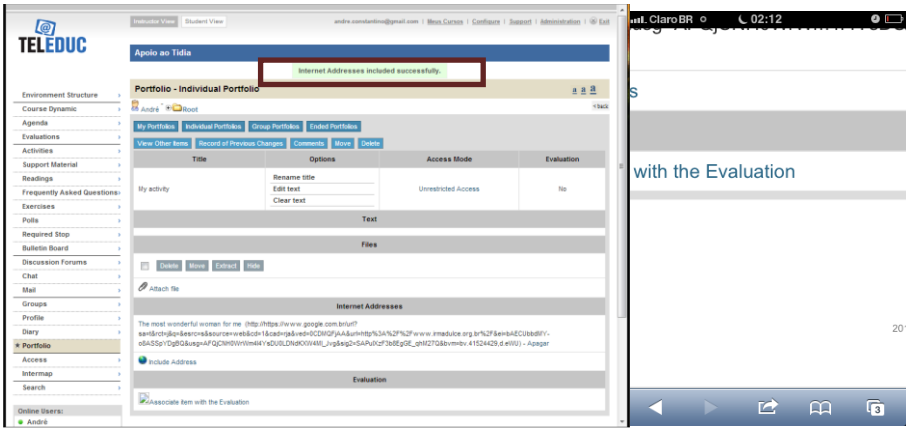
After copy the URL to do the defined activity in task 4, two users had another problem: how to return to TelEduc, since another tab was opened (*Problem 4*). The button to trigger the action to show opened tabs is at bottom on iPhone and is in at top on Android-based smartphones. One of the users prefers typing the TelEduc address again instead of searching for how to go to an opened tab. The other user asked for help.

Most of TelEduc feedback appears on the page top (Fig. 3a), and to draw the user´s attention the feedback blinks. In mobile devices, with the user is visualizing another part, the feedback is not visible (*Problem 5*). One example happens when the user is posting a URL in the Portfolio item (doing the task 5), and after to tap the "Ok" button, the system response with the feedback "Internet Addresses included successfully." in the page top, but the user does not see since she was interaction with the elements in the bottom (Fig. 3b). It is important to highlight that the TelEduc form to show feedbacks differs from the smartphones form to do it. In smartphones feedbacks were showed as a popup dialog.

The last identified problem is about the time a feedback message is displayed (*Problem 6*). When the user sends a message, the TelEduc shows a feedback page to inform that the message was successful sent for 2000 milliseconds. Since the smartphones take more time to render the page and shows all the page content, the waiting time expires; the browser closes the feedback page almost immediately, the user can read the feedback message, giving the impression that an error happed.

Analyzing the user opinion questionnaire and considering all identified problems, the users agree with TelEduc have good usability. Three of the four volunteers described feel difficult to interact, and the last one related does not feel any difficult to interact.

5.3 Solutions



(a) (b)

Figure 3. Print screens of TelEduc feedback on (a) desktop and (b) mobile devices after the user click in the “Ok” link to post the link in the Portfolio item to do the task 5.

Problem 1 is about the mobile user cannot write the content in most of TelEduc due the CKEditor is not displayed on mobile devices. A good solution is to allow mobile user only write plain text, similar happen to write messages in TelEduc Mail Tool. Analyzing the Portfolio tool code, we discovery that the content field, a textarea tag, was not showed due a style property (display:none) that CKEditor changes when it loads. Since mobile devices do not load the CKEditor, this property is not changed. Changing the code to get the content from the value property when CKeditor is not load, and get the content from CKEditor when it loaded, resolve the problem, destroying this barrier.

Problem 2 (user tapping in the space between menu item label and the symbol ‘>’ to trigger an action) is easily to resolve. The tool menu is implemented with table and anchor tags, just changing the order putting the li tag inside the <a> tag, becoming all the cell area a link.

Problem 3 (trigger a text selection) and Problem 4 (return to a previous tab) are related with the smartphones operation system. Norman and Nielsen (2010) discuss discoverability and visibility problems in touchscreen devices, and they argue there is a lack of established guidelines for gestural control.

A solution for the Problem 5 (TelEduc feedback is fixed at the top) is show feedback messages using JavaScript dialog when the device have JavaScript support. Since browsers for mobile devices have JavaScript engine inside, the browser have the responsibility to show the message in the visual standard used in the mobile device. This solution may be applied to the Problem 6 (feedback time), giving the user the feeling of control over the application.

6. CONCLUSION AND FUTURE WORK

Mobile devices, such as smartphones and tablets, are becoming increasingly popular; most of them have touch screen displays, Internet access and enough computing power to process Web pages, allowing mobile users access Web applications, such e-Learning environments. The e-Learning environments were initially designed to be used with keyboard, mouse and a medium size display, and now have to consider their access in mobile devices. We believe that Internet is a meeting point for all devices, so the Web applications need to be access by any device. Which kind of barriers and problems do mobile users meet when browsing in an e-Learning environment? We did a user test case with four volunteers accessing the TelEduc environment through iPhone and Android-based smartphones, and discovery 6 problems that impact in the usability. Do usability studies with users is a hard work, but it is necessary due the lack of techniques to do this kind of evaluation. The discovered problem is related with the consistence between device interfaces and TelEduc interface, discoverability and visibility of the features and code structure.

e-Learning environments have a lot of contributions to m-Learning, offering a platform to teachers and students do their teaching and learning activities, but some technologic gaps need to be filled. With this work, we started with the first step finding and eliminating barriers and interaction problems that become hard mobile users access e-Learning features. Another step is taking advantages of the mobile device features in

pro learning activities such create content like photos and videos. More research is need, since the interaction style changed and different features are available, e.g., the mobile users write text with fewer words? Analyzing the mail message sent from our volunteers to teachers to inform the activity was done, we noted just a sentence was write. Is it happened due to the profile of our younger volunteers or due the mobile device restrictions? How this influences in the activities in the environments? Mobile users prefer record a video or write a big text? These questions needs more research to be explained, but needs an e-Learning environment without barrier to be accessed on mobile devices.

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INTEGRATING A LEARNING MANAGEMENT SYSTEM WITH A STUDENT ASSIGNMENTS DIGITAL REPOSITORY. A CASE STUDY

Javier Díaz*, Alejandra Schiavoni*, María Alejandra Osorio*,
Ana Paola Amadeo* and María Emilia Charnelli*
**LINTI- New Information Technologies Research Laboratory*
Computer Science School
National University of La Plata
La Plata, Buenos Aires, Argentina

ABSTRACT

The integration of different platforms and information Systems in the academic environment is highly important and quite a challenge within the field of Information Technology. This integration allows for higher resource availability and improved interaction among intervening actors. In the field of e-Learning, where Learning Management Systems are used to develop the courses, their integration with other platforms and applications is more than interesting, in particular with Digital Repositories. This article describes the integration of the Moodle LMS, used by the School for the last seven years, with the DSpace repository, currently widely spread as well. The integration process consists of two stages, in order to establish full communication to and from the repository. For communication from Moodle to the repository, with the goal of consulting and transferring elements from DSpace, modules already implemented for both platforms were used. The current stage is implementing a specific module in order to establish communication in the other direction and allow transferring resources and learning objects from the LMS to the repository. This module is very useful for educational material that can be made publicly available through a repository and thus transcending the borders of an educational environment. The initial implementation is oriented towards the publication of work done by the students and presented for evaluation through the Moodle platform. The incorporation of metadata to the published resource is automatic, taking context information from the platform, and at a later stage, with the intervention of librarians, who contribute their knowledge in the classification.

KEYWORDS

E-learning, LMS, repositories, Learning Objects

1. INTRODUCTION

In current times, information systems integration is paramount, and constitutes a challenge in the field of Information Technology. Systems are generally not designed for integration. Instead, they are typically developed to solve specific problems. Thus, each system uses languages and technologies of its own, according to the needs of each application, which makes communication between them difficult. Integration comes from the need to share data among heterogeneous systems, in order to achieve unification in information access and create the impression in users that they are interacting with a single system. An integral view allows for the retrieval and reuse of information through one single point of access.

There is a wide set of applications in multiple environments that benefit from information integration, for example, in the area of e-commerce and e-business, business services and transactions can be made simple through networks [1]. In the field of e-Learning, where Learning Management Systems (LMSs) are used for course development, their integration with other platforms and applications can help increase resource availability and communication among users. In this field, Learning Objects (LOs) are the basis of interoperability, which is why integration among intervening systems is particularly important in this context. The possibility of integrating LMSs with general purpose Digital Repositories and Learning Object Repositories (LORs) proposes a change in how teachers think, plan and build educational content [2].

The Moodle LMS has been used in the School for over seven years. There is a great amount of stored academic material and a high number of users. Currently, in light of the new trends in educational material and with the growth of OERs (Open Educational Resources), there arose the initiative of storing content in one single public space available for everyone. For this reason, DSpace began to be used as a repository to store LOs and all the content produced by the School, in order to facilitate its retrieval and reuse.

This article describes the integration of the Moodle LMS with the DSpace repository, both from and to the repository. It will describe in detail the implementation of the module that will allow communication towards DSpace for the transference of learning objects from the LMS to the repository. The transference from DSpace to Moodle was solved through the Rest API provided by DSpace and a specific module available in Moodle [3].

The first stage consists of the development of the module that allows communication from Moodle to DSpace for a particular use case that is the publication of work done by the students and stored in the LMS through the Tasks functionality in Moodle. This paper will describe the way in which the resource is prepared for its publication and the process of incorporation of the metadata. In order to show the work context, we will also describe the use of the LMS in the School as a fundamental e-Learning tool for the dissemination of educational material and the advantages of the use of a repository for storing the resources generated within the institution.

2. DSPACE DIGITAL REPOSITORY

The current academic and scientific development of all universities increases the general production of scientific material and consequently generates a need to group, store, preserve and distribute great amounts of information in a timely manner. Thus, it gives rise to new ways to store information, such as the digital library at first, and later, the digital repository, a more global and abstract method. Digital repositories are virtual spaces that store sets of documents in multiple digital formats, organized according to preestablished criteria [4].

There are currently a number of initiatives that develop and encourage the use of repositories in general and LORs in particular, a fact that can be verified by checking the repositories that are available online, with tens of thousands of resources in storage. There are also initiatives that are working towards interoperability between repositories, with the goal of generating networks of distributed systems for general searches [5].

In our case, the institutional repository was created out of a need to store in a single publicly accessible location the material produced by the School that deserves global distribution. Consequently, a repository was implemented through DSpace, an open source application that offers a wide range of functionality for resource management. The first stage will consist of the storage of projects developed by students for one of the subjects of the School. These projects are sometimes assigned by the teachers, or written by students who become especially interested in a certain topic and choose to develop a related application.

If the subject contemplates this option, the best projects can be used with real users to meet specific demands, such as, for example, a system that kept the statistics of a local soccer team, or one that kept a record of the resources in the historical archive of the Province of Buenos Aires, to name a few examples. Later stages contemplate the incorporation of learning objects designed for courses, final reports, and degree theses.

In order to store the aforementioned educational material, a structure of collections will be created and divided into subjects. The resources will be classified using descriptive metadata related to the characteristics of the project, such as topic, platform used, and installation requirements, among others. The possibility of permanently and publicly storing these projects will allow other students to become acquainted with them and will serve as a basis for their further development. These developments can be also used by the teachers of other subjects aiding as examples of applications and technologies in use.

The repository that was implemented at the School, DSpace version 1.8, is currently beta in design and content, and can be found at http://dspace.linti.unlp.edu.ar.

3. MOODLE VIRTUAL PLATFORM

The School has been working with the Moodle virtual platform for online course management for over 7 years as a complement to in-person undergraduate and postgraduate classes, as well as courses offered by the Secretary of Extension. The platform includes over 10000 registered users in around 170 courses.

The **study material** is comprised of digital resources in multiple formats. For example, some Extension courses have experimented with the use of standardized virtual classes through learning objects. The possibility of using LOs that comply with the SCORM standard allows not only reusing them, but also following and keeping a record of the progress of each student. All the content is also published in HTML, PDF and slideshow format. Some cases include videos that work as triggers for new topics or as complements to an explanation. These videos are published in the platform and linked through the resource of a website. Software is also included when necessary in the proposed activities, as well as links with extra contents and ad-hoc specific material for web developers [6] [7]. Fig. 1 shows the used of multiple resources in the platform through the years.

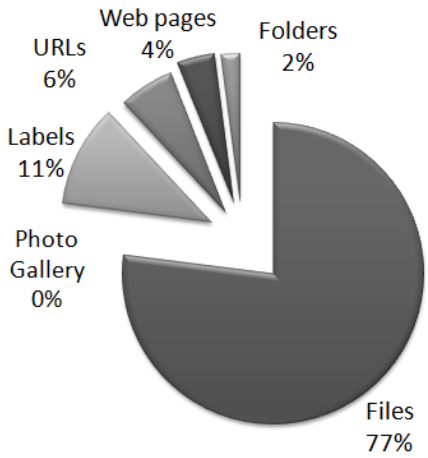

Figure 1. Resources used in the Moodle virtual platform

Content distribution, both theoretical and practical, is achieved mostly through files in multiple formats such as PDFs, text, and slides, among others. These files, together with tags for course organization and URLs for further information, make up the three most used types of resource in the virtual platform.

Activities include **discussion forums**, used for communication between students and teachers, and in some cases for general notifications, such as exam dates or other important information. **Questionnaires** have been used in many subjects for approximately two years, and are very useful for self evaluations or discussions of specific topics, in mass courses. Graduate courses tend to use them before virtual encounters in order to level contents so as to better seize them. **Choices** are used, for example, to survey the general opinion of the students on an activity or a class or specific administrative matters, or even to measure attendance to a mid-term. Fig. 2 shows the use of the activities in the courses. As seen, discussion forums are the most used, mainly for communication with the students, both in academic and administrative matters. Assignments come second and are the central motivating axis of this paper. This workgroup has also developed a social networking connection module, a Twitter Activity Module [https://github.com/mcharnelli/moodle-module_twitter], growing in use for communication between students and teachers.

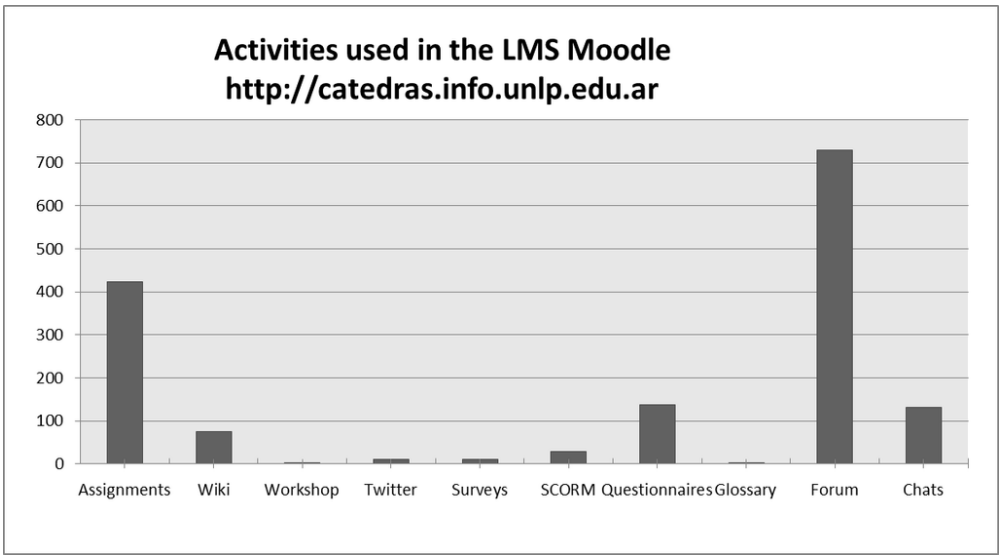

Figure 2. Activities used in the Moodle virtual platform

Assignment is one of the most used modules because of the practical nature of the courses that habitually use the virtual platform. Through **assignments**, students can upload files that can later be evaluated by their teachers, who grade and give feedback through Moodle. Grade and feedback are sent to students by email and can only be seen by them and the teachers. This is useful both for teachers and students, as the latter can upload their work online from home and any time before the established deadline.

As previously mentioned, some projects are developed with a specific goal in mind and for use in one institution that requires them. They are also sometimes used as material for the course in the years that follow, although these are rare cases and generally discarded each year. Taking the amount of total projects uploaded to the platform into account, which is over 2700, the waste is significant and there is high reuse and resignification potential within the same course or by other educational institutions that find it useful.

4. COMMUNICATION BETWEEN DSPACE AND MOODLE THROUGH THE SWORD PROTOCOL

As mentioned in previous sections, both the Moodle LMS and the DSpace repository use their own technologies according to their needs, and in many cases their integration is not immediate, despite the increasing flexibilities they have been offering through time.

The development of the Moodle platform has been continuously growing. Moodle Version 2.0 incorporated the concept of repository and communication with other well known repositories such as Alfresco, Merlot, Flicker, Google Drive, Picasa, and Dropbox was implemented. This feature considerably increased flexibility in file handing and access to external repositories within the platform itself. Although this extension is very useful, it is important to highlight that communication is always established in one direction only, from Moodle.

The initial goal was to obtain communication from Moodle to the repository, with the goal of retrieving and transfering elements from DSpace. Modules were used to extend the functionality of the platforms that would be involved in the new communication channel. In the repository, a module that installs an API using REST and that is available through the DSpace community was used. The LMS has a Repository API that was used to incorporate a specific plugin to DSpace, created by the Moodle community.

In relation to the other communication channel, a new functionality was implemented that makes it possible to publish content from the Moodle platform to different repositories. This new functionality is very useful to export all kinds of material from the courses, such as theoretical or practical content, documentation, and projects delivered by the students. It is also possible to export standardized content as learning objects.

The development of this tool involved the Sword protocol [9], which implements simple remote storage of resources into a repository from other applications.

In our application case, the functionality was incorporated from the interface of the Assignment module in Moodle, which allows for automatic delivery of these assignments. Fig. 3 shows the send to repository link (Enviar al repositorio) on the upper left corner, circled in green. This link will establish communication between the LMS and the repository, described in detail in later sections.

Figure 3. Interface for the visualization of Moodle tasks, with the Send to Repository link

4.1 Metadata Assignment

The incorporation of resources into a repository requires the generation and instantiation of metadata that act as indices to locate technological resources. Making use of the right metadata guarantees fast and effective tracking of a sought resource and enables greater production visibility. In the case of the presented repository, cataloging the resources generated by the students is done through a specific module and uses its own metadata format, given that Moodle does not implement its own metadata format.

The information for each course, resource and assignments is stored by Moodle in the database and can be used for generating metadata in any established standard, in our case Dublin Core, the standard used by DSpace. Aftterwards, depending on the metadata defined for sending to the repository, the information is retrieved and is sent together with the resource to DSpace. In the case of the works by the students, the context information of the Task is taken as metadata, including course name, year, teacher in charge, teacher email address and data about the Task itself such as author or authors, email addresses, grade, comments by the teachers and assignment. Implementing text mining can result in the retrieval of specific information and key words that allow for a more detailed classification of the material to aid future queries. Fig. 4 shows the cataloging process and its actors.

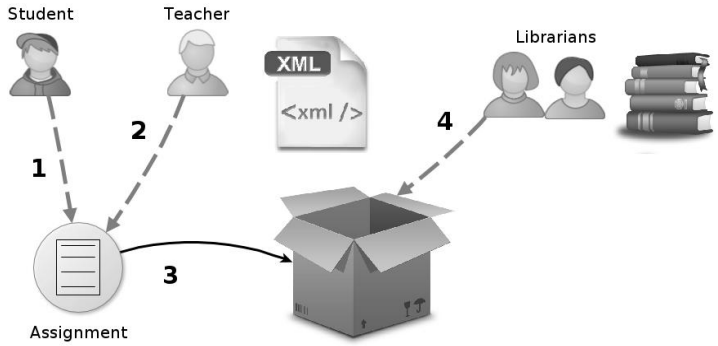

Figure 4. Resource cataloging shared among authors (students), revisers (teachers) and additional revisers (librarians)

It is important to emphasize that while most of the data is extracted automatically, the teacher and the student can incorporate additional information such as additional authors, platform and programming languages used for coding the resource.

The repository can also be accessed through Meran, a free software system developed by the UNLP for full library user and resource management. Librarians can also catalog these resources as part of a certain specialty, by means of virtual shelves associated with a course, numbering, among others.

4.2 The SWORD Protocol

The SWORD protocol (Simple Web-service Offering Repository Deposit) is an APP (Atom Publishing Protocol) application that defines simple remote content storage into a repository from other applications.

With only two basic operations, SWORD creates services that offer functionalities such as deposit from multiple locations or from standard applications, and multiple storage to different repositories. The availability of SWORD libraries in multiple languages, such as PHP, Java, Python and Ruby promotes the use of this kind of integration. DSpace, Fedora Eprints, IntraLibrary, and DataBank are examples of repositories that implement this service.

An interesting aspect of this protocol is that the sending service can be configured so that any user can upload information directly to the repository without logging in. This solves the problem of worrying about the amount of users or permissions, as this process would be managed through the application, and later, a qualified repository user could validate and complement the received data.

4.3 Implementing Communication

After analyzing the architecture of DSpace it became apparent that no implementation or installation was necessary, as the repository incorporated the communication functionality through this protocol. In version 1.8, DSpace implemented the protocol in two ways, as a server and as a client, both compatible with SWORD v2.

In contrast, Moodle does not offer this communication functionality, which is why it was necessary to use the Client API provided by SWORD to implement a specific module that will retrieve the requested information and prepare it according to the standards established by the protocol, to send it to the repository.

For our application case, the implemented module must retrieve the file stored in the Moodle Assignment and then build the package in the SWORD format with the corresponding metadata. Following, we describe the process of package creation, metadata assignment and package sending between the two platforms.

4.3.1 Creating the Package

As previously mentioned, Moodle does not have a metadata standard, it stores basic information in its database tables, which can be used to generate metadata in an established standard such as Dublin Core in our case.

Moodle has its own classes to handle the File System and the files themselves. When the requested file or files are retrieved through the Stored File class, resource data is retrieved including name, creation date, last date of modification, author, format, and type of resource within Moodle, among others. Information such as Assignment name, course name, and platform name can be extracted from resource context data.

The application generates a METS (Metadata Encoding and Transmission Standard) [10] package with files and administrative, descriptive and structural metadata that the repository will use to incorporate the resource. The metadata are placed in an xml file that includes: a heading, descriptive metadata in MODS format, Creative Commons license, list of files and structural map. Later, this set of files will be packed in a single zip file.

4.3.2 Sending the Package

The package is sent through the instantiation of a client of the PHP API provided by SWORD. The function deposit is used to automatically deliver it to the repository. It is necessary to specify in this function the URL of the repository, an access account and password if necessary, the content format, the destination collection and the zip file with the content. Fig. 5 shows the steps followed when sending a resource from Moodle to DSpace.

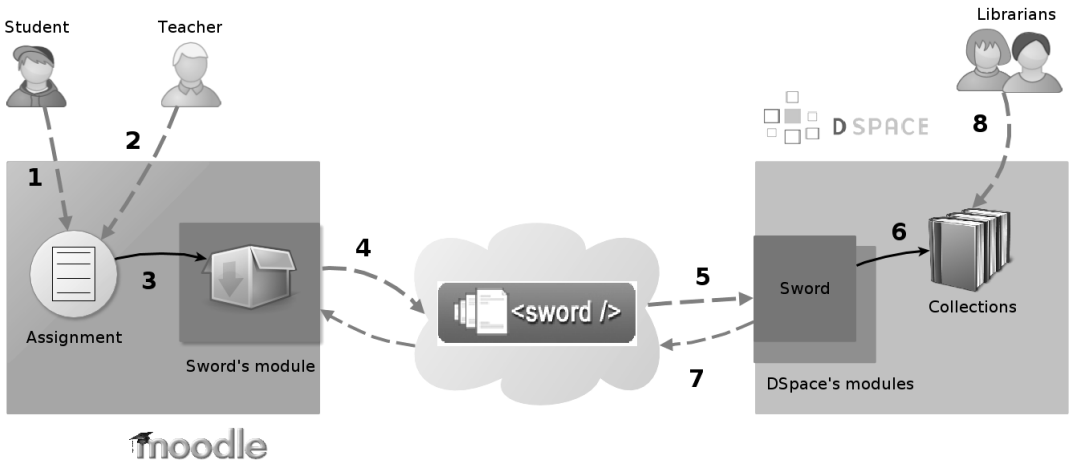

Figure 5. Communication scheme between Moodle and DSpace through SWORD

The steps are as follows:

1 The students deliver their assignment by uploading a file.
2 The teacher follows the deliveries and the corresponding corrections, sending feedback to the students when necessary. Once the delivery is finished, the teacher can choose to send it to the repository.
3 Once the teacher decides to make a delivery, the module comes into play. It takes each one of the assignments and packs them with their corresponding metadata into a zip file.
4 The package is sent through SWORD to a specific collection in the chosen repository.
5 The default SWORD module in DSpace unpacks it and retrieves the Dublin Core metadata and files.
6 Each of the files is added as items to the specific collection.
7 DSpace's SWORD module sends an xml response to the Moodle newly created module indicating operation status.
8 Librarians catalog the resources

After sending, the complete resource is stored in the corresponding collection within the repository, with its associated metadata. The result of this operation is the same as if the item was added manually following the steps required by DSpace for resource storage.

5. CONCLUSIONS

In e-learning, communication among platforms facilitates exchange, integration and reuse of educational resources that have been developed in heterogeneous platforms and tools. Standard creation and adoption established the use of certain norms for digital content creation and communication among systems. The growth of distance education has resulted in users placing emphasis in technical aspects related to connecting and using distributed resources in other platforms such as digital repositories.

The communication implemented between the Moodle LMS and the DSpace repository allows for a reduction in the overload of storing the same resources in multiple platforms. This encourages the teachers that manage their courses in the educational platform to publish one or more student projects delivered in one or multiple external repositories, as they do not need to be familiar with their interface and mode of access. Moreover, the module implemented prepares the information to be transferred by incorporating metadata with course context information, in the standard format used by destination repositories. Semi-automatic publishing of material is more practical as it is not necessary to follow all the steps required within the repository to upload the resource and complete the metadata that are indispensable for search and retrieval. In our case, the module is being tested with the DSpace repository, and the transferred resource remains with its basic Dublin Core metadata complete. The functionality of this module can be extended to other repositories,

adapting the way in which material is organized, taking into account the standards used in each specific platform. To incorporate specific metadata that match other criteria and goals classification is planned the intervention of an interdisciplinary group of librarians who contribute their expertise on cataloging. In our project, librarians participation is done at a later stage in the teacher publishing process. This will complete the registration of metadata with resource specific information from external aspects and offer different contribution when performing searches.

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ON THE RECOMMENDER SYSTEM FOR UNIVERSITY LIBRARY

Shunkai Fu, Yao Zhang and Seinminn
Computer Science and Technology, Huaqiao University, No.665 Ave. Jimei, Xiamen, China

ABSTRACT

Libraries are important to universities, and they have two primary features: readers as well as collections are highly professional. In this study, based on the experimental study with five millions of users' borrowing records, our discussion covers: (1) the necessity of recommender system for university libraries; (2) collaborative filtering (CF) technique is applicable and feasible; (3) user-based CF technique is preferred over item-based; (4) the performance of applying classical used-based collaborative filtering algorithm; (5) the effectiveness of local recommendation and the great saving of computing resource it may bring potentially. Since the data size used in our experiments is the largest one among similar studies, it is believed a valuable reference on this specific direction.

KEYWORDS

Recommender system, university library, collaborative filtering, user modeling

1. INTRODUCTION

In most universities, libraries are well equipped with modern IT infrastructure, and large amount of usage data have chance to been collected and stored. As compared with public libraries, university libraries have two primary features, (1) large volume of abstruse collection on science and engineering, and (2) readers have in-depth knowledge on related fields. Meanwhile, due to the explosion of knowledge, the scale of collection increases quickly as well.

For a long time, we depend on the search engine to retrieve items (or books) in the collection. To do so, we may have to iteratively try different keywords, and adjust them given the results if necessary. It repeats until satisfactory items are found. During this procedure, those who know how to represent their requests clearly, especially in a manner "liked" by the engine, may reach their goals soon. Besides, users' carefully made decision and options could not benefit others who have similar requests, although the system has helped to record who has borrowed which books at what time. Hence, in conclusion, search engine is not enough for us to effectively find what we want in university library, and we desire a smarter assistant which could make use of peers' options. In this project, we work to build a suitable recommender for university library, but, in this submission, we only share what we have gained from some early experiments. The discovery may guide our future work.

This paper is structured as follows. In Section 2, related works are reviewed and our contributions are listed. In Section 3, we analysis the necessity, feasibility and a potential solution based on the specific requirements of university libraries. Then, in Section 4, we introduce two primary collaborative filtering algorithms, and discuss the cause of our selection. In Section 5, a series of experiments are conducted, using about five millions of records from one Chinese university, Huaqiao University. We conclude in Section 6.

2. RELATED WORK AND OUR CONTRIBUTION

There are some published works on the recommender system for university library. According to whether there are reported experiments with real data as contained, we filtered out with only trustable ones left, including contributions based on clustering [1, 2], association analysis [3, 4] and collaborative filtering (CF) [5, 6] respectively. Though our discussion focuses on CF as well, it has some obvious differences:

1. We analysis the necessity in a quantitative way (see next section), while [1-6] only provide qualitative analysis;
2. Like [1, 3, 4], we directly use the original borrowing records like *<user_id, book_id, timestamp>*, i.e. each one indicates someone borrowed some book at some time. However, in [5], it uses the circulation log of the reading room. In [6], since it provides online reading, a score is estimated as the preference on behalf of the user, based on how many pages viewed. Borrowing log is used in [1] as well, but a score is also calculated according to the borrowing length (i.e. how long the reader keep the book) and whether renewal happens;
3. For the first time, we discovered that local search is effective to construct top-N recommendation list while applying CF-based recommender for university library (see Section 5). This would bring great reduction on computing complexity as compared with conventional global search way;
4. Previous studies only used tiny or small scale of usage log in their experiments. For example, only 38,078 records were used in [5]; data about 2,358 users and 4,352 books were used in [4]; 7,090 loan records between January and March, 2003 in [3]; records collected between September 2006 and May 2007 were used in [1]; two semesters of records in [2]. In our study, totally 4,932,579 borrowing records are used, with a span of 10 years, and it is at least ten times of the largest one found in previous studies. Hence, it is closer to the real application scenario.

3. NECESSITY AND FEASIBILITY

How to bridge the 'gap' between the professional readers and involved scholarly collections is one of the most challenging tasks faced by university libraries. Recommender system, due for its success in many fields in the past two decades, is believed an economic and workable solution.

3.1 Necessity

The necessity of building recommender system for university library can be explained with, but not limited to, the following points:

- Fundamental information system in library is mature, including easy-to-use text retrieval function. However, we have to transform our own abstract and/or abstruse requests into one or few keywords, facing the traditional search engine. This step demands intensive brain work, and it may greatly influence the quality of retrieval. Worse thing is that it only returns text-related results, preventing us from accessing books unknown but may interested us [7];
- Meta information of each book in the database is rare, which furthermore restricts retrieval function. For example, most books in our university's collection only contain basic sections like titles, authors and publishers, but no abstract, saying nothing of contents. The shortage of these rich information will make current text retrieval function work poorly;
- Low penetration rate due to the fact that our collection is abstruse. For example, in our library, totally there are around two millions of volume and 450 thousands unique items. However, only 47.51% of (unique) items once be borrowed. Can we declare that those remaining items are just not interesting? Or can we say that they are not known by readers? I think the second is more likely, so we need a 'smart' recommender system to help readers in university library find what they want, especially those they don't know yet but may feel interested;
- We hope such a system won't disturb us, e.g. we need to inform it what we want now and then explicitly, but just use the recorded our usage data and work 'silently'. By assuming that we borrow a book only when we like it, existing recommender technique is an ideal candidate since it could use these implicit data to produce something useful.

3.2 Feasibility

There are two primary information filtering techniques: content-based [8, 9] and collaborative filtering-based [10, 11]. Most methods used in content-based come from information retrieval, and it has limits in, at least, three aspects:

- It works by comparing if content features are matched with user profiles. To do so, we need some way to extract features of the target content, and furthermore, we want the features to be complete as well as concise. However, there is no effective approach to do feature selection, especially when we face multimedia resource, and extracted features alone cannot tell us the quality of information, which may influence users' satisfaction level. Finally, our fact is that we only have rare information about the book, as discussed above;
- Even though we have enough information on content, constructing users' profile is again a challenging task since it may also rely on the feature extractions of contents;
- Content-based filtering technique may disturb users since their privacy would be 'touched', due to the inborn mechanism of this approach.

Hence, collaborative filtering (CF) based recommendation is the remaining option. The most feature of this technique is its independence of content, therefore it is applicable to not only text but multimedia. Its basic assumption is that users similar to each other may have similar interest, i.e. borrowing similar books here. Some observations and features of this application are listed as below, and they are solvable by CF technique, or useful to the success of this technique:

- Meta data about books is rare. Besides, on most conventional library system, readers have no way to comment or give explicit feedback online, though this is quite common on Internet today;
- Readers' borrowing records can be viewed as their profile. Since readers normally make the selection only after careful checking and consideration, circulation record could be a strong indication that whether one user 'like' a book;
- Enough readers' borrowing records are collected. Totally we have around five millions of borrowing records. Because of the relatively high frequency of circulation in university, new records emerge and are collected every day, which could be used to update users' profile;
- Borrowing behavior is of implicit type of feedback, without having to modify the existing system, and bring no interrupt during users' interaction with system;
- Implementation based on CF technique may minimize the influence on existing three-tier system (Web/Application/Database). Because what data required by the recommender can be retrieved from database directly, we need not intervene with application layer. For security and performance consideration, we may create an independent database on the recommender side, and synchronize it with online database according to acceptable strategy, e.g. incremental updating during low transaction volume period;
- Outputs by the recommender can be exposed with REST (Representational State Transfer) interface, and easily be plugged into existing application systems (see Figure 1). For example, what produced by our recommender may be presented as "Users who borrow this book also borrow them";

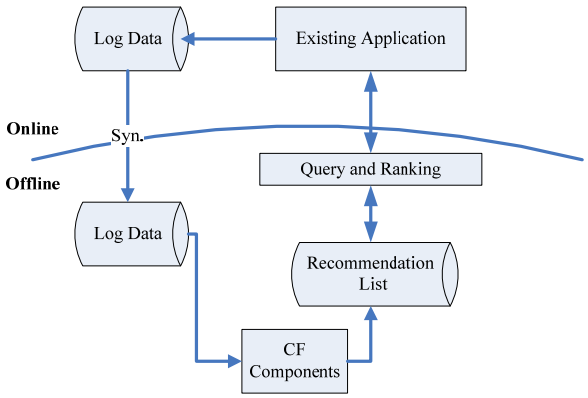

Figure 1. Overall logical view of the existing application and the recommender

- Research on collaborative filtering has been lasted for over 15 years, and there are many successful applications [12-14].

Therefore, CF is chosen in this project. Like clustering algorithms, CF also depends on the search of near neighbors, but CF can provide more fine-grained results. Besides, classical k-means algorithm also requires users to specify the choice of parameter k. As compared with association analysis, CF could tell us more previously unknown knowledge from similar users, and in a faster way. To avoid generating too many rules, association analysis has to increase the support and confidence level, which will influence the discovery of some new items.

4. COMPARISON OF CF ALGORITHMS

4.1 Overview

There are two kinds of CF algorithms, user-based [10] and item-based [11]. Both use user-item score matrix and some active user as input, and produce an item recommendation list for this active user.

The so-called user-item score matrix is the core data structure in CF algorithm, and it is of size $m \times n$, i.e. m users' preferences/options on n items. It is denoted as $S_{m\times n}$. The value of each cell $S(u,i)$ expresses user 's preference on item i, and it can either be boolean or numeric. In our application, $S(u,i)$ is boolean, with 1 indicates that user u once borrowed item i and 0 for not. Similarly, $S(u,\cdot)$ refers to user u's circulation vector, and $S(\cdot,j)^T$ for the circulation vector about item j.

Given $S_{m\times n}$, the kernel step in CF is to determine the similarity between users/items. Widely used measures include cosine similarity, Pearson's correlation, various revised cosine similarity and *Tanimoto* coefficient (also called *Jaccard* index/coefficient often) for binary data [15], which can easily be found in nearly all statistics books. In our application, *Tanimoto* coefficient is used, and its equation in user-based scenario is shown below:

$$sim(u,v) = \frac{S(u,\cdot)S(v,\cdot)^T}{\|S(u,\cdot)\|^2+\|S(v,\cdot)\|^2-S(u,\cdot)S(v,\cdot)^T} \quad (1)$$

The corresponding equation given item-based calculation is similar

$$sim(i,j) = \frac{S(\cdot,i)^T S(\cdot,j)}{\|S(\cdot,i)^T\|^2+\|S(\cdot,j)^T\|^2-S(\cdot,i)^T S(\cdot,j)} \quad (2)$$

4.2 User-based CF

It is the earliest CF algorithm being proposed. Based on the calculation of user similar (see equation (1)) , we are able to find k users closest to the active user a. Then, for each item $x \in \cup_{u=1}^{k}\{j|S(u,j)=1\}\backslash\{y|S(a,y)=1\}$, we can predict user a's possible preference on x as below:

$$S(a,x) = \frac{\sum_{i=1}^{k}(sim(a,i)\times S(i,x))}{\sum_{i=1}^{k} sim(a,i)} \quad (3)$$

By sorting all such $S(a,x)$ in descending order, we could produce a recommendation list containing N items with the highest score, i.e. the known top- N recommendation.

4.3 Item-based CF

For some online recommender, the 'long tail' effect of users is more prominent than item's. For example, there are hundreds of millions of users, but millions of items, on Amazon.com. Furthermore, their users' amount and profiles changes all alone, so we have to calculate the similarity of users online if we hope to catch users' updates in time, which will slow down the response speed of recommender built upon user-based CF technique. Differently, similarities between items are relatively stable, so their similarity could be calculated offline in item-based CF, and be updated periodically (and also offline), which ensures the speed of online response. Hence, item-based CF is preferred on most large scale Web sites when construct their own recommender systems [13, 16].

4.4 Our Choice

In our project, used-based CF algorithm is finally selected based on the following causes:

- There are around 70 thousands of users and 500 thousands of books (items) in database, and more items are added to the collection than newly enrolled students per year;
- Item-based CF will compute the prediction on an item *i* for a user u by computing the sum of the ratings given by the user on the item similar to *i*, and each ratings is weighted by the corresponding similarity *sim(i,j)* between items *i* and *j*. However, the 'interest' of readers in university is NOT stable – it may be completely different between adjacent semesters. Hence, what one read in this semester may have little influence on what s/he would select in the next semester, which limits the 'power' of item-based CF algorithm;
- Based on our experimental results, readers' interest is rather stable (see the next section) in macroscopic perspective, i.e. limited to their profession. This means that readers from the same major will have share on reading selections, and this is the basis of user-based CF.

5. EXPERIMENTS: DESIGN, DISCOVERY AND DISCUSSION

There are two kinds of evaluation for recommender systems, online and offline. Online evaluation requires the recommender to work online with existing application to collect actual interaction log. Its cost is high, and it is not suitable for repeating test, especially when the work is not mature since it may sacrifice the experience of users. Most research work on recommender takes offline experiments, i.e. feed recommender system with partial history data to train it, and compare the predicated value with those parts left but observed in history log.

5.1 Dataset

Dataset used in this project is from the library of Huaqiao University, ranging from 1998 to 2011. There is various information as contained, but we only use the users' borrowing records, basic profile (including which department s/he belongs to) and brief description of books. Related summary statistics can be found in Table 1.

Table 1. Summary statistics of dataset

Total # of borrowing records		4,932,579	
Total # of books in system	445,722	**Total # of books with borrowing record**	211,776
Total # of users in system	76,524	**Total # of users with borrowing records**	65,483
Avg. # records per users	75	**Avg. # records per books**	23

Regarding books, we only count the number of different books, ignore multiple copies

In the current dataset, due to some unknown reason (probably early users' borrowing records were not saved), there are 11,041 users with no borrowing records. Even we remove these users and those books with no records from consideration, the user-item matrix is still very sparse, about 0.036% (=4,932,579/(65,483 211,776)).

We also extract summary statistics about two typical colleges, Materials Science and Engineering (MSE) and Public Administration and Service (PAS), as Table 2.

Table 2. Summary statistics of two colleges: MSE and PAS

	College of MSE	**College of PAS**
# of lending records	548,998	270,351
# of users with records	7,277	3,377
# of books covered	87,745	63,925
Avg.# of records per user	75	80

5.2 Experimental Design and Discussion

It is mentioned (in last section) readers from the same college/department would be similar one another on reading interest, so we could only refer to these users' preferences during the decision making in used-based CF. If this could be confirmed, we need only conduct a local search of neighbors, instead of looking for similar users from the whole user set. To do so, we select MSE and PAS colleges as examples. We compare the recommendation effect on MSE and PAS given a recommender trained by the whole dataset (see Table 1) and dataset related to these two colleges(see Table 2) respectively.

Given the dataset, we take the 10-folder strategy, i.e. dividing the data into ten groups, selecting one for testing and the remaining ones for training. By repeating the experiments for ten times, we measure the average precision and recall. Although there are various measures proposed to evaluate one recommender [17], such as coverage and serendipity, accuracy is still the most concerned index.

As mentioned in last section, we implement the recommender as user-based, and Tanimoto coefficient is applied to measure the similarities. We select K neighbors, and study the top-N recommendation list. By differentiating K and N, we have the chance to compare their influence on recommendation accuracy.

5.3 Recommender trained with whole Dataset

Firstly, we train the recommender with whole dataset, and use it to provide recommendation list for MSE and PAS colleges. This is the typical mechanism in conventional CF-based recommender. In experiments, K is set as 10, 20, 30, 40 and 50 respectively; N is set 10, 20 and 30.

It is observed from Figure 1 that, (1) Both precision and recall increase with larger K, e.g. the precision of MSE has 34% increase when K increases from 10 to 50 given $N = 10$; (2) Given the same K , smaller N results with higher precision but lower recall. For example, the precision of PAS when N =10 is about 38% higher when N =30 given K=10; while the corresponding recall when N =10 is only 46% of that when N =30.

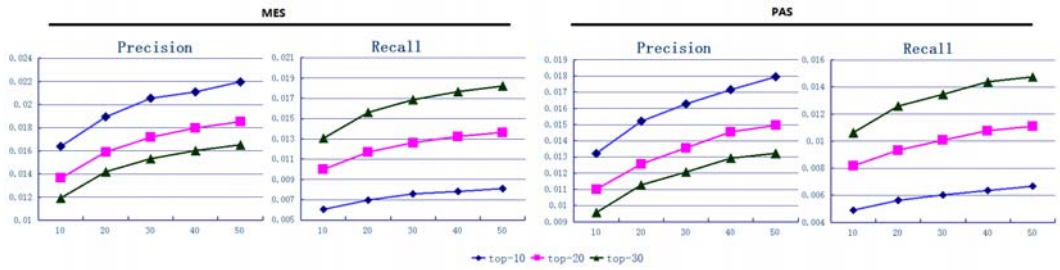

Figure 2. Average precision and recall about MSE and PAS by recommender trained with the whole dataset

5.4 Recommender trained with Partial Dataset

Secondly, we train the recommender with partial dataset. For instance, a recommender is trained by the MSE dataset, and used to provide recommendation list for readers belonging to MSE. This is different from the conventional solution, and the remaining settings are kept the same.

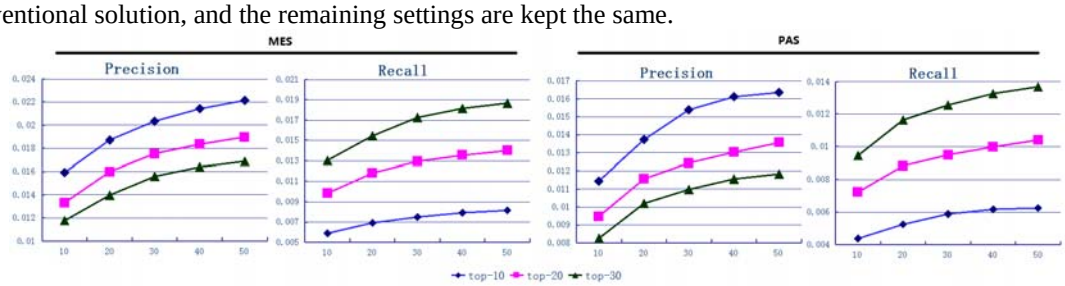

Figure 3. Precision and recall about MSE and PAS by recommender trained with only MSE and PAS dataset respectively

Similar trend as in Figure 2 is observed from Figure 3, (1) both precision and recall increase with larger *K*; (2) given same *K* , smaller *N* results with higher precision but lower recall.

5.5 Global vs. Local Recommendation

For easy reference, we call recommender trained by whole dataset as global recommendation, and that by partial dataset as local recommendation.

Table 3. Precision (P1) and Recall(R1) achieved by whole data VS. Precision(P2) and Recall (R2) achieved by partial data (P2) about MSE's users: (P1/P2) and (R1/R2)

K \ N	***10***		***20***		***30***	
	P1/P2	***R1/R2***	***P1/P2***	***R1/R2***	***P1/P2***	***R1/R2***
10	*1.03*	*1.03*	*1.02*	*1.02*	1.01	1.00
20	*1.01*	*1.01*	*0.99*	*0.99*	1.02	1.01
30	*1.01*	*1.01*	*0.98*	*0.98*	0.98	0.98
40	*0.99*	*0.99*	*0.98*	*0.98*	*0.98*	*0.97*
50	*0.99*	*0.99*	*0.98*	*0.98*	*0.98*	*0.98*

Table 4. Precision (P1) and Recall(R1) achieved by whole data VS. Precision(P2) and Recall (R2) achieved by partial data (P2) about PAS's users: (P1/P2) and (R1/R2)

K \ N	***10***		***20***		***30***	
	P1/P2	***R1/R2***	***P1/P2***	***R1/R2***	***P1/P2***	***R1/R2***
10	*1.16*	*1.12*	*1.16*	*1.13*	1.16	1.12
20	*1.11*	*1.07*	*1.09*	*1.06*	1.11	1.08
30	*1.06*	*1.03*	*1.09*	*1.06*	1.10	1.07
40	*1.06*	*1.03*	*1.12*	*1.08*	*1.12*	*1.09*
50	*1.10*	*1.06*	*1.10*	*1.07*	*1.12*	*1.08*

Table 3 and Table 4 are about the comparison of precision and recall achieved by global and local recommendation on MSE's and PAS's readers respectively. It can be observed and concluded that:

- Local recommendation may even achieve higher precision and recall than global recommendation, which can be observed from the gray cells in Table 3. However, this is NOT observed in Table 4, which may be explained that engineering readers' (e.g. college of MSE here) interest is NOT as diverse as that of non-engineering readers (e.g. college of PAS here);
- Regarding MSE's readers, by average, the global recommendation achieves 10.9% and 7.6% higher precision and recall respectively than local recommendation. Considering the great computing complexity saved by local recommendation, this cost is affordable;
- *K*=30 and *N*=20 are the suggested parameters observed in our experiments.

6. CONCLUSION AND FUTURE WORK

In this article, we discuss the necessity of building recommender system for university library firstly. Then, we compare and propose that user-based CF algorithm is more suitable for this application. We conduct experiments with five millions of lending records collected in one Chinese university, National Huaqiao University. The results confirm that we could train individual recommender for each college (or even department), or at least, show recommendations from these individual recommenders with higher priority than those from global recommender. This finding could bring great reduction on computing complexity, with affordable cost on recommendation accuracy.

Although we focus only on accuracy here, we are interested to study the serendipity in future study, aiming at better service. However, till now, there is no mature definition and measure on serendipity.

Meanwhile, how to tradeoff the accuracy and serendipity is an interesting topic as well. More experiments will be designed and conducted to help us gain more knowledge and experience about the application of recommender in university library, before we start to develop the real system.

ACKNOWLEDGEMENT

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DEVELOPING AND IMPLEMENTING A NEW ONLINE BACHELOR PROGRAM: FORMAL ADOPTION OF VIDEOCONFERENCING AND SOCIAL NETWORKING AS A STEP TOWARDS M-LEARNING

Roland van Oostveen, PhD and François Desjardins, PhD
Faculty of Education, University of Ontario Institute of Technology

ABSTRACT

The political will to move educational opportunities online is growing for numerous reasons and new mobile technologies are being adopted at unprecedented rates. Such a context presents opportunities to develop online programs and experiments in universities, with new affordances to solve old problems such as access and isolation.
This paper presents an initial experiment in the creation, development and first implementation of an online Bachelor's program in adult education and digital technology. It was designed with a central videoconferencing component intended to reduce isolation for the students and technical affordances were selected to promote course development for both a mobile implementation and for at least partial open access.
The results of this initiative have both demonstrated the potential of such an approach as well as allowed some of the finer elements to emerge, such as expectations on all parts and administrative adaptation to this new reality.

KEYWORDS

Videoconferencing, social networking, m-Learning, online program, curriculum development

1. THE CONTEXT

People are social beings (Lowenthal, 2010). They rely on all senses for connecting with others (Gunawardena, 1995), and they are constantly on the move. This implies that for any education endeavour to be successful, it must not only allow for, but promote learning in groups or teams or communities. The learners much prefer to be able to interact with others in a direct a manner. Consequently, the live, face-to-face discussion is generally preferred over all other modes of interaction. The learning situations must also address all senses and all dimension of the human experience for it to be relevant. The written word is fine for getting to information, but to access rich thick information, the experience of involving sights, sounds, and even interacting with objects, fosters the construction of multidimensional knowledge. Finally, in this age of short careers and constant need for re-education and lifelong learning, this upgrading of one's education is done on the run, in transit, as less time is available to commit long periods in a day to one single activity.

These three elements of human nature present challenges for post secondary education, particularly university education, as it is facing yet another milestone in its continued evolution. With a continued pressure for democratization of education in all corners of the world reaching the tertiary sector, the demands for access to student spaces are, by far, exceeding the capacity of a system that was designed for the exceptions rather than the masses (Trow, 2006). As the higher education sector has been scrambling to adapt to this new reality following a recent economic downturn, some governments, such as is the case in Ontario (Canada), have been actively initiating conversations to find new, effective and efficient ways to meet this challenge. Locally, in Ontario, the MTCU (Ministry of Training Colleges and Universities, 2012) has recently been advocating for both colleges and universities to increase their online offerings in terms of courses and programs. This political will provides both the challenges as well as opportunities to support university initiatives to explore new avenues in the development of online education.

The current state of technological development as well as its extensive adoption by populations around the globe is fostering many initiatives in online education aiming at addressing these challenges. The rapidly

increasing use of synchronous modes of communication, facilitated by the adoption of videoconferencing platforms and recently adding the possibilities of group video meetings, live collaboration at a distance is easy, affordable and directly fosters a greater sense of community, even online (McInnerney, & Roberts, 2004). In addition, these live media, also call upon much more than textual information. They make use of sight and sound. They promote the live social interaction between people in a more complete experience. Adding to this the fact that adult learners tend to select their programs of study based on specialisation rather than the proximity of the institution, the availability of online options become an important solution for both educational institutions and the learners. Furthermore, with career changes becoming far more frequent, the need for constant upgrading of skills and competencies is matched only by the increase need for commuting to the next job or project. These kinds of changes tend to involve more time spent in transit or in remote locations (hotels, offsite work locations, etc.) and the possibility of dedicating some of that time for study is beginning to surface as a desired option. Making use of synchronous communications on mobile technology in order to access and participate in formal education from anywhere, anytime will shortly become an absolute necessity for a very large number of post-secondary learners.

In the midst of a multiplicity of online education initiatives by institutions around the world, members of the Faculty of Education at the University of Ontario Institute of Technology (UOIT) were interested in providing an alternative form of program which would capitalize on available online technology, while paying attention to the learner needs for socialisation, multisensory experiences, and mobility. In this context, a project was initiated to create a Bachelor level program (B.A.) that would, on the one hand, expand on the strengths of existing programs in education, and on the other, provide the impetus for developing the necessary experience in online learning to eventually integrate mobile learning as a regular affordance in all online courses. Such a program would have to be designed in a manner as to have the modes of interaction between all participants (professors and students), as well as being fully consistent with the objectives and content of all the courses. As initial internal faculty discussions started, the idea of using desktop (or mobile) videoconferencing (VC) and social networking quickly emerged both as the target and the necessary context.

It was assumed that the VC proposition would attract some resistance and consequently attention was paid to attempt to understand and address the major concerns. The most important criticism was that online learning was perceived as cold and isolating, one where the student interacts mostly with online documents as well as with sparse and impersonal communications through e-mail or disembodied discussion forums (Goldrick, O'Higgins Norman, 2012). Recognising that creating a meaningful learning experience requires the establishment of a community of personal relationships between the students themselves as well as with their professors and tutors, the concept of using more face-to-face communications became a central objective for the new program. Therefore, it was proposed that all courses should include regular (weekly) meetings using some form of VC allowing students to access from any location that was equipped with broadband availability. It was also suggested that these meetings would serve to foster rich, meaningful discussions and interactions that would take advantage of the immediacy of the communication which included the facial expression and body language nuancing between all participants as a community exercise. Current two-way VC technology is now widespread enough with offerings such as Skype (Microsoft), Facetime (Apple) and others, that it is no longer seen as something impossible to use by the general public. Although these systems are used mostly for *one-to-one* conversations, many systems are available for *many–to-many* or *multipoint* VC, and are being used in the higher education sector as a possible solution to address a large part of the student isolation concerns (Goldrick, O'Higgins Norman, 2012).

This brought on another concern, that of necessary flexibility. One of the perceived advantages of online learning using the more traditional asynchronous communications models is that students can work on their own schedule, at their own pace. Proposing the weekly scheduled video meetings seemed to seriously reduce this flexibility. Creating a model that would strike an appropriate balance between this desired flexibility and the need for opportunities for direct real-time interactions while maintaining the advantage of doing all this from home, no matter where that may be, became a prime objective.

Moving to a mobile virtual platform also necessitated the adoption of a pedagogical or learning model that is radically different from that used in most traditional classrooms as the learners will be expected to access Internet-based documents in a wide variety of formats and virtual environments rather than confining themselves to a specific textbook or classroom set of paper-based documents. An online problem based learning curriculum development model (Savin-Baden, 2007) was adopted as it allowed for the incorporation of problem scenarios or contexts within which learners could identify their own problems and work towards

creating solutions, thereby learning about the content while actively engaging with it. All of the technological tools required for this type of work are available for mobile device platforms.

It has also often been stated that for a great variety of reasons, many of today's post-secondary learners tend to balance studies with work, family and other time constraints. In addition, the reality of spending a substantial amount of time commuting between these activities, or even at locations away from home, means that there would be a great advantage to having as much of the planned learning activities designed in a manner as to be accessible on mobile devices from anywhere, anytime.

For these reasons, a Bachelor of Arts in Adult Education and Digital Technology was designed, formally proposed and implemented. It was to be offered completely online, with a dominant real-time videoconferencing component and a pedagogical framework that would foster the development of meaningful teacher-learner and learner-learner relationships as well as taking advantage of any and all opportunities of access to information and experts in the domain being studied. This paper discusses some of the initial stages in the designing and implementation process as well as some of the concerns that have emerged along the way.

2. PROGRAM FRAMEWORK

In the initial documents, intending for every aspect of this program to fall within all university regulations, a typical 36 hour (3 credit) course was designed to be articulated in 12 weekly modules each including:

- a total of 3-4 (approx. 12 minutes each) video clips publically available online (ie.: YouTube). This was to represent the "lecture" part of a traditional course and was intended to avoid the perceived necessity of such lecturing in the videoconferencing portion of the course. The video clips were initially to be written by a content expert, (i.e., professor from our own Faculty or a recognised expert from another institution). These have since mostly been produced either by the professors themselves or by media specialists. These were then to be installed on the institution's video repository or simply on some public site such as YouTube.
- 60 minutes of synchronous group activities in Adobe Connect (videoconferencing) moderated by one teaching assistant for each 30 students. These could include planned discussions on specific questions, teamwork on predesigned problems, or any activity that would foster collaborative knowledge construction. The synchronous group activities in the videoconferencing platform are planned in detail by the professor (content expert) with the explicit opportunity to consult with other professors in the program or with the institution's instructional designers. The online activities are then run by the TA on a weekly basis. By scheduling the different groups at different times of the day and of the week, the courses are able to accommodate students from a wide variety of time zones
- Equivalent of one hour of work to be done online asynchronously (i.e.: Blackboard discussion forum, wiki entries, etc.). This is to allow for students to engage in a more reflective set of activities where time can be taken to express thoughts or ideas at one's individual rate, without the pressure of the immediate discussion. The final element of each weekly class includes many other online activities such as forum discussions, self-directed learning activities, etc. as deemed appropriate for the course. Although this covers the basic weekly three-hour commitment to the class, it is to be noted that additional reading or other course work is usually expected from the student.

In order to meet the requirement of reaching the students wherever they maybe at anytime, the technical systems were chosen with the additional characteristic of necessarily being able to run on most mobile devices such as the smartphones and tablets supported by the dominant mobile platforms, i.e., iOS, Android and Blackberry10.

3. IMPLEMENTATION

3.1 Online Pedagogical Model

From this initial design, the group involved in the program made use of a digital space that currently includes: 1) video clips publically posted on YouTube to present concepts and ideas, 2) email and file

repository capabilities as provided by a Learning Management System (LMS), 3) synchronous virtual audio/video conferencing conducted using Adobe Connect® for tutorial discussions and, 4) a wide variety of Open Educational Resources (OER), such as Wiki's, Discussion Forums and Blogs for assignments and tasks.

Most of the applications comprising this digital space can be accessed using mobile devices of all kinds, thus providing systems, structures, and processes that facilitate ubiquitous learning. The digital space is used to define the context of a 'completely' online (using synchronous, as well as asynchronous digital tools) program in that all interactions with students in a formal 'course' setting will occur within the space to ensure equity of access and experience to all students regardless of geographic or temporal location.

The model designed for the development of courses within the program was based, to a large extent, on the work of Anderson (2007) and Savin-Baden (2007). The model details that learning within the program occurs where the sphere of social presence (the availability for interaction with others) interacts with the sphere of cognitive presence (the availability for interaction with ideas and theories, as well as the creation of knowledge).

Social presence within the program occurs within the context of an online community of inquiry that was welcoming to a wide diversity of learners. It was understood that the community could not be structured as most physical classrooms are, with information dispensers and information gatherers, since classrooms in this program are situated in the Internet, which provides access to more information than any single teacher could ever hope to provide. Since there was no need to provide material to the learners and in order to give the learners opportunities to investigate issues of personal import it was decided to pursue a learning model that was as horizontally flat as possible. All members of the community, inclusive of students, teaching assistants and professors, would be involved in learning, critiquing, assessing and evaluating. In the online learning environment, the distinctions of power, the barriers between the 'haves' and the 'have nots', and the obstacles of authority or expertise were not as important as promoting communal collaborative inquiry allowing students to freely and safely exchange criticisms, views, and opinions.

According to Anderson (2007), the cognitive presence encourages students to:

- approach problems creatively and strategically,
- actively seek out sources of information,
- identify and address bias, prejudice, and privilege,
- manage, analyse and synthesize large quantities of information, and
- formulate and defend personal views and positions.

Students in the BA program access course 'lectures' in the form of publically available video files posted to YouTube using a Creative Commons – Attribution licence. YouTube was chosen as the publication site primarily due to its availability to most individuals with apps provided for all of the major mobile platforms. Publically publishing video clips dealing with educational material on YouTube not only establishes Open Educational Resources (OER), it simultaneously plays an outreach function allowing those not registered in the courses to access the material.

Within the B.A. courses, the institutional learning management system (LMS) is used as a common email and file repository system. All program students are registered into an additional 'course' that is set up within the LMS. This allows for posting of announcements and administrative messages that are sent directly to the students.

Within small tutorial groups, students discussed their particular understandings of the situation portrayed in the video clips, eventually agreeing on a specific question or questions that they would collaboratively investigate, identifying resources and knowledge that was possessed or required in order to create answers to the questions that were posed (vanOostveen, Desjardins & Bullock, 2010).

In this program, collaborative learning occurs primarily through the use of synchronous technologies, such as Adobe Connect and Skype, in an environment in which the cognitive presence, social presence, and digital space intersect; an environment in which "members of a community of inquiry […] construct meaning though sustained communication" (Anderson, 2008). Learners are encouraged to nurture the development of valuable social and cognitive skills that are essential to the establishment of a critical learning community. A learning community relies on the process of peer review to ensure that a certain standard of rigour and quality is maintained (Wenger, 2000). Students in the B.A. program learn to adopt characteristics of a community of learners in order to determine the strength of warrants for knowledge claims. Longino (1994) identifies four conditions that a community of practitioners must meet if consensus is to count as knowledge rather than mere opinion.

1. There must be publicly recognized forums for criticism.
2. There must be uptake of criticism.
3. There must be publicly recognized standards for evaluation of theory and practice.
4. There must be equality of intellectual authority.

Students within the program are regularly required to engage in academic critiques of their work and the work of their colleagues.

The establishment of a learning community requires both asynchronous and synchronous technologies. Synchronous online learning has been reported as being more social in nature than asynchronous online learning and it avoids frustration by allowing for conversations in real time. Two-way videoconferencing offers access to all the non-verbal communication, all of which provides for greater nuancing of the interactions. In addition, social networking apps such as Twitter and many blogging sites, are growing in use within the program, and are intended to foster a different mode of asynchronous discussion. Many of these applications have associated mobile apps or are available through mobile browsers.

3.2 Curriculum Development Model

Content experts from within UOIT's Faculty of Education, other Faculties and from beyond the university were contracted to develop the course outlines, video clips, course assignments/tasks, rubrics and any other activities in order to create an online environment within which the students could learn. The developers followed a curriculum development model designed to promote problem-based learning (PBL) (Savin-Baden, 2007) and constructivist learning orientations (Vygotsky, 1978).

Each course contains several opportunities to use collaborative PBL processes to learn about content. This is typically done using the video clips posted to YouTube to present students with a situation or a context representing. PBL, as used in the B.A. program, is defined as 'a curriculum model designed around real life problems that are ill structured, open ended or ambiguous' and it is suggested that 'PBL engages students in intriguing, real and relevant intellectual inquiry and allows them to learn from these life situations' (Fogarty, 1997). Problems are identified by the students when they bring their own particular perspectives to bear on the presented situation. Once a problem or set of problems have been chosen by a group of students, over the course of the next few weeks they will meet virtually, using Skype or a general Adobe Connect room that has been set up for all students taking B.A. courses. The general room is available to all students, TAs and professors 24hrs per day, 7 days per week.

The video clips are formatted very precisely using a pattern laid out in the curriculum development document requiring the incorporation of 3-5 analysis questions at the beginning of every clip. Analysis questions are designed to invite the viewer to break down the remainder of the video clip into component parts in order to identify embedded problems (inductive processes). A further 3-5 synthesis questions are posed at the conclusion of each video clip. Synthesis questions are designed to invite the viewer to compile information gleaned from the video clip content to propose solutions (deductive processes). The video clips then become instigations for the discussions that follow in the tutorial sessions conducted using Adobe Connect.

The structure of the tutorials tends to be most effective if there is a strong tie between the video clip portion of the courses and the tutorial sessions. As the sessions are usually facilitated by Teaching Assistants (TAs), it was vital that a strong relationship was established between the instructor and the TA in a course. TAs and professors function as facilitators, rather than disseminators of information, during the tutorial sessions. De Grave, Dolmans & van der Vleuten (1999) state that the facilitation role should "scaffold student learning in order to:

- simulate the elaboration of information and ideas
- guide the learning process, including stimulation of reflection on the learning process
- stimulate the creation and integration of knowledge
- stimulate and support student interaction and individual accountability" (p.901)

Tasks and activities which are designed to provide synthesis, evaluation and creation experiences are assigned to students while they are engaged in the courses. While there is a fair amount of variety in the types of tasks that are assigned, such as the production of learning objects, video 'papers', and briefing notes, these are primarily collaborative in nature, requiring students to meet virtually using a number of technologies such as email, Twitter, Google Drive, YouTube, ScreenCast, etc. Course TAs meet virtually with the students on a regular basis in order to support this work.

4. CONCLUDING REMARKS

At the time of this writing, students in the B.A. program's first class are entering their second term. There are approximately 20 students registered in the program, approximately half of these are registered in 4 or 5 courses per term and the remainder are registered in 1 or 2 courses as fits their personal schedules and workloads. While this is not a large number of students for the inaugural year, it has been reported that this is an extraordinarily good response for a program that bridges between college and university experiences. Additional students, 4 or 5 per course, from other faculties in UOIT have joined the program by taking individual courses as electives to augment their studies in other degree programs.

Most of the students who are registered in the program are working full time and many have families that need part of their daily attention. A wide diversity of backgrounds is represented with students coming from security services, fine arts, and various commercial interests. Several of the students are employed as instructors by community colleges in Ontario. These students are required to obtain university degrees and the B.A. program provides the flexibility to do this while continuing to be employed.

Over the course of the first term, teaching staff (professors and TA's) and students were polled every few weeks. Two questions were asked: 1) What do you like about this program so far? Why? and, 2) What would you like to change/modify about the program so that it better suits your needs? Why? Approximately ½ of the teaching staff and student population responded to each survey

Anecdotal responses to the first question reflected a positive reaction to the flexibility of the program in terms of time, as the only synchronous portions are the tutorials. Some students mentioned that a warm collaborative learning environment had been established allowing them to feel connected to classmates and the learning community as a whole. PBL was singled out as being a new way to learn which required some adjustment but was appreciated none the less.

The comments posted in response to the second question reflected the transitioning that was required of all. Most of the statements reflected challenges using all of the digital technologies. Some students noted difficulties in synchronizing schedules with others within groups and a struggle to adjust to the demands of a university program which requires a lot of reading, collaborative group work and synthesis and evaluation of concepts. One student complained that the tutorial sessions were not long enough as the discussions are often cut short. An instructor also noted that since the students are included in the discussions about customizing the learning environment the modifications of the courses were being done continuously reflecting an individualized curriculum, or perhaps making significant strides towards this goal.

5. COURSE DEVELOPMENT COMMENTS

10 courses have been developed to date for the B.A. program. Five of these were implemented over the past term, with the remaining five being initiated in the winter 2013 term. Some of the courses are foundational to the program. For instance, in the fall term, the Foundations of Digital Teaching and Learning Technologies course was offered, providing students a framework that can be used to analyse teaching and learning technologies. Additional courses regarding the Foundations of Adult learning and Psychological Foundations of Digital Technologies will be implemented in the winter term. Other offerings include courses in Problem Based Learning, Creating Digital Tools, Culture and Digital Technologies, Digital Technologies and Advanced Teaching Methods, Online Learning, Professional Writing, as well as a course about Serious Games and Simulations. Next year there are plans to develop an additional 9 courses, ranging from Digital Communication Technologies, Graphic Design, Information Literacy, Workplace Learning and a year-long double course that requires students to design and implement an applied research project resulting in a brief thesis. In the following 2 years, the remainder of the courses will be developed and brought online when they are required for the Direct Entry registrants who will register in the program directly from high school. In the past year, and in the upcoming years, there are several courses that will be and have been developed by professors in other faculties. It is likely that these courses will be cross-listed for students in other programs so that the university as a whole can benefit from the development of these fully online courses, providing alleviation, for those who prefer the convenience, of the space constraints currently experienced.

Professors who are interested in course development work fulfil a contract with the UOIT Teaching and Learning Centre. Comments from course developers describe the extreme amount of work and writing that is

required to produce the course outlines, tasks and video clips. One professor estimated that the video clip scripts, which are required in order to transcribe the audio components for closed captioning on YouTube, comprised in excess of 40,000 words or a sizable book. Another professor expressed an appreciation for the level of detail that was provided in the curriculum development model but as it did not provide a prescription for the course that was being built, the professor found herself engaged in a problem based learning scenario and she was able to produce a course that, in a paraphrase of her words, will be engaging and demanding for the students. Other challenges lie in the area of keeping the video clips short, relevant and engaging. Obtaining copyright permissions is another issue that has required due diligence on the part of the program administration and library staff.

In December of 2012, a full day workshop was held for more than 20 teaching staff using the services provided through the Adobe Connect general room. The program for the workshop included sessions on: Managing the Culture, which concentrated on understanding the technology/pedagogy relationship and process of change; BA Graduate Career Aspirations, which focussed on determining what are the target competencies for graduates of the program; and finally, Assessing the Program/Students. The main function of the workshop was to provide opportunities for all to discuss these issues so that a set of common views could begin to develop. Teaching staff also experienced limited project based learning activities and were able to better appreciate it, particularly if it was new to them.

A number of challenges exist across the university when contemplating moving to an mobile online model of teaching and learning. In order to determine what these challenges are, a gap analysis is being conducted. It is hoped that this process will be able to identify the discrepancies between the level of services that are not yet available but are required for fully online learners to take their place in the university student body without ever physically being present on campus. Some of these challenges come from those who express serious reservations about the level of academic rigour that is possible in online learning environments. Other challenges, such as faculty development, technology support, resource availability and programming issues have already been alluded to. Others such as a rationalized fee structure and the implementation of a comprehensive orientation program have yet to be resolved. Promotion of the program beyond the borders of the province and the country when all of the recruitment efforts to date have been focussed on face-2-face meetings also offers a considerable test. It is hoped that the use of social media and Internet advertising will be of some value in getting the message out regarding the program. Finally, building and implementing a course and program evaluation process that recognizes the various constraints inherent in online teaching and learning, along with on-going program review processes, will be vital to the viability of this type of program.

While the number of outstanding challenges can be daunting, the overall promise of moving into an online teaching and learning environment, particularly when it is premised on the use of synchronous digital technologies and includes opportunities to employ mobile devices providing anytime, anywhere access, is positive. As can be seen from this project, centred on the creation of the B.A. in Adult Education and Digital Technology program at UOIT, flexibility of thought and planning provides an answer for the physical constraints that currently hamper the university while simultaneously opening a door to a possible revisioning of educational and learning processes.

Finally, concerns have been raised on the issue of service provisioning for online students as being totally different to regular on-site students. From the perspective of working within fully online programs, it is possible to forget that others may not think that attending class from your office or home is normal and therefore, this kind of information is now flowing up to many institutional departments to find ways to better serve these new online students. Some of the issues currently under study are:

1. Tuition and auxiliary fee structures for online students (must be transparent in the application of charges and non-residential fees should not be substantially different from residents as there are few additional costs)
2. Establishment of an online learning community
3. Inclusion of online students in student life and government
4. Orientation programs to invite students into each term
5. Ongoing communication between units of the university which are responsible for the myriad of details regarding the program
6. Programming, including cross-listing across programs and faculties, maximizing access to courses for all students
7. Registration services and program administration support

8. Technical support for the IT infrastructure that is developing
9. Faculty development creating links between facilitation and resources
10. Library support, particularly in the area of open educational resources
11. Specific online course and program evaluation processes that are separate from those used for f2f classes

Solving these issues represents some of the next steps in institutionalising online learning that is mobile ready, and solving these will allow us to move towards the next level of mobile learning in the Faculty of Education.

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DEVELOPING A USER ORIENTED DESIGN METHODOLOGY FOR LEARNING ACTIVITIES USING BOUNDARY OBJECTS

Olga Fragou and Achilles Kameas
Educational Content, Methodology and Technology Laboratory (e-CO-ME-T Lab), Hellenic Open University
P. Claus Str. 278, Patras

ABSTRACT

International Standards in High and Open and Distance Education are used for developing Open Educational Resources (OERs). Current issues in e-learning community are the specification of learning chunks and the definition of describing designs for different units of learning (activities, units, courses) in a generic though expandable format. Developing educational content, courseware and pedagogical tools to support Subject Matter Experts in their educational practice is a challenging task for the Instructional Design Field. This paper's aim is to introduce a user oriented design methodology for Open and Distance Learning (ODL) activities orchestrating pedagogical tools so as to develop e-learning activities in Hellenic Open University (HOU) by the use of Boundary Objects (BOs).

KEYWORDS

Participatory Design, Communities of Practice, Boundary Objects, Learning Design, Design Research, Empirical Research

1. INTRODUCTION

With the advent of technological tools and a plethora of learning theories provided, course designers and Subject Matter Experts need guidance in producing learning activities which take account the new reality (complexity of technological tools provided, variation in students' profile, culture of subject domain) and maximize the potential technologies offer. The design problem arising out of that educational reality is about capturing and representing practice in Higher Education (HE) institutions and providing "scaffolding" or support in practitioners for designing learning activities which draw on good practice and make effective use of tools and pedagogies, not necessarily in a linear mode. Sharing and reuse of educational material needs to be based on these attributes of learning design: a) to be based on sound pedagogical principles, b) to promote sharing of expertise, c) to support the community through available support services (Walker and Masterman, 2010).

Learning Design is not understood uniformly, with perceptions ranging from misconstruction to highly developed understanding: teachers need technical training on how to use the tools but also they need training to help them understand how to use the tools to achieve pedagogical goals (Bower and Wittmann, 2010). In this case basic research aim has been to involve practitioners in the design of learning activities and capture their contribution on the structures' schematization of Open and Distance Learning activities followed by the selection of the appropriate educational content. The activity definition selected in this research approach has been the one viewing learning activities in relation to the design process "as a specific interaction of learner(s) with other(s) using specific tools and resources, orientated towards specific outcomes" (Beetham and Sharpe, 2007). The rationale has been to structure small Communities of Practice (CoPs) as a springboard to further expand the future development of online larger communities, based on models which offer "scaffolding" into the practice of sharing.

Most of the current instructional design models are spin-offs or variations of the ADDIE instructional design model (Peterson, 2003). However, one commonly accepted improvement to this model is the use of *Rapid Prototyping* (Fischer, 2011): the idea of receiving continual or formative feedback while instructional materials are being created, catching design problems while they are still easy to fix. Springboard of the design rationale of the specific research scheme has been not to use from the early design stages a specific Instructional Design model, but use instead a methodology open for allowing the emergence and iterative development of activity schemata and pedagogical tools under development. A *Learning Design* (Koper, 2006) approach has been adapted as a) a means of eliciting designs from academics in a format that can be tested and reviewed by developers, b) a means of reusing designs of activities, c) a means of tentatively supporting practitioners through the process of creating new learning activities . As Conole (2010) has stated the key facet to adapt and reuse existing learning activities has been to abstract the essential and transferrable properties of learning activities in generic schemata, expandable however in more complicated forms. As a means to achieve that we have selected the Participatory Design (PD) approach as an instructional strategy technique and the use of *Mediating Artifacts (* MA, Conole 2010) in a Communities of Practice (CoPs) format as means of developing learning activities' structures and generic pedagogical tools, used by the Hellenic Open University's practitioners. There has been an effort to ground Instructional Design Theory (IDT) in educational practice, to examine the profession as a living, changing and growing practice capturing elements and aspects of Tutors' educational experience in shaping learning activities' structures and pedagogical tools under development. In providing an optimum learning experience we chose a) to continually evaluate the learning media for usability and effectiveness, and as early as possible, b) to immediately revise, rewrite, recreate, or add to the learning media in a cyclic pattern. Basic aims have been to understand the mechanisms of interaction between (i) the world of design and users and ii) between loops of co design and loops of uses so as to produce guidelines of an user oriented methodology for designing and developing learning activities and supportive pedagogical tools which provide scaffolding to practitioners. This paper is structured as follows: a short, critical presentation of the Learning Design approach is developed followed by the basic characteristics of Rapid Prototyping and Boundary Objects which structured the basis of the proposed methodology. In the proceeding sections a description is presented of the research schema implementation and basic components of the first generation pedagogical design followed by preliminary data comprising an example of the methodology introduced. Conclusion is presented in section 4.

2. DEVELOPING A USER ORIENTED DESIGN METHODOLOGY FOR E-LEARNING ACTIVITIES

2.1 The Learning Design (LD) Approach

The term Learning Design (LD) has been inextricably linked with the development of IMS-Learning Design specification (http://www.imsglobal.org/learningdesign/index.html) aiming at providing a means of formal representation and reuse of learning sequences. Since then LD has been broadly used by researchers and developers in course design and there has been a shift from content creation and presentation to focus on learning activities. The ADDIE model has been dominant and profoundly influential in forming educational practice in the terms of designing educational courses and adaptive systems supporting these (Conole and Retalis, 2010). However, it has been criticized of a) not being necessarily leading to the best instructional solutions, b) not providing solutions in a timely and efficient manner, c) not taking advantage of technologies that allow for less linear approaches to Instructional Design (ID) such as Rapid Prototyping (RP). It has been argued that its application in real educational settings is time consuming and produces boring courseware (Dick et al, 2011) .

2.2 Rapid Prototyping (RP) and Boundary Objects (BOs)

The Rapid Prototyping (RP) process involves quickly developing a prototype product in the very early stages of the instructional design project and then going through a series of rapid tryouts and revision cycles: this design technique has been advocated as a means of producing quality instructional materials in less time than is required when more conventional instructional design techniques are employed. Rapid prototyping models involve learners and/or Subject Matter Experts interacting with prototypes and instructional designers in a continuous review/revision cycle (Fischer et al, 2011, Dick et al, 2012). Developing a prototype is practically the first step, while front-end analysis is generally reduced or converted into an on-going, interactive process between subject-matter, objectives, and materials. Basic criteria for implementing this process have been a) promoting the discussion between Practitioners, Instructional Designer, Learners in a focused way, by concentrating on the facts and the results ,rather than *a priori* selected and defined ID models and learning theories, b) developing shared understanding among the HOU practitioners and instructional designer involved in the project so as to build trust and create a common language between fields, c) making the design and development process open to new emerging ideas, d) making the design open to emerging needs from test and evaluation phases, e) focusing on pedagogical design (teaching) instead\of course materials preparation and technology. The rapid prototype creates an early iteration loop that provides valuable feedback on technical issues, creative treatment, and effectiveness of instruction.

CoPs consist of practitioners who work as a community in a certain domain undertaking similar work (Fischer, 2011). A community of practice has many possible paths and many roles (identities) within it (e.g., leader, scribe, power-user, visionary, and so forth). *Boundary objects* (Fischer, 2011) are externalizations of ideas that are used to communicate and facilitate shared understandings across spatial, temporal, conceptual, or technological gaps: as intermediary productions, they result from interactions between designers' and users' world, based on rules identified by the designers: utilization of these artifacts in the users' activity constitutes an opportunity for testing the hypothesis of designers, revealing their consequences and possibly enriching or shifting them. These objects incorporate the knowledge coproduced during the design process: uses in real practice improve the validity of this produced knowledge. Boundary objects play an important role in the emergence of both socio-technical compromises and mutual learning processes. In order to play this role three characteristics are essential: a) *robustness:* boundary knowledge incorporate all the knowledge (Theoretical and Actionable) produced during the design process and allow for their interactions, b) *openness:* the use of generic, plastic, reconfigurable objects allows for their adaptation to different purposes and needs, c) *simulation/visualization capacity:* visual representations as used in this case are a basis for practitioners' –designers' communications and enrich the knowledge creation process. End User Development (EUD) is necessary as it is impossible to design artifacts (software systems, learning environments) at design time for all the problems that occur in use time.

3. IMPLEMENTATION

Research shows that tutors prefer to use models as an inspiration for creating learning designs that suit their own style and context rather than simply copying the shared samples (Walker and Masterman, 2010) . A major obstacle to teacher adoption of learning designs is an insufficient level of pedagogical understanding required to make use of resources (Cameron, 2010). Basic aim has been to capture HOU Lecturers' experience of educational practice and allow for emergence of reusable concepts and educational content in Micro level (activity) to Meso level (module) and Macro level (Thematic Unit) of (4) Thematic Units. (14) HOU Lecturers participated in the conducted research, as well as (200) adult students of both Undergraduate and Postgraduate Courses. Focus Groups sessions have been used as a context for supporting the design of learning activities and actual testing of LAMS (http://lams.org) learning activities in adult HOU students has taken place during October and November of 2012. Basic pedagogical guidelines have been adopted to produce generic learning designs through the use of pedagogical planning tools: generic activity templates have been produced and educational content in the form of Learning Objects has emerged out of the process. Basic aim has been to allow for iterative cycles of design with in parallel development of both pedagogical planning tools used and activity schemata produced by the HOU Tutors. The designed activities have been oriented towards learning trends such as assessment based learning, cooperative learning, self regulated

learning (Beethan and Sharpe, 2007): their generic pedagogical characteristics emerged out of the tutors' design, they are however expandable in richer formats and more complex forms. The structural components of the methodology used have been intentionally selected to apply in an array of subject domains: HOU numbers (203) Thematic Units in (4) Schools: Humanities, Social Sciences, Sciences and Technology, Applied Arts. The LAMS platform has been used experimentally in order to assess students' and teachers' attitudes on using it as an ICT tool in their educational and learning practice. However, the approach implemented can be mapped in other LMS platforms such as Moodle. Whereas LAMS is designed to operate more at the level of individual lessons, Moodle is designed to structure courses (Bower & Whittmann, 2011). LAMS more tightly defines the sequence with which resources and activities are accessed whereas Moodle offers more student control over the order in which resources and tools are used. There are limitations in each case, however there is also the ability to implement Moodle learning activities within LAMS. The produced representations out of the design process have been a) learning sequences in LAMS, b) conceptual maps of the educational content used, c) paper artifacts representing the structure of learning activity, d) verification of the structure of the pedagogical planning tool designed and used, the Design for Pedagogy Tool (D4P). Practice focused representations have been used (eg case studies, lesson plans and patterns), conceptual representations (eg mind maps), abstract representations eg (vocabulary) (Conole, 2010).

3.1 Methodology Applied

E-Co-Me T Lab (http://www.eeyem.eap.gr) is a supporting organization of HOU courses providing innovations in design of educational methodologies and educational content production. A design research methodology (Fischer et al, 2011) has been implemented, involving HOU Lecturers and the E-Co-Me T Lab ID Team in producing mediating artifacts for (4) TU of HOU that have been used so as to design and develop learning design activities using LAMS. The design research approach has been used so as to form prototheory, explore concepts and processes so as to further develop in the future the initial design in iterative cycles (Fischer, 2011). Practitioners used a) flashcards to arrange the infrastructure of a Learning Activity in LAMS, b) diagrammatic representation of the educational content used for the activity design, c) Bloom's taxonomy so as to produce expected Learning Outcomes (LOs) for their activities. Basic steps of the activity design process are presented in Figure 1:

Figure 1. Basic steps of the activity design process

The design research methodology supported the use of ethnographic practices: qualitative data, collected from (2) Focus Group (FG) sessions aimed at revealing the connection between what and why, uncovering concepts, relationships and processes while a questionnaire has been used for evaluation of both LAMS designed learning activities and FG sessions. Both activities' paper artifacts and LAMS learning sequence archetypes have been used as boundary objects in further development and filtering of the learning activities. Generic templates of learning sequences and pedagogical tools further expandable have been developed so as to facilitate learning design in HOU. The design criterion of the activity template has been to use a generic form so as :a) to motivate lecturers to contribute to production of new material and increase participation, b) to support and encourage the development of learning examples, and emerging conceptual models. Basic aim has been to encapsulate critical pedagogical properties of the design: theories of learning have been reflected to designed activities. Grouping Learning Design resources' aspects by discreet discipline domains is expected to allow for simultaneous investigation on what works within domain using specific frameworks and explore the relationships between the domains.

3.2 Preliminary Data-First Generation Pedagogical Design

Basic phases of the User Oriented Design Methodology are i) limiting the design problem by analyzing the specific problem to solve, ii) building a theoretical support by building construction principles and design rules, iii) building archetypes by the use of boundary objects as a result of interaction between HOU practitioners and instructional designer, iv) experimentation by two complementary phases and forthcoming scenario based evaluation of the boundary objects produced, v) the adoption-adaptation process which progressively spread and transform the organizational context. These are presented in the following figure:

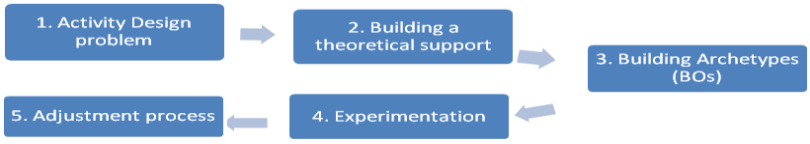


Figure 2. Basic phases of the UO Methodology

Boundary objects result from compromises and negotiations between designers and users, they allow the work of mutual adaptation i.e the co evolution of designers' and users' world. An important aspect stressed by most authors is the careful planning of all ODL activities from a pedagogical, organizational, financial, managerial and administrative point of view (Conole, 2010). The types of Boundary Objects that have been used are presented in Figure 3:

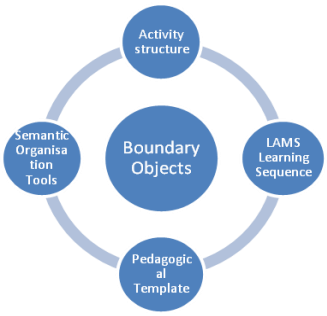


Figure 3. Types of Boundary Objects used

As main objectives of the proposed methodology have been:

- Classification and reuse of ODL concepts and content in HOU educational curriculum
- Integration and authorized exchange/dissemination of information and knowledge
- User friendly design i.e. usage requires only basic IT skills
- Extendibility and flexibility of educational content used
- Design and implementation of learning modules using existing educational content and concepts without excluding the emergence of new educational material
- Creating learning chunks for using LOs
- Based on open standards and existing LMS technologies

Object Based Learning (OBL) has been selected as compatible with HE standards and amiable to already produced educational content and already designed Learning Objects of HOU courses. Hierarchical structure of major and minor learning objectives in learning activities supports a) structuring of learning experience from simpler to more complex forms, b) emergence of important and less important concepts of educational content and principles in design activities, c) relatively easy transition from Micro level (activity) to Meso level (module) and Macro level (Thematic Unit). Using reusable concepts and educational content of various Thematic Units forms a modular curriculum under which theory and practice are closely interwined and less important aspects of educational content are left behind, providing space to innovation of educational content used. The design strategies developed in the scope of the framework that has been described earlier have been the following:

- Define learning outcomes in Micro-Meso-Macro level
- Structure Activities-Units-Modules according to learning outcomes set in specific criteria by HOU Lecturers
- Use ODL Standards to design learning activities, supported by generic but flexible instructional design tools
- Set Expected Learning Outcomes but also allow for emergence of non Expected Learning Outcomes
- Allign LOs with Assessment tasks and use Learning Outcomes as a springboard for emerging Learning Objects
- Use both students and teacher profile for the learning and teaching process: design for diversity
- Set criteria for learner performance: specify how students achieve knowledge
- Encourage deep level learning: from description to explanation
- Encourage learner's selection: choosing between focus of learning experience
- Provide educational material which gradually becomes more difficult for the learner to tackle with
- Allowing for emergence of policy changes in organizational settings
- Focus on both concepts and skills

Textual and content mapping representations are probably the most common ways in which teachers think about their designs (Conole, 2010). However, in this case hierarchical semantic organization tools have been used in the format of concept maps (expandable however in ontology schemata) and pedagogical principles generated in the (4) learning activities. Pedagogical tools initially designed and developed have been pilot tested in HOU Practitioners, process which actually confirmed the initial structure of these. In a design research scope selected (Fischer et al, 2011), there has been a process of reshaping parameters of the pedagogical tools used, extending their use in learning theories such as self regulated learning, cooperative and constructivist learning. The design components, influencing the first generation pedagogical design which emerged out of the implementation of our methodology are presented in the Table 1. Table 2 presents produced combinations among Lams Learning Activities, Learning Outcomes and Learning Object Types:

Table 1. Design components influencing first generation pedagogical design

Components Influencing Pedagogical Design	Category I	Category II
Learning Outcomes	**Bloom's taxonomy**	Types of LOs
Learner Characteristics	**Prior Knowledge**	Learner's Profile
Structure	**Activity components**	Conceptual Map
Information Presentation	**Activity structure**	Tasks
Learning Environment	**LAMS tools**	Support & Scaffolding, Assessment

Table 2. Produced Combinations between LAMS Learning Activities, Learning Outcomes and Learning Object Types

LAMS Learning Activity	Learning Outcomes	Learning Object Types
Message Board Activity	**LO1, LO2, LO3, LO4, LO5,LO8,LO9, LO10,LO13,**	Text
Share Resources	**LO5**	Video
Report Submission	**LO5**	Exercise
Questions and Answers	**LO5,LO6,LO11,LO12**	Multiple Choice Question

In Figure 4 a snapshot of LAMS Activity (1) and the conceptual map in Thematic Unit (TU) ICT31 is presented:

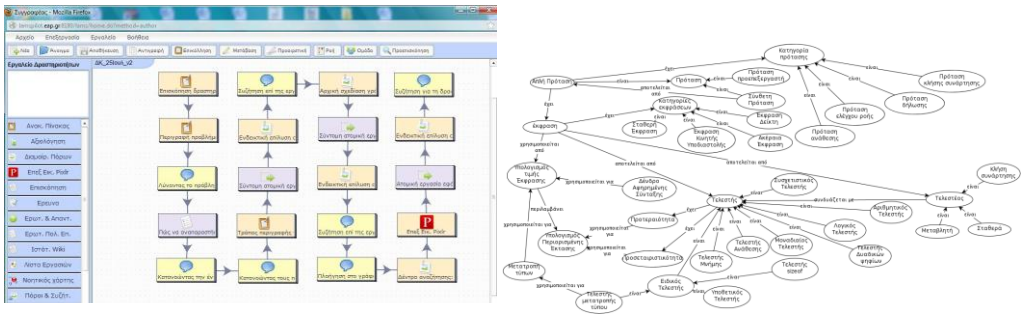
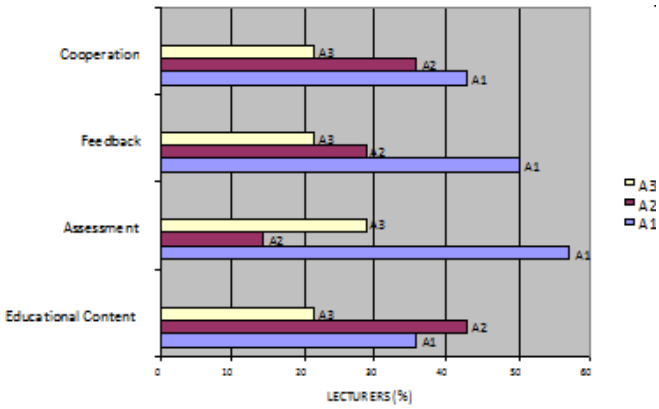


Figure 4. Snapshot of LAMS Activity (1) in HOU TU ICT31and the conceptual map of the educational content

As a result of the proposed methodology the following data have been produced: (4) structures of learning activities using LAMS presenting however a variety in designed Learning Outcomes and frequency of LAMS tools used under different pedagogical underpinning rationale. Interaction of the research team with HOU lecturers according to specific research agenda revealed important issues regarding the quality of educational material used in actual HOU courses and HOU Lecturers' reflection on its use in educational practice. The paper prototypes and digital archetypes have been evaluated and their structure confirmed during the pilot study period. Formative evaluation has been conducted using questionnaires on conducting Focus Groups and use of designed LAMS activities. These have provided feedback on the design effectiveness of tools used and allowed us reach the conclusion that the proposed research scheme, its products and their basic operation has been understood and accepted for use by HOU Practitioners. Table 3 presents Lecturers' percentage on attitudes regarding using basic categories of LAMS Activities (Educational Content, Assessment, Cooperation, Feedback) in (3) LAMS Learning sequences that have actually been tested to HOU students:

Table 3. Lecturers' attitudes on usefulness of basic categories of LAMS tools used in (3) Activities



4. CONCLUSION

The objective of this paper is to briefly present and propose basic characteristics of a user oriented methodology for designing and developing e- learning activities using LAMS. Our methodology provides new insight into achieving customization of e -learning activities and pedagogical tools in organizational contexts. This methodology is based on the following characteristics: a) the utilization of artifacts in the practitioners' activities and educational practice as an opportunity for testing, enriching and shifting them, b)

an iterative cycle process: building intermediary productions at each loop allows to articulate the multiple rationalities existing in an educational network and this articulation requires substantial labor of translation, negotiation, debate, triangulation and simplification, c) using boundary objects as mediators for the co evolution of both designers' world and practitioners' world. We have argued that the construction of successive boundary objects and their uses in real situations allows for close interaction between scholars and practitioners, an emergent process of arbitrage in which practitioners and instructional designers engage with one another to produce together the solutions and both theoretical and practical knowledge in the field of management. Future work includes an iterative phase of testing the revised LAMS Learning Activities in HOU students, expansion of generic pedagogical tools used and further process and analysis of data collected. A professional framework needs to be put in place for two purposes: a) to educate users about learning design based on pedagogical principles, b) to facilitate adoption in alignment with pedagogical goals set at an institutional level. The development of the pedagogical framework needs time and involvement of participants from various jurisdictions so as to create rich pedagogical structures that can be used as a starting point for localized adaptation.

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USER ACCEPTANCE OF A HAPTIC INTERFACE FOR LEARNING ANATOMY

Soonja Yeom[1], Derek Choi-Lundberg[2], Andrew Fluck[3] and Arthur Sale[1]
[1]*School of Computing and Information Systems, University of Tasmania, Australia*
Private Bag 100 Hobart, Tasmania, Australia
[2]*School of Medicine, University of Tasmania, Australia, Private Bag 34 Hobart, Tasmania, Australia*
[3]*School of Education, University of Tasmania, Australia, Locked Bag 1307 Launceston, Tasmania, Australia*

ABSTRACT

Visualizing the structure and relationships in three dimensions (3D) of organs is a challenge for students of anatomy. To provide an alternative way of learning anatomy engaging multiple senses, we are developing a force-feedback (haptic) interface for manipulation of 3D virtual organs, using design research methodology, with iterations of system implementation, formative evaluation, and cyclic enhancements. In the present study, we aimed to determine the user acceptance of the haptic interface for exploring anatomical structures and relationships. Undergraduate computing (n=10) and medical (n=35) students from the University of Tasmania, Australia, who volunteered to try two iterations of the system (n=18 and 27 in two separate user tests) reported on anonymous questionnaire with quantitative and qualitative questions that the system was easy to use, useful for learning, and neither physically nor mentally stressful. We conclude that many medical students would accept a haptic interface for manipulating 3D virtual organs as an aid to learning anatomy. Further development of the system will involve development of learning and assessment modules, and we plan to evaluate the system's usefulness in promoting learning of anatomy.

KEYWORDS

Anatomy, haptic interface, technology-enhanced learning, higher education, medical education

1. INTRODUCTION

Efforts to improve learning experiences with technology have been actively pursued for decades (Reiser, 2001). Different teaching strategies and learning resources vary in effectiveness for learners with different learning styles (Murphy et al., 2004, Dobson, 2009); thus, offering a variety of learning options is pedagogically sound. This article describes the initial stages of development and evaluation of a system for exploring three-dimensional (3D) anatomical structure and relationships of human organs with haptic feedback.

As students of human biology may have only limited time to learn from real human organs or realistic 3D physical (eg, plastic) models, such a system provides an additional option for exploring 3D anatomical structures, making use of new technological opportunities to enhance learning experiences through activating multiple sensory systems of the learner. Students have reported difficulty in learning anatomy from 2D resources such as textbook diagrams (Yeom, 2011). Providing a 3D model with haptic feedback reduces the gap between a learning system and reality. When information is presented in a multisensory format, it improves learning and memory ability (Shams and Seitz, 2008). A display device and a controlling device are the main computer peripherals required for this system. This study investigated the acceptance of a haptic system with 3D anatomical models for learning anatomy by undergraduate computing and medical students at the University of Tasmania (UTAS).

3D simulations with interaction in anatomy, radiological imaging, and surgery is an active research area (Behringer et al., 2003, Chien, 2010, Dieperink, 2006, Nicholson et al., 2006, Sakellariou et al., 2009, Tan et al., 2012, Temkin et al., 2006, Yushkevich et al., 2006, Liao et al., 2010). For example, learning from a 3D computer model and standard two-dimensional (2D) images of laryngeal anatomy did not differ, but learners preferred the 3D model (Tan et al., 2012). In contrast, Nicholson et al. (2006) found learning outcomes were

improved with 3D computer models of the ear compared to traditional 2D images, possibly due to greater interactivity and complexity of the 3D computer models vs the 2D images. Computer-generated 3D models may be particularly effective in providing visualization of anatomy that is hard to represent through traditional 2D images (Sakellariou et al., 2009). User responses to virtual reality (VR) with a haptic interface were "positive and the majority of users found the VR system more engaging, interesting and easy to use and more efficient in elucidating spatial inter-relationships of structures" (Sakellariou et al., 2009). However it is unclear whether the positive results were due to 3D models produced in VR, the haptic interface, or a combination of both. The effectiveness of a haptic interface may not be easy to measure due to the complexity of the system, with interactivity, quality of the system, and learning outcome goals important additional variables (San Diego et al., 2012).

As educational research incorporating haptic technology for learning human anatomy in health fields is currently mostly limited to advanced, post-graduate trainees, our research aims to determine if a haptic interface can assist undergraduate medical students in learning anatomy. Our overarching research question is to determine whether learning anatomy in a 3D system with a force-feedback palpable (haptic) control will enhance anatomy learning and transfer of knowledge into realistic settings. As a work-in-progress, research sub-questions are to investigate if the haptic interface will lead to more effective learning, whether users accept a haptic interface to learn anatomy, and what factors affect learning and user acceptance. This paper focuses on evaluating user acceptance of the haptic interface.

2. METHODOLOGY

We used the design research approach, with iterations of system implementation, formative evaluation and cyclic enhancements to develop our haptic system (Bannan-Ritland, 2003; Collins et al., 2004; McKenney, 2001 and Reeves, 2006). To date, the system has been through two phases of development and user tests.

2.1 Interface and Interaction

The interface domain in this study comprises 3D modeling and 3D interface space with the Phantom Omni haptic device (Figure 1), which provides six degrees of freedom: three for position (x,y,z) and one each for pitch, yaw and roll (rotation in the forward vertical, horizontal and transverse planes). Force feedback gives different amounts of resistance to an input depending on the state of the virtual operation.

Figure 1. Haptic device (Phantom Omni) used in the system and user tests

The system supports functions such as moving selected organs, zooming, and rotating. Particular parts of an organ can be selected to display its name (Figure 2), and these labels can be turned on or off.

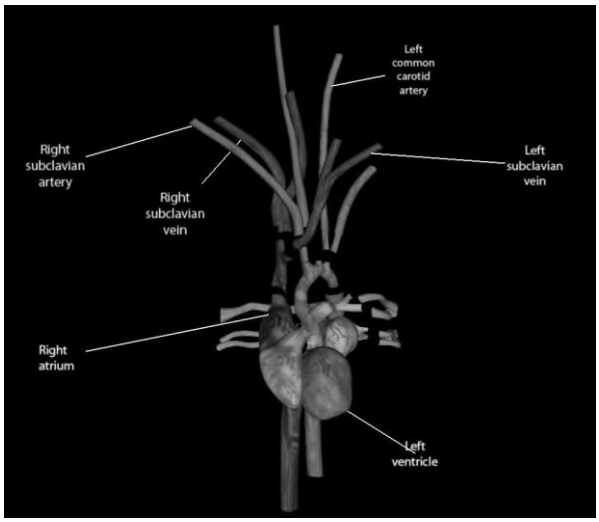

Figure 2. Screenshot of organs displayed in user test 2. Several labels have been turned on

The user receives tactile feedback, the force of which depends upon the part pressed. For example, different levels of surface deformation were set: the lung is 'spongy' (Figure 3), while the liver is firm. In Figure 3, the lung surface is being deformed, and the user is experiencing haptic feedback.

Figure 3. Screenshot of the lungs displayed with surface deformation in user test 1

The organs displayed in user test 1 included the lung, liver, and heart. For user test two, the organs displayed were the heart with its four chambers, and numerous blood vessels.

2.2 Development Environment

The computer system used in user test 1 was an Intel ® Core ™ Duo CPU @ 2GHz, RAM 2GB. An upgraded system was used in user test 2, which provided more sensitive feedback to the user. Its specification was Intel® Core ™ i7-2600 CPU @ 3.4GHz, RAM 16GB.

2.3 Formative Evaluation

To investigate user acceptance of the haptic interface, we recruited first to third year undergraduate medical students and computing students at UTAS to try the system. For user test 1, an email invitation was sent to all (n=230) second and third year medical students. In addition, computing students engaged in activities in a computer lab were invited to test the system, which was set up in an office. For user test 2, all first year medical students (n=115) were invited to test the system during a practical laboratory class.

Demographic information and prior experience with computers and haptic devices was gathered from participants prior to each test via a short questionnaire. After a brief introduction to using the system, each user was free to explore it. The lead researcher and a research assistant observed the users, to observe how they learned to use the interface and any difficulties they encountered. After exploring the system, participants were asked to complete a questionnaire with both visual analogue scale (VAS) questions and an open response comment box on their experiences with the system.

Results of quantitative questions are presented as mean, standard deviation (SD), and standard error of the mean (SEM). T-tests were used to compare results from user tests 1 and 2, with significance level conservatively adjusted to $\alpha = 0.01$ using the Bonferroni correction for multiple comparisons (type I family-wise error rate of $\bar{\alpha} = 0.05$ divided by 5, the number of comparisons). Quantitative analysis was performed in Excel and SPSS. Qualitative analysis of open response comments was through coding and identifying themes (Braun and Clarke, 2006).

3. RESULTS

3.1 User Test 1 Settings and Demographics of Participants

We emailed all year 2 and 3 Bachelor of Medicine, Bachelor of Surgery (MBBS) students at UTAS (n=230), inviting them to participate in our research project by trying the haptic system and completing a questionnaire. The system was set up in a vacant tutorial room at the School of Medicine campus, three times for two hours each, when at least some of the students did not have classes. In addition, some computing students at UTAS were invited to participate (n=20). The system was set up in an office at the School of Computing and Information Systems for two days.

In total, 18 students, 15 males and 3 females, tried the system and completed the questionnaire, including eight medical students (3.5% response rate) and ten computing students (50% response rate). The average age of all participants was 23, and four reported previous experience with haptic devices, but none with the Phantom Omni haptic device.

3.2 User Test 2 Setting and Demographics of Participants

Sample size calculations ($n = 2*[(z_\alpha-z_\beta)\sigma/(\mu_1-\mu_2)]^2$), based on an estimate of standard deviation (σ) of 22 derived from the average of the observed standard deviations on the five VAS questions relating to user acceptance in the first user test, and a desire to detect a difference in mean scores ($\mu_1-\mu_2$) of 20 on the 100-point VAS with $\beta=0.20$ (power = 0.80, $z_\beta=-0.84$), yielded required sample sizes of n=19 at $\alpha=0.05$ ($z_\alpha=1.96$) and n=29 at $\alpha=0.01$ ($z_\alpha=2.575$). We emailed all year 1 MBBS students at UTAS (n=115), inviting them to participate in our research project by trying the system and completing a questionnaire. The system was set up at two practical laboratory sessions, each two hours long with half the class each. Twenty-seven students (23% response rate), 16 males and 11 females, tried the system, but only 25 participants completed the questionnaire, with two participants each not answering one question. More students wanted to try the system than were able to, and many students watched other students using the system. The average age of all participants was 19, and one reported previous experience with haptic devices, described as a mobile phone.

3.3 User Acceptance of the Haptic System

Participants were asked to complete a questionnaire immediately after using the system, which included VAS responses (scale of 0 to 100) and an open response comment box. The design of the questionnaire was based on the Technology Acceptance Model (TAM). According to the model, acceptability of a system is determined by two main factors, perceived usefulness and perceived ease of use (Chuttur, 2009). On average, participants rated the interface useful, easy to use, indicated that they performed well with the interface, and reported low levels of mental and physical stress (Table 1).

Table 1. Comparison of questionnaire responses in user tests 1 and 2

Question	User Test	n	Mean	SD	SEM	t	p
Did you perform well with the interface? (0=very poor to 100=very good)	1	18	71	19	4.5	1.02	.32
	2	24	63	22	4.5		
Was the interface useful? (0=totally useless to 100=very useful	1	18	81	15	3.5	1.87	.07
	2	24	69	17	3.5		
Was it easy to use? (0=very difficult to 100=very easy)	1	18	73	18	4.2	2.13	.04
	2	25	58	20	4.0		
Did you become mentally stressed? (0=not at all to 100=very stressed)	1	18	22	30	7.1	-.44	.66
	2	25	32	27	5.4		
Did you become physically stressed? (0=not at all to 100=very stressed)	1	18	21	29	6.8	1.22	.23
	2	25	17	19	3.8		

Observing the participants using the haptic device during the first user test, we noted that when the cursor was moved too far in the z-axis, users found it hard to bring the cursor back. This was mitigated by the faster computer in the second test. The status of developed prototype was the main difference between two user tests. The user test 1 version included only three organs (heart, lungs, liver), and provided basic interaction with 3D models and haptic feedback. The user test 2 version had 28 objects (heart chambers and blood vessels), and increased functionality including clicking to make labels appear. There were some speed issues with version 2 when the users tried to do more complex activities such as moving smaller objects.

The questionnaire responses show that ease of use and perceived usefulness of the haptic interface decreased somewhat in the second test compared to the first, but these were not statistically significant at $p = 0.01$ (adjusted for multiple comparisons). In both user tests, most participants were using the haptic interface well after a few minutes. Questionnaire responses from the second user test indicated most participants would like to use the system as an aid to learning when fully developed, with an average value of 75 out of 100 (n=21 respondents to this question, SD=17, SEM=3.8; 0=not at all to 100=very likely). Responses to this question correlated positively with the questions on usefulness (r^2=0.56), ease of use (r^2=0.31), and performing well (r^2=0.14); however, there was no correlation with physical stress (r^2<0.01), and a weak negative correlation with mental stress (r^2=0.07).

Qualitative analysis of written comments on any aspect of the system involved coding the responses across both user tests, with 19 participants providing written comments. Seven participants requested additional functionality, relating to greater anatomical detail, more options to manipulate organs, or additional physiology or pathology content. Seven participants described system interface problems, relating to difficulty with placing the cursor, slow or jittery response, or the cursor getting stuck. In contrast, five participants praised the haptic feedback or other functionality, such as the ability to rotate organs. For example, one wrote: “I felt that the interface was appropriate for the task, with a high level of fine control permitted. I was impressed with the texture and density feedback test, there was a definite difference between the lung and liver in terms of feedback through the haptic interface.” One participant wrote they didn’t learn anything, another questioned usefulness for learning, and one described it as “fun”. In contrast, two participants described the system as a useful learning tool, and two others wrote they would like to try it again when further developed.

4. DISCUSSION

Our main finding was that the majority of undergraduate computing and medical students who participated in this research study were favorable towards a haptic interface for exploring the structure and relationships of virtual 3D organs (Table 1). Our observations of the participants during the user tests suggest that students can rapidly learn to use the features of the system (moving organs, rotation, zooming, pressing organs). This was confirmed in questionnaire responses that most users found the system easy to use. This concurs with earlier work showing the 'naturalness' of the haptic interface, and the ease with which users adapt to it (Massie and Salisbury, 1994, Sankaranarayanan et al., 2003). The intuitiveness and ease of using a system like this should minimize extraneous cognitive load while learning from the system. However, open response feedback from the questionnaire indicates that further work is needed to smooth responsiveness of the cursor to movement of the haptic device; greater processor speed would assist. Many students would also like additional functionality to increase the potential to learn from the system. Most participants indicated they would like to use the system as an aid to learning when it is fully developed, suggesting intention to use this system. In agreement with the technology acceptance model (Chuttur, 2009), behavioural intention to use the system correlated strongly with perceived usefulness ('was the interface useful?', r^2=0.56) and perceived ease of use ('was it easy to use?', r^2=0.31).

The majority of participants in this study were young males. There were no obvious gender differences in accepting the new interface, with both males and females expressing enthusiasm. The smaller number of female volunteers may have been because fewer females were interested in trying a new technology system, or, in the second user test conducted during a regularly scheduled class (laboratory practical session), females may have been more focused on their learning tasks than males. We did not have a large enough number of participants to enable comparing responses by participant age. Anecdotally, one mature-age student showed frustration and stopped using the system. The current generation of 18-20 year old undergraduate students are 'digital natives' who have used technology since they were 5 or 6 years old (Prensky, 2001), confirmed in our questionnaire demographic data. In contrast, some older students may be less comfortable with new technology.

The greater interest (response rate) in the second test compared to the first may have been due to students seeing the haptic device, and watching others trying the device and expressing enthusiasm. In addition, the anatomical structures displayed (heart and blood vessels, Figure 2) were related to the learning objectives of the laboratory practical session (relating to introductory anatomy of several organ systems, including the cardiovascular system) at which the system was set up.

A limitation of this study is potential self-selection bias in the samples of students that tested the system. In the first user test, computing students and year 2 and 3 medical students were invited to try the system via email; there was a very low response rate (3.5%) from the medical students. In the second test, the system was set up in a laboratory practical class for first year medical students, and a higher, but still low response rate (23%) was obtained. In both cases, the students electing to participate in the research and try the system may have had a positive bias towards accepting new technology. Thus, the high level of user acceptance, and low self-reported levels of stress, may differ from the general undergraduate student population.

Although the user acceptance was not statistically significantly different between the first and second user tests, there were trends for decreased acceptance levels. Sample size calculations at power of 0.80 (80% chance of detecting an actual difference) yielded n = 19 or 29 at α=0.05 or 0.01, respectively. Our actual numbers of respondents to the questions were 18 and 24-25 in user tests 1 and 2, respectively, indicating we had somewhat less chance of detecting an actual difference between our two user tests. The trends towards decreased acceptance may have been due to different sample populations. In the first test, computing students and second and third year medical students were invited to participate. In the second test, we selected the group of students more likely to use the system in its present level of anatomical complexity, that is, first year medical students. It is possible that computing students, in particular, may have had a higher level of acceptance of the new technology.

5. CONCLUSION

We conclude that undergraduate medical students accepted a haptic interface to explore the structure and anatomical relationships of virtual 3D organs. However, the low response rate and positive self-selection may have resulted in a more positive response than the population. Additionally, positive responses may have been due to a novelty effect or that they were being observed trying the system. Further development of our system will provide another learning resource that engages multiple sensory systems for use by undergraduate medical students. However, a factor limiting wider availability of this system is the requirement for the computer peripheral, the haptic device. The next phase of the research is to develop learning activities including formative assessment opportunities, and testing materials to measure the users' learning achievement with the system compared to traditional learning resources.

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E-LEARNING SOFTWARE FOR IMPROVING STUDENT'S MUSIC PERFORMANCE USING COMPARISONS

Delgado, M., Fajardo, W. and Molina-Solana, M.
Universidad de Granada. Dept. Computer Science and Artificial Intelligence, Granada. Spain

ABSTRACT

In the last decades there have been several attempts to use computers in Music Education. New pedagogical trends encourage incorporating technology tools in the process of learning music. Between them, those systems based on Artificial Intelligence are the most promising ones, as they can derive new information from the inputs and visualize them in several meaningful ways. This paper presents an application of machine learning to music performance which is able to discover the similarities and differences between a given performance and those from other musicians. Such a system would help students to better learning how to perform a certain piece of music, allowing them to compare with other students or master performers.

KEYWORDS

E-Learning, Music education, Music Performance, Machine Learning.

1. INTRODUCTION

Student musicians spend most of their time practising. These countless hours of practising help them learn to interpret a piece of music as the composer imagine it, but also developing their own style -one that is unique to each of them. Said in other words, what makes a piece of music come alive is also what distinguishes great artists from any other.

In this work, we propose a piece of software and a machine learning algorithm which are able to classify performances according to their similarity to those of famous musicians. Such a system would help students to understand the musical resources some of the greatest performers use and how to imitate them.

We focus on the task of characterizing performers from their playing style using descriptors that are automatically extracted from commercial audio recordings by means of state-of-the-art feature extraction tools. This learning process is done by employing the system described in Molina-Solana *et al.* (Molina-Solana, M. et al., 2010). This approach is quite different from those in the literature, in which a heavy human intervention is needed in order to manually annotate the music. That is, however, what makes it feasible for being employed in an automated system such as the one we present here. The devised software requires no human intervention, being the whole process done in an automatic way.

Software tools aimed to help students to better perform have mainly the drawback that they are limited to a range of previously analysed songs. That is not the case of our system as far as the learning model we have chosen, is able to capture how the performer plays, regardless the piece being performed. This way, the student is assessed of how to play a work even though the expert musician did never play it.

No special hardware (e.g. MIDI instruments) is required to appraise the student's unique way of performing. Only an audio recording of the student performing with their own instrument is required. Thus, the performance is no biased in any sense: students play with their own instrument and there is no need of them being aware of them being recorded. In fact, it is relatively easy to count with students' recordings nowadays because many teachers encourage their students to record themselves when playing.

This paper is organized as follows. Firstly, in Section 2 we provide some background about both Music Performance and Music Education. In section 3, we briefly explain the model we use to represent the information about performances, and how that information is extracted from audio files. Section 4 presents the devised software and how it can be used. Finally, Section 5 points out some conclusions and further developments.

2. BACKGROUND

This section describes what Music Performance is, and how computers can be used for Music Education. Former works in those areas are also revised to provide the reader a proper framework for the rest of the paper.

2.1 Music Performance

The literal execution of a musical score is frequently judge as being significantly less interesting than a performance of that piece by even a moderately skilled musician. The reason is straightforward: musicians do not produce literal renditions of the score. That is, they do not play a piece of music mechanically, with constant tempo or loudness, exactly as written in the printed music score. Rather, skilled performers slow down at some places, speed up at others and stress certain notes or passages. Tempo variations and loudness variations are the most important parameters available to a performer, being also the main source of expression in music (Palmer, C., 1996). The way these parameters 'should be' varied is not precisely specified in the printed score; so that, it is the performer the one in charge of using them properly.

According to Widmer and Goebl (Widmer, G. and Goebl, W., 2004), expressive music performance can be defined as the deliberate shaping of the music by the performer, in the moment of playing, by means of continuous variations of parameters such as timing, loudness or articulation. Changes in tempo (timing) are modifications of the regular grid of beats that defines time in a score. Changes in loudness (dynamics) are modifications of the intensity of notes with respect to the others and to the general energy of the fragment in consideration. Articulation consists in varying the gap between contiguous notes by, for instance, making the first one shorter or overlapping it with the next.

Music performance is a complex activity involving physical, acoustic, psychological, social and artistic issues. At the same time, it is also a deeply human activity, relating to emotional as well as cognitive and artistic categories. Furthermore, it is dramatically affected by performer's mood and physical condition.

As said before, research in music performance has a multidisciplinary character, with studies that range from understanding expressive behaviour to modelling aspects of renditions in a formal quantitative and predictive way. Historically, research in expressive music performance has focused on finding general principles underlying the types of expressive 'deviations' from the musical score (e.g., in terms of timing, dynamics and phrasing) that are a sign of expressive interpretation. Works by De Poli (Poli, G. D., 2004), Widmer and Goebl (Widmer, G. and Goebl, W., 2004), and Delgado *et al.* (Delgado, M. et al., 2011) contain overviews on expressive performance modelling. The reader should refer to them for further information.

One of the issues in this area is the representation of the way certain performers play by just analysing some of their renditions -studies into the individual style of famous musicians. That information would enable us to identify performers by just listening to their renditions (Molina-Solana, M. et al., 2010; Saunders, C. et al., 2008; Stamatatos, E. and Widmer, G., 2005; Widmer, G. et al., 2003). These studies are difficult because the same professional musician can perform the same score in very different ways. Among the methods for the recognition of music performers and their style, the most relevant are the fitting of performance parameters in rule-based performance models, and the application of machine learning methods for the identification of performing style of musicians. Recent results of specialized experiments show surprising artist recognition rates (for instance, see those from Saunders *et al.* (Stamatatos, E. and Widmer, G., 2005) or Molina-Solana *et al.* (Molina-Solana, M. et al., 2010)).

2.2 Computers in Music Education

According to Brown (Brown, A.R., 2007), there are three main roles in which a computer can take part in music education: they can act as a tool, a medium or a musical instrument. A tool for recording, editing, analyzing and sequencing sounds; a medium for music storage, indexing and distribution; and a musical instrument for synthesizing music in real time.

In the last decades there have been several attempts to use computers in Music Education. The field is highly interdisciplinary, involving contributions from disciplines such as Music, Education, Artificial Intelligence, Psychology, Linguistics, Human Computer Interaction and many others. Advances in research,

as well as new software tools for the analysis of data, open up a new area in the field of music education, as stated by Friberg and Battel (Friberg, A. and Battel, G. U., 2002).

Artificial Intelligence in Music Education is also a very diverse field, being the work by Holland (Holland, S., 2000) still an interesting review in the topic. Attempts in this area can be classified into four categories, according to Brandao *et al.* (Brandao et al., 1999), which are intended to: teach fundamentals of music, teach musical composition skills, perform analysis of music, and teach musical performance skills. In this paper, we propose an example within the scope of the last group.

However, music performance is not a well-defined domain. There are no clear goals, correct answers or an only way of doing things. That is probably why it is a tough domain researchers are not willing to face. Persson *et al.* (Persson, R. S. et al., 1996) pointed it out when they stated that relatively little time is dedicated to interpretative and emotional aspects of performance in comparison with that dedicated to learning notation -a domain that can be more easily represented.

So, why using technology for such a task? Despite computers will hardly replace music teachers, they can complement them. The benefits of individualized instruction, assessment and motivation can be used to supplement the learning. Using technology, students can work at their own pace, focusing on those aspects they need to improve. Because the learning is individual, there is no peer competition that, in many cases, is counterproductive. Evaluation of responses can be totally accurate and impartial. These possibilities have been tested with promising results by Friberg and Battel (Friberg, A. and Battel, G. U., 2002).

New pedagogical trends suggest recording students' performances. This way, they can hear how they play and analyse critically their work. Listening to both professional and amateur recordings is also a valuable teaching opportunity for music students. On the one hand, this allow them to compare their own current performance to those of professional musicians, being a motivational way of helping students to set goals for practising. On the other hand, students can identify improvements with respect to previous recordings and be aware of their progression and achievements during the time.

Beside the role recordings play to identify errors, the use of recordings can also be useful for going further and focus on specific musical elements or sections, providing a deeper understanding of the performance. Furthermore, it gives students the possibility of record themselves in other places different than the classroom, releasing them of the pressure of a classroom situation and allowing them to better perform.

Once recordings are available, we can also take advantage of them by means of computational tools, like the one we are presenting in this paper. These tools might be able to point out the tempo of the work, to discover irregularities in the rhythm, or to stress some musical parameters. Of special interest is the possibility of representing the sound in a new meaningful way, like in the works by Lagner and Goebl (Langner, J. and Goebl, W., 2003) or Saap (Sapp, C., 2007). In our case, we are able to offer a list of performers that played in a similar way of the input recording.

The analytical comparison between a natural performance and performances with particular expressive intentions also seems to possess a potential for music pedagogy. One of these tools is *Director Musices* (Friberg, A. et al., 2000) which is able to play a song applying some performance rules. This way, certain acoustic parameters can be exaggerated so that anybody, regardless of their musical training, can detect the differences and concentrate on particular aspects of the performance.

3. LEARNING ALGORITHM

Our approach for dealing with the characterization of performers is based on the acquisition of trend models, which represent each particular performance. As said before, we employ the learning algorithm described in Molina-Solana *et al.* (Molina-Solana, M. et al., 2010). It is a quick and automatic method for collecting information about the performer of a musical piece from its audio. It obtains an approximate score with information about pitch and energy. Because the method is automatic, there is no manual annotation and a confident musical analysis is not performed.

Despite those apparent drawbacks, the alternative the trend model presents consist in taking a more global perspective of a performer by trying to capture his essential (and recurrent) expressive decisions. This method does not focus in concrete cues, but in the general tendency. Because only an approximated score derived from the audio is available, a melodic contour segmentation is employed as a way to capture the

musical structure of the piece. This segmentation allows an analysis in terms of melodic intervals, i.e. precision on pitch detection is not critical.

Specifically, a trend model characterizes, for a specific audio descriptor, the relationships a given performer is establishing among groups of neighbour musical events. A qualitative analysis of the variations of the audio descriptors is performed with a local perspective. Two trend models will be used: energy and duration. The trend model for the energy descriptor relates, qualitatively, the energy variation for a given set of consecutive notes, and it is related to dynamics. On the other hand, the trend model for duration indicates, also qualitatively, how note durations change for note sequences. Duration is related to articulation and timing.

Given an input musical recording of a piece, the trend analysis is performed by aggregating the qualitative variations on their small melody segments. Thus, in advance of building trend models, input streams are broken down into segments of three-note long. As most automatic melody segmentation approaches do, note grouping is performed according to a human perception model. At the training stage, the goal of our system is to characterize performers by extracting expressive features and constructing trend models. Next, at the identification stage, the system analyses the input performance and looks for the most similar previously learned model.

3.1 Data Representation

As said, the first step consists in extracting audio features. So far, we only consider fundamental frequency and energy, as these are the main low-level audio features related to melody. These features are then used to identify note boundaries and to generate melodic segments. This module provides a vector with instantaneous fundamental frequency and energy values calculated every 0.01 seconds.

After some post-processing for deleting noise, a smooth vector of pitches is obtained. By knowing on which samples pitches are changing, a note-by-note segmentation of the whole recording is performed. For each note, its pitch, duration and energy are collected.

It is assumed that there might be some errors in this automatic segmentation, given the heterogeneity of recording conditions. The trendmodel algorithm proposes a more abstract representation (but still close to the melody) than the real notes for dealing with this problem. That is, instead of focusing on the absolute notes, we are interested in modelling the melodic surface.

To do that, a simple contour model that identifies some melodic patterns from the melody is used. These patterns are three-note long and are related with the direction of the two intervals that exist in them.

3.2 Classification

A nearest neighbour classifier is used to generate the list of similar performers for each input recording. Trend models acquired in the training stage, as described in the previous section, are used as class patterns. When the student's recording is presented to the system, its trend model is created and compared with the previously acquired ones. The system outputs a ranked list of performer candidates where distances determine the order, with 1 being the most likely performer relative to the results of the training phase.

The distance d_{ij} between two performances i and j, is defined as the weighted sum of distances between respective contour patterns. Weights have been introduced for balancing the importance of the patterns with respect to the number of times they appear. Frequent patterns are considered more informative due to the fact that they come from more representative samples. When several audio descriptors are considered, the individual corresponding distances are aggregated. Readers should refer to the original paper describing this algorithm (Molina-Solana, M. et al., 2010) in order to find more details and the exact equations.

3.3 Model Performance

The feasibility and accuracy of the system have already been tested by using several works from Sonatas and Partitas by J.S. Bach (Molina-Solana, M. et al., 2010). In those experiments, the model was employed to identify several violinists by using some already labelled performances. The results were quite promising: much better than those from a random chance classifier and probably better that those achievable by a human

expert. It was also demonstrated that the information that trend models contain can be used to derive meaningful musicological data.

The system has only been tested with violin recordings, but the underlying machine learning model (trendmodel algorithm) is flexible enough to allow the employment of other monophonic instruments. The application itself is capable of dealing with any instrument or song as long as the information it receives is properly formatted.

4. SOFTWARE

We have implemented in MATLAB all the tools for extracting the information from musical signals, representing those data, and using it for comparing: the whole trend-model algorithm and an interface to use all the developed tools.

The software is very user-friendly. The procedure is as follow: 1) the user/student selects the file with their performance; 2) selects the files to compare with; 3) waits for the audio analysis at the learning stage; 4) launches the comparator.

The devised interface (see Figure 1) enables the user to load a set of files to be used as comparing performances. On the left, we find a list of all the audio files with performances that we have in the folder. From those, we can select only those we are interested in being used. On the right, we select the audio file containng the student's performance we want to compare with the others. The developed software uses audio files in wav format as input.

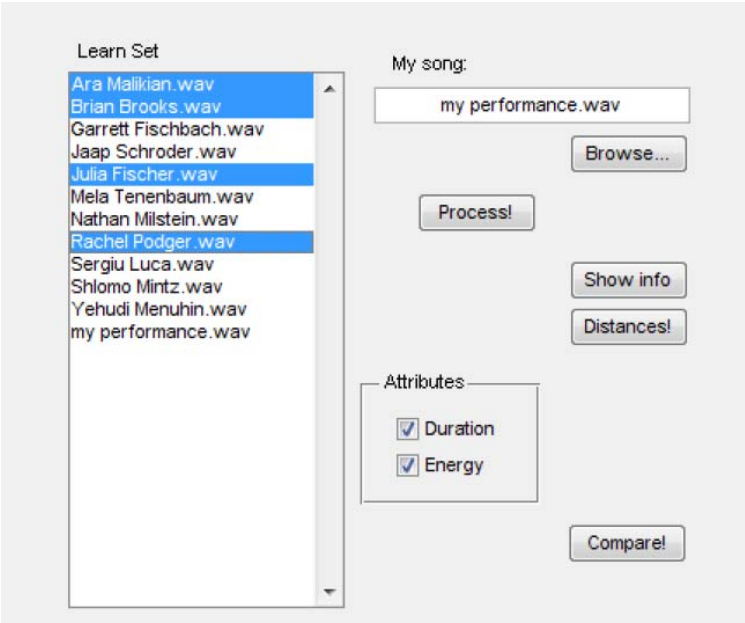

Figure 1. Main window of the devised interface of the system

Once we have selected the files we want to use, the system needs to extract information from them, and represent them by means of trend models. That is done when the 'Process' button is pressed. The interface offers the student the possibility to choose which (or all) attributes they want to use when comparing performances ('Attributes' section in the interface). Currently, only two possibilities are allowed as they are the attributes used in the learning stage: duration of notes and their energy. Those two attributes are the main ones in music performance, as previously explained in Section 2.1. Thus, students can compare themselves in terms of timing, in terms of energy, or in both together. Results may differ depending on the selection. However, any other musical attribute can be used as long as they are extracted from the audio and learned in the learning stage.

'Distances' shows a distance matrix comparing the distances between each pair of performances (including the one by the student). An example can be seen in Figure 2. A 2D-cluster representation of the

performances is also shown (Figure 3). This representation is done by comparing the distances between each pair of performances (in a high dimension space) and projecting them to a plain. For instance, here we can see that the student's performance is pretty similar to that of Jaap Schroder (always according to our described method for representing performances), and quite different from Garret Fischbach's.

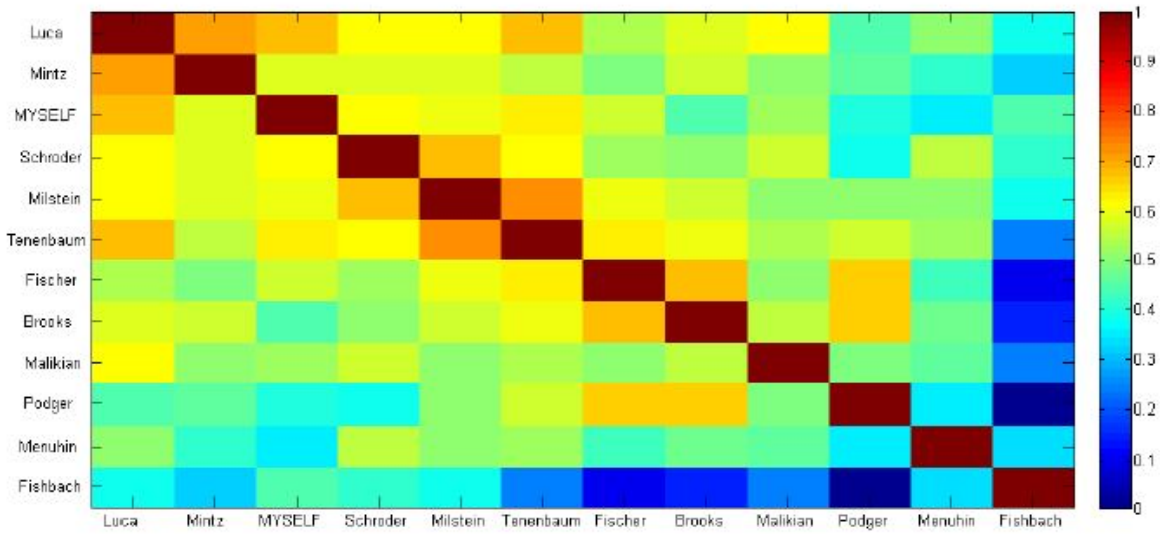

Figure 2. Normalized similarity matrix between performances

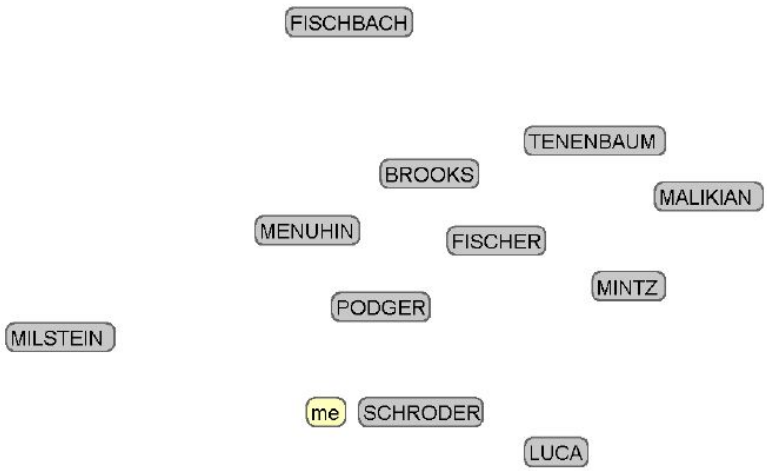

Figure 3. Cluster representation of the performances

This cluster representation gives an idea of how the student plays in comparison with others. However, it cannot tell where the differences are nor the changes to be made to their style in order get closer to a certain performer. 'Show info' offers a representation of trend models. They are represented as histograms. Each bar indicates how a performer tends to play for a certain musical pattern. More details can be found in the paper where the algorithm is described (Molina-Solana, M. et al., 2010).

Finally, we can obtain a list of sorted performers ('Compare' button), with the first one being the most similar to the student one, and the last being the most different. The software offers the result as an image (see Figure 4). In black, we find the most similar performer, whereas in white is the furthest one.

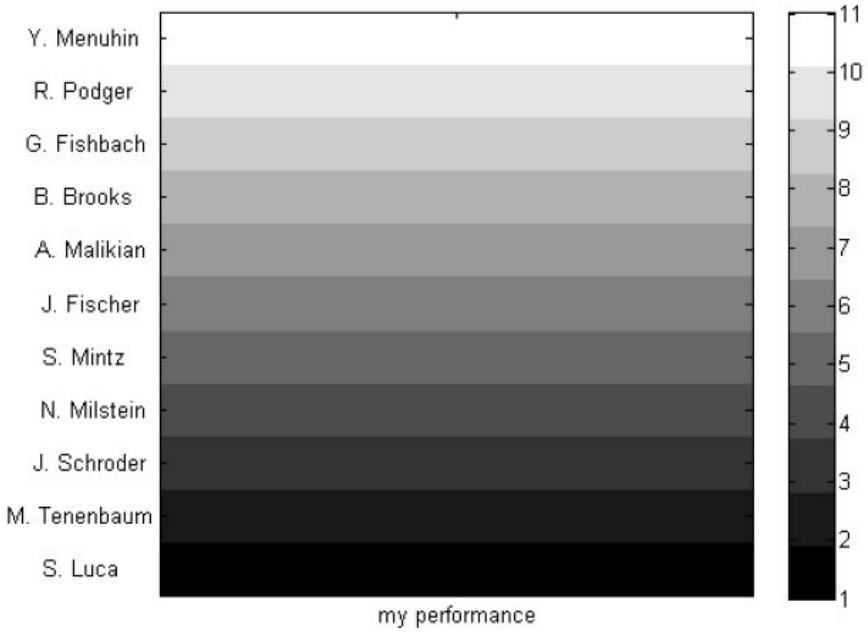

Figure 4. Ranking of similar performers

5. CONCLUSION

In this paper, we have presented an application of machine learning to music performance. The software we have developed is able to discover and show the similarities and differences between a given performance and those from other musicians. In our opinion, such a system would be of great interest for music students, as it can help them to better perform a piece of music. It shows them the similarities and differences with those renditions of famous performers.

Technology applied to music education is a very promising area. New pedagogical tendencies suggest recording students' performances. Our system uses precisely those recordings to proceed, not needing any other special hardware to collect the information. Doing so, we get another advantage: all the data is gathered in a transparent way, not interfering with the performance. We have employed and algorithm already in the literature which matches well with our constraints.

Research on music performance can point out expressive resources that traditionally have been hiding in musicians' skill and musical intuition. When explicitly formulated, these resources will give the user the possibility to play music with different expressive colouring. Even more, they would allow a computer to do so. Not in vain, the art of performing music is not well-defined and it is the result of several years of training; a knowledge that is very difficult to be appraised by a computer. Thus, studies in music performance are of great value in our time.

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A DIGITAL GAME FOR INTERNATIONAL STUDENTS' ADJUSTMENT

Maryam Bisadi, Alton Y.K Chua and Lee Chu Keong
[1]*Wee Kim Wee School of Communication and Information,*
Nanyang Technological University,
31 Nanyang Link, WKWSCI Building,
Singapore 637718

ABSTRACT

Although digital games have been developed for various subject areas, little attention has been focused on using digital games to address international students' adjustment issues. For this reason, this paper endeavors to explore the use of a digital game in facilitating international students acquire adjustment-related information. Specifically, the objectives of this paper are twofold. One, it seeks to introduce a digital game called Digital Game for International Student Training (DGIST) which is intended to satisfy important aspects of international students' information needs through fun. Two, it seeks to perform a preliminary evaluation of DGIST in terms of its efficacy in helping international students acquire adjustment-related information through a before-and-after with control experimental design. A total of 80 participants were involved in the study. Despite a few shortcomings, the results for DGIST appeared to be promising. Statistical analyses confirmed that DGIST was more effective in helping students acquire adjustment-related information than the paper-based document. This paper concludes with some limitations and suggests a few areas for further research.

KEYWORDS

Information need, adjustment, fun, gameplay, international student

1. INTRODUCTION

One of the outcomes of globalization today is the growing number of international students who are keen to gain knowledge and professional skills in different countries. Although studying in a cross-cultural setting may be valuable, international students may experience challenges and acculturative stress in adjusting to the new environment (Poyrazli and Grahame, 2007). Consequently, the feelings of confusion, anxiety, sense of loss and isolation may arise. If not managed properly, international students' academic success, social well-being and psychological health could be in jeopardy (Hechanova-Alampay et al., 2002).

Challenges associated with adjustment faced by international students could be mitigated using digital games. Exerting positive effects on understanding, learning and practicing new knowledge, it is no surprise that digital games have been increasingly deployed for pedagogical purposes (Gee, 2003). By infusing the element of enjoyment, the barrier to learning is lowered (Li et al., 2013; Prensky, 2001). Although digital games have been developed for various subject areas ranging from information systems (Martin, 2000) to second language learning (Kongmee, et al., 2011), little attention, both in terms of research and practice, has been focused on using digital games to address international students' adjustment issues. For this reason, this paper endeavors to explore the use of a digital game in facilitating international students acquire adjustment-related information. Specifically, the objectives of this paper are twofold. One, it seeks to introduce a digital game called Digital Game for International Student Training (DGIST) which is intended to satisfy important aspects of international students' information needs through fun. Two, it seeks to perform a preliminary evaluation of DGIST in terms of its efficacy in helping international students acquire adjustment-related information. The evaluation was conducted using a before-and-after with control experimental design.

The rest of the paper is structured as follows. Section 2 describes a literature review on international students' adjustment issues and their corresponding information needs. In addition, the fun aspects to make a digital game enjoyable are reviewed. Section 3 explains the design overview of DGIST which is built on the literature described earlier. The research methodology and the evaluation process of the game are presented in section 4. The results of the evaluation are reported in Section 5 while insights drawn from evaluation are highlighted in Section 6. Finally, section 7 concludes the paper with a note for future research directions.

2. LITERATURE REVIEW

2.1 International Students' Adjustment Issues

As the demand for oversea education increases, issues related to intercontinental adjustment come to be fore (Tseng and Newton, 2002). Studying in a foreign country and experiencing sharp changes in culture, language and the surrounding environment may cause acculturative stress and adjustment problems. Extant literature suggests at least four categories of adjustment issues, namely, preliminary needs, cultural, educational and psychological challenges.

When international students move to another country, they may face some difficulties in satisfying their preliminary needs, such as finding a suitable accommodation, applying for social security ID, learning how to use transportation system, adapting to local food and being familiar with campus. If these basic information needs remain unaddressed upon arrival, international students will likely be stressed (Hechanova-Alampay et al., 2002). To deal with these preliminary adjustment problems researchers suggest different methods including a tour of the campus, orientation program, interacting with other senior overseas compatriot students (Poyrazli and Grahame, 2007) and expanding individual world view (Tseng and Newton, 2002).

Cultural differences are one of the most significant adjustment challenges for international students (Zhai, 2004). In particular, unfamiliarity with cultural references, idioms, sarcasm, slang and missing cultural specific cues, such as verbal and non-verbal messages affect overseas students' tendency to seek out social interaction in the host culture (Olivas and Li, 2006). An effective way to overcome these issues is to connect to the host people or participate in their cultural activities (Tseng and Newton, 2002). Creating social interaction with local students is another way to foster cultural adaption. In parallel, international students who positively adjust should be encouraged to offer help to new incomers (Olivas and Li, 2006).

Although academic systems are fairly comparable all over the world, they are not completely identical (Ridley, 2004). Conceivably, international students in their first year of study face more educational challenges than their local counter-parts (Zhao et al., 2005). Furthermore, language barrier in the academic environment can aggravate the situation. International students can overcome these educational challenges by asking for help from other students or faculty (Tseng and Newton, 2002). Also, the role of orientation programs in transferring university information should not be ignored.

International students experience some inevitable psychological challenges such as acculturative stress, homesickness, loneliness, frustration, depression or isolation and feelings of worthlessness (Olivas and Li, 2006; Tseng and Newton, 2002). Since they are far from their family and friends, they experience less social support vis-à-vis local students (Hechanova-Alampay et al., 2002). Communicating with other students and creating a social network may mitigate their need for social support (Poyrazli and Grahame, 2007).

2.2 Fun Principles in Digital Games

Games are a subset of play and fun (Prensky, 2001). People play games because they are seeking fun (Bartle, 2004). As an organized play, digital games not only offer enjoyment but could be used to heighten the motivation for learning and improve academic achievement (Kebritchia, et al., 2010).

To unravel the amorphous concept of fun in digital games, a theoretical framework which comprises three main factors, namely, immersion, challenges and social interaction has been developed as shown in Table 1. Each of these factors comprises overlapping sub-factors.

Immersion refers to the extent to which a player is engaged with a game (McMahan, 2003). Factors that lead to immersion include deep involvement, emotion and control. *Deep involvement* is a psychological state

that occurs when the related set of activities or events in the game are solely in focus (Witmer and Singer, 1998). Players become oblivious to their surrounding (Johnson and Wiles, 2003; Brown and Cairns, 2004), and lose their sense of time and concern over everyday life (Klug and Schell, 2006). Yet, involvement is crucial for learning. It can be used to transfer knowledge and information efficiently (Csikszentmihalyi, 1990). The other factor that leads to immersion is *emotion.* Players could sometimes be emotionally affected by their progress in the game (Brown and Cairns, 2004). Narration, sound (Sweetser and Johnson 2004) and features of fantasy (Li et al., 2013) are elements that endear players to the game. Furthermore, immersion is not achievable unless players have appropriate *control* over the game. The game control should be simple to learn and easily customizable (Gee, 2003; Johnson and Wiles 2003).

Challenge refers to the differential between a player's skills and the current demands imposed by the game. Existence of a variety of difficulty levels, clear goals and appropriate rewards are necessary ingredients for a game to be deemed challenging. Games' *difficulty levels* should be varied and gradually increased based on players' development to keep their interest. Appropriate pacing is required to keep the players engaged (Pagulayan et al., 2003). Furthermore, completing difficult tasks and surpassing opponents satisfy the players and lead to pleasure and a sense of accomplishment (Vorderer et al., 2003; Poyrazli and Grahame, 2007; Lazzaro, 2009). Also, each level of game should have its own clear *goals* (Csikszentmihalyi, 1990; Pagulayan et al., 2003). Moreover, players must be *rewarded* sufficiently and equitably to their expended effort to sustain their interest in the game (Pagulayan et al., 2003; Brown and Cairns, 2004).

Social interaction is another factor that contributes to fun. In the context of a game, social interaction takes the form of *competition*, *cooperation* and *connection* (Lazzaro, 2009), each of which caters to a different player profile. Players with a strong desire to win or hinder other players from winning will find competitive elements in the game gratifying (Brathwaite and Schreiber, 2008). Players who prefer to work together to improve their standing in the game will find cooperative elements appealing (Salen and Zimmerman, 2004). Players who engage in a game not solely for gameplay but for social reasons likely to enjoy the connection forged with fellow players both inside and outside of the game (Lazzaro, 2009).

Table 1. Fun framework

Fun factors	**Dimensions**	**Description**
Immersion	Deep involvement	▪ Psychological state happened by focusing (Witmer and Singer, 1998) ▪ Oblivious to their surrounding environment (Johnson and Wiles, 2003; Brown and Cairns, 2004) ▪ Loss concern without effort (Klug and Schell, 2006)
	Emotion	▪ Affected by the player progress in the game (Brown and Cairns, 2004) ▪ Affected by narration, sound (Sweetser and Johnson, 2004) and features of fantasy (Li et al., 2013)
	Control	▪ Basic controls features (Gee, 2003; Johnson and Wiles, 2003) ▪ Easily customizable (Gee, 2003; Johnson and Wiles, 2003)
Challenges	Difficulty level	▪ Different challenges' level based on player progress (Pagulayan et al., 2003) ▪ New challenges at an appropriate Pace (Pagulayan et al., 2003) ▪ Satisfaction from accomplishing difficult level and surpassing opponents (Vorderer et al., 2003; Poyrazli and Grahame, 2007; Lazzaro, 2009)
	Goals	▪ Clear goals (Csikszentmihalyi, 1990; Pagulayan et al., 2003) ▪ Multiple goals in each level (Csikszentmihalyi, 1990; Pagulayan et al., 2003)
	Rewards	▪ Efforts should be rewarded (Brown & Cairns 2004; Pagulayan et al., 2003) ▪ Encourage players to continue (Brown and Cairns, 2004; Pagulayan et al., 2003)
Social interaction	Competition	▪ Some players enjoy fighting and beating each other (Lazzaro, 2009) ▪ It is an effective motivation to continue playing (Brathwaite and Schreiber, 2008)
	Cooperation	▪ Emphasize is on fun rather than competition (Salen and Zimmerman, 2004) ▪ Work toghether to improve their standing in the game (Salen and Zimmerman, 2004)
	Connection	▪ Some players play not solely for gameplay but for social reasons (Lazzaro, 2004) ▪ Social connection inside and outside the game (Lazzaro, 2009)

3. DGIST – DESIGN OVERVIEW

DGIST (Digital Game for International Student Training) is a desktop online multiplayer game built on design principles related to international students' information needs and the fun aspects of games. It is designed to combine learning and entertainment. The scenario of DGIST is the story of an international student (represented by an avatar) who comes to a host country (Singapore) to study at a local university. During this journey, the avatar is required to navigate in a virtual environment to acquire adjustment's information.

The main goal of DGIST is to facilitate international students acquire adjustment-related information through fun. The game features six different spaces, namely, Location, Food, History, Culture, Education and Social Networking. These spaces are intended to meet the four adjustment-related information needs, as shown in Table 2.

Table 2. Spaces in DGIST

Spaces in DGIST	Description	Adjustment-related information needs
Location	▪ Introduces important locations ▪ Shows the way they can be reached	Preliminary Needs
Food	▪ Introduces local food and drinks ▪ Teaches how to prepare local foods and drinks	
History	▪ Offers Singapore historical information by narration ▪ Asks historical questions	Cultural Needs
Culture	▪ Introduces some aspects of Chinese, Indian and Malay cultures ▪ Introduces some local idiom and phrases	
Education	▪ Introduces the local university facilities and rules	Educational needs
Social Networking	▪ Allows virtual clubs to be created ▪ Supports connection via chatting tool or bilboard ▪ Allows competition and cooperation in virtual clubs	Psychological needs

Difficulty level of each space is increased gradually based on the progress of the player. Figure 1 shows some screen shots of DGIST. A brief description of each space is as follows.

(a) (b) (c)

Figure. 1. (a) DGIST's main menu (b) Jigsaw Puzzle in *Location* space (c) Question/answer in *History* space

The DGIST's *Location* space is designed to familiarize players with important locations in Singapore and how they can reach there. In this space players are presented with a set of Jigsaw puzzles and question/answer games. For example, to learn how to get to the Immigration & Checkpoint Authority (ICA), players solve the Mass Rapid Transit (MRT) jigsaw puzzle to know where the nearest MRT station to ICA is.

To make international students familiar with the host country's food, DGIST introduces some local food and drinks. In *Food* space, players learn how to prepare local food and drinks by selecting their ingredients and adding them to pot or solving word puzzle to be acquainted with the names of local food.

History space offers Singapore's historical information through narration and question/answer game. For instance, though having a student's pass is essential for international students to stay in Singapore; the player is guided how to get it via narration. He/she should find out where to go and answers historical question to gain enough points and get the student pass as a reward.

Singapore is a multi-racial society which comprises three distinct ethnic groups: Chinese, Indian and Malay. In the DGIST's *Culture* space, players become familiarize with some salient aspects of these three cultures, for instance the appropriate form of greeting or gift-giving. Although English is the official language in Singapore, some idiom and phrases used locally are derived from Chinese or Malay languages. The most common use of these phrases and their meaning are also covered in *Culture* space. In addition, since DGIST was designed for a local university, specific university's facilities and rules are introduced in *Educational* space.

Social interaction during the gameplay is facilitated through chatting and virtual communities. New players are required to enter some information such as program of study and nationality. Thereafter, players can create a virtual club and named it based on their countries or program of study to make a domicile for others with similar profiles. DGIST's virtual clubs serve as a social platform that allows students to plan activities in its virtual environment or in the real world. For instance, club members can set an online chess competition or arrange playing basketball at weekend in the school's court. All club members can create preferred event on the billboard while others can add further comments on these events. Players can register in different clubs. To encourage the expansion of social networks, DGIST allocates points for inviting friends to the clubs. Each club shows its online and offline members.

Mentioned earlier, the fun framework is considered in the design of DGIST to make it entertaining. For instance, jigsaw puzzle game, question/answer, cooperation and competition in virtual clubs have been incorporated into DGIST to create an immersive experience for players. Narration and sound effects are used as features to influence emotion. Also, DGIST offers the sense of control by letting players choose their avatars, the activities they prefer to be involved in their virtual club and the part of the game they want to proceed.

Challenges, another factor, is achieved in DGIST by defining different levels of difficulty with various goals in each space. For example, in the basic level question/answer game offers multiple choices while in more advanced level, players are required to submit their answers in free-text format. Also, rewards players receive in DGIST commesurate with the different levels of difficulty.

Based on the fun framework social interaction is another key element that leads to enjoyment in the game. *Social Network* space of DGIST is designed for this reason, and its chatting tool and virtual clubs with bilboards are used to create competition, cooperation and social connection between players. Table 3 illustrates how fun factors have been incorporated into DGIST.

Table 3. Fun framework & corresponding DGIST features

Fun factors	**Dimensions**	**DGIST's Features**
Immersion	▪ Deep involvement ▪ Emotion ▪ Control	▪ Puzzle game, question/answer, cooperation/ competition in virtual clubs ▪ Narration and sound effects ▪ Choosing avatars, activities in virtual club, ingame navigation
Challenges	▪ Difficulty level ▪ Goals ▪ Rewards	▪ Different levels of challenges that increased gradually ▪ Various goals in each level ▪ Specific rewards that are designed for each level.
Social interaction	▪ Competition ▪ Cooperation ▪ Connection	▪ Chatting tool ▪ Virtual clubs ▪ Bilboards

4. METHODOLOGY

A total of 80 graduate international students in a local university in Singapore were invited as part of the study. With an average age of 26 years old, all had arrived in Singapore for less than a year. They came from nine countries, including China, India, Iran, Spain, Italy, Sweden, Indonesia, Kazakhstan and Myanmar.

Before-and-After with control experimental design was used to evaluate the effectiveness of DGIST (Kothari, 2004). The 80 participants were randomly and equally divided into the control and experimental group. In the pre-test, all 80 participants in both groups were asked to answer a questionnaire which comprises 39 multiple-choice questions about Singapore's location, food, history, culture as well as University's rules and facilities. All questions have only one correct answer. The purpose of the pre-test was to assess participants' familiarity with adjustment-related information before treatment.

Thereafter, during the treatment phase, participants in the control group were given a six pages paper-based document which contained a combination of text and images, not unlike a typical travel guidebook. It includes the required information to answer all the questions in the questionnaire. In contrast, participants in the experimental group played DGIST to acquire the same information. Based on a pilot study which was done before post-test, five minutes was deemed sufficient to scan the document or play DGIST. Thus, the treatment phase lasted for five minutes for all participants to ensure that both groups were exposed to similar conditions in the study (Kothari, 2004).

In the post-test, participants in both groups were requested to revisit the questionnaire, and amend any answers they felt to be erroneous. However, control group participants were not allowed to refer back to the paper-based document while experimental group participants were denied access to DGIST. To differentiate markings made during the pre-test and the post-test, participants used a different colored pen. To capture participants' experiences from the control and experimental group, qualitative feedback was collected via face-to-face interviews. Specifically, participants were asked how they were able to retain adjustment-related information and what improvement could be made to enhance the acquisition of such information.

To compare the effectiveness between the paper-based document and DGIST in helping participants acquire adjustment-related information, the paired t-test was used to check for any differences between the improvements of the two groups.

5. RESULTS AND DISCUSSION

5.1 Analysis of Pre-Test and Post-Test Scores

Scores obtained from all participants were normalized to 100 for easy computation. In the pre-test, the mean score of the control group was 44.29 ± 13.24 and that for the experimental group was 44.35 ± 13.99 At 5% level of significance, there was no statistical difference between the two group. This means that participants in both groups were comparable in terms of their knowledge on adjustment-related information.

In the post-test, the control group obtained a mean score of 57.88 ± 15.78 points. The mean improvement is 13.59 ± 8.33. At 5% level of significance, the pre-test scores and the post-test scores of the control group were found to have unequal variances ($t(39)=10.31$, $p < 0.001$). This indicates that the paper-based document had been effective in helping participants in the control group acquire adjustment-related information.

The experimental group, however, obtained a markedly higher mean score of 84.16 ± 12.03 in the post-test. The mean improvement is 39.81±12.48. At 5% level of significance, the pre-test scores and the post-test scores of the experimental group were found to have unequal variances ($t(39)=20.15$, $p < 0.001$). This indicates that DGIST had been effective in the experimental group to acquire adjustment-related information.

To compare the efficiency of document and game based training, the improvements in scores of all participants in each group were evaluated. The mean of this improvement in control group is 13.59 and in experimental group it is 39.81. At 5% level of significance, the improvement scores between the control group and that of the experimental group were found to have unequal variances ($t(78)=11.95$, $p < 0.001$). This shows that the effectiveness of the two approaches is significantly different. In particular, DGIST appeared to be more effective compared to the paper-based document approach in helping international students acquire adjustment-related information.

5.2 Qualitative Feedback from Participants

Fun could be one of the features of DGIST that contributed to its effectiveness. The participants in experimental group were able to acquire information easily through gameplay. For example, Participant 1 indicated that "*it was helpful and fun, I won't forget the information I learned and it was much better than reading stuff*". Moreover, social interaction in DGIST is the way of overcoming psychological challenges. Participant 10 mentioned that "*being part of the DGIST's virtual communities helps to create sense of belongingness*". The graphic, sound effects and fun aspects of DGIST enabled players to be deeply involved in the game. For example, Participant 28 smiled after he saw the Malay lady character in *Culture* space and commented that "*this cute Malay lady helps me to distinguish Malay women easier*".

When asked what improvements could be made to DGIST, a few suggestions were made. For instance, some players mentioned that after they acquired information on DGIST, they were less motivated to persist in the game. In particular, Participant 15 mentioned that *"I wish to see different questions each time I play question/answer game"*. This was due to the limited set of questions/answer at each level of difficulty in DGIST. Next, players suggested that DGIST be deployed as a mobile game. Participant 35 indicated *"I want to have DGIST on my mobile devices to play it while I am on the way to school"*. Another suggestion was to allow for greater interaction among players during gameplay. Participant 17 mentioned that *"I wish I could input comments in each space and share my experiences about how to answer questions and do puzzles with my friends"*.

While the document-based method was also effective in helping participants acquire adjustment-related information, it may be difficult to sustain attention from participants. Most of the participants in control group showed little interest to read the document and found it boring. For instance, Participant 48 said "*this document reminds me of my exam days*". When asked on the improvements to be made to enhance information acquisition, participants were generally averse to the use of paper-based document. In fact, as digital devices become ubiquitous, using a paper-based document was considered a nightmare. Participant 61 commented that "*I really miss Ctr+F function key*".

Thus, although both paper-based document and DGIST could be used for adjustment-related information acquisition, the latter was found to be more effective. In particular, the entertainment features in DGIST not only sustained participants' interests, but contributed to better information retention.

6. CONCLUSION

To help international students cope with adjustment issues, this paper seeks a two-fold objectives. The first is to introduce DGIST as a means to satisfy important aspects of international students' information needs through fun. The second is to perform a preliminary evaluation of DGIST in terms of its efficacy in helping international students acquire adjustment-related information. To address the first objective, DGIST was developed on the basis of the literature. The game features six different spaces, namely, Location, Food, History, Culture, Education and Social Networking, which are intended to meet the preliminary needs, cultural needs, educational needs and psychological needs of international students. To address the second objective, a before-and-after with control experimental design was used to compare the efficacy between DGIST and a paper-based document. A total of 80 participants were involved in the study. Despite a few shortcomings, the results for DGIST appeared promising. Statistical analyses confirmed that DGIST was more effective in helping students acquire adjustment-related information than the paper-based document.

Nonetheless, some limitations should be acknowledged in this study. First, the findings must be interpreted in light of the limited sample size of 80 participants. The second limitation is related to DGIST. Its design was confined to Singapore's culture and one of its local universities. Thus, it is only applicable to a specific context.

Therefore, expanding the number of participants and inviting more international students from different universities can be considered as a future work to make the results more reliable. The other possible extension to the current work is to broaden DGIST's design to cover more cultures and educational rules. In addition, knowledge sharing functionalities can be incorporated into DGIST to encourage players to be more helpful and interactive. Also, increasing the complexity of the game and adapt it based on players proficiency level will be considered as a future work to make it more attractive for players.

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DEVELOPING AN ICT-LITERACY TASK-BASED ASSESSMENT INSTRUMENT: THE FINDINGS ON THE FINAL TESTING PHASE

Jessnor Elmy Mat-jizat
Faculty of Management and Leadership,
Sultan Idris Education University, Perak, Malaysia

ABSTRACT

This paper reports the findings of a study which seeks to identify the information and communications technology (ICT) literacy levels of trainee teachers, by investigating their ICT proficiency using a task-bask assessment instrument. The Delphi technique was used as a primary validation method for the new assessment tool and the ICT literacy task-based assessment tool was developed to assess trainee teacher's levels of ICT-literacy. The findings showed that the ICT-literacy task-based assessment instrument were able to predict trainee teacher's ICT-literacy area of weaknesses.

KEYWORDS

ICT-literacy, task-based assessment, trainee teachers.

1. INTRODUCTION

The central concern of this study is to develop an ICT-literacy task-based assessment (TBA) instrument that may be used to evaluate trainee teacher's level of ICT-literacy. The current literature acknowledges the need for a measurement instrument that evaluates level of ICT-literacy levels (Wong 2002; Markauskaite 2005; Katz & Macklin 2007).

This type of measurement instrument is currently used as an entry level testing tool for university and job placements. However, existing ICT-literacy assessment instruments are either too expensive to be implemented, or too rigid with their expected answers. Moreover, they are not tailored to teacher's individual needs. The existing instruments either uses self-efficacy techniques or step-by-step task/instructions whereby they do not allow flexibility and creativity in completing the task (International ICT Literacy Panel 2002; Cox & Marshall 2007).

Following the inauguration of the International ICT-literacy Panel in 2000, the International Society for Technology in Education (ISTE) in 2008, proposed that in order to accurately assess level of ICT-literacy, such an assessment must include both technical and information literacy (International ICT Literacy Panel 2002; International Society for Technology in Education 2008). Two ICT standards which are the Information Literacy Competency Standards for Higher Education developed by the Association of College and Research Libraries (ACRL) and the Australian and New Zealand Information Literacy (ANZIIL) also echo the views of the 2000 International ICT-literacy Panel and 2008 ISTE (Association of College and Research Libraries 2000; ANZIIL 2008).

2. WHY TRAINEE TEACHERS?

Currently, ICT-literacy has been actively promoted in Malaysian schools by various agencies of the Malaysian Ministry of Education. The Ministry has also made it compulsory for all trainee teachers to be exposed to ICT tools, and by implication, the use of ICT-literacy in their pedagogical strategies (Chan 2002b).

The project team who was responsible for the ICT-implementation in Malaysian schools has listed three abilities expected of Malaysian students. This abilities include competencies to use ICT tools and ICT sources to: 1) collect, analyse, process, and present information; 2) support meaningful learning in various contexts; and 3) prepare students for employment (Smart School Project Team 1997). The competencies listed by the team coincide with the definition of technology literacy described by NAE and NRC; which called for an understanding of technology at a level that enable effective functioning in a modern technological society (NAE & NRC 2006). In focusing on improving school children's ICT-literacy, it is possible that current Malaysian trainee teachers may not be adequately prepared to teach under this new approach.

In spite of this, ICT tools must never be mistaken as the mechanism that we learn 'from', but rather as the tool that we learn 'with'. By having ICT tools such as computers, for example, they should be regarded as a learning aid rather than a learning point. Yet, in looking at the current Malaysian school scenario, Chan (2002a) identifies a serious gap between what is being understood by the teachers and what they actually practice. Most teachers prefer to use ICT to enhance rather than transform their current curriculum. Rather than changing their old teaching module to include ICT in their teaching activities, most teachers felt that it would be easier to use ICT to accommodate and enhance their existing/older teaching modules. For example: instead of using the overhead projector (OHP), the teachers would input their teaching notes into a digital presentation application (for example MS Powerpoint); or instead of manually creating a class timetable, the teachers are now using spreadsheets. It is proposed that these teachers may not have the initiative or time to explore other aspects of ICT that they could use to improve their teaching activities (BECTA June 2004).

In 2004, a group from the National Academy of Engineering (NAE) and the National Research Council (NRC) conducted a study to determine the most viable approach to assessing technological literacy in the US for K-12 students, K-12 teachers, and out-of-school adults. The report found that there was very little information available on the technological literacy of teachers (NAE & NRC 2006). Although many school children have sophisticated technological capabilities, they cannot be fully technologically literate unless their teachers are. There is an urgent need for an in-depth study on this topic and development of a suitable task-based (technological capability) assessment instrument.

3. THE NEED FOR A DIFFERENT INSTRUMENT TO ASSESS TRAINEE TEACHERS' ICT-LITERACY

Several studies have been conducted on students (Katz 2007; Russell & Finger 2007), trainee teachers, and in-service teachers (Luke 2001; Knezek & Christensen 2002; Jamieson-Proctor, Burnett, Finger & Watson 2006). Most of them involve participants' perceptions and attitudes on their preparedness to integrate ICT as tools or teaching ICT as the class subject.

The quality of the research design in ICT-literacy studies is also an issue because too many research studies applied the self-assessment methodologies (see Jamieson-Proctor, Burnett, Finger & Watson 2006; Markauskaite 2007; Ball & Levy 2008). Computer self-efficacy involves a belief of one's capability to use a computer. Markauskaite's (2007) study for example, utilised the self-efficacy theory in her questionnaire design. Each test-item in her questionnaire started with the phrase "I believe I have the capability…" and was measured using a six-point Likert scale.

Other studies applied a combination of both self-efficacy methodology and a more hands-on evaluation of the participants ICT-literacy. One such example was in Wong (2002) study. In her study, she developed an IT preparedness assessment instrument, which measured teachers' preparedness in using ICT using three different measures: a self-efficacy instrument to evaluate their attitude towards using ICT; a hands-on instrument to assess their ICT skills; and ICT-knowledge exam-based questions that consists of 25 multiple choice questions which tested the teachers knowledge on ICT and computers. Nonetheless, the hands-on instrument lacks flexibility and does not encourage critical and analytical thinking, as it gives the teachers step-by-step instructions of what was to be performed, and the exam-based questions may not represent the teachers' actual ICT knowledge as the multiple choice questions may allow guessing.

To cope with today's technological demands, people need to acquire more than just the basic ICT skills and knowledge. They need to know how to use their acquired knowledge and skills by: thinking critically; applying knowledge to new situations; analysing information; generating new ideas; communicating;

collaborating; solving problems; and making decisions. These skills can provide both flexibility and security. People who can learn new information, are able to use software programs and conceive new ways of doing things, have much better prospects than those who cannot (Partnership for the 21st Century Skills 2002).

The lack of ability to think critically and analytically, and also to make decisions is apparent in Malaysian school students. Earlier studies have shown that students' critical and analytical thinking abilities in Malaysia were between below satisfactory and fair (Zaharah 1995; Azlan 1997; Razali 1999).

It is further noted that Malaysian teachers may also lack the ability to teach these skills or are less prepared to teach by incorporating these skills in teaching and learning activities (Rajendran 2001; Rosnani 2002). Teachers may understand the importance of teaching critical thinking to students, yet some appear to not have the necessary instructional strategies to teach it (Rosnani 2002). These issues corroborate this study's need for an enhanced ICT-literacy TBA instrument that is flexible; not based on self-assessment; and includes test-items that test cognitive skills. The tasks for the ICT-literacy TBA instrument should focus on familiar/normal, computer-based activities for a classroom environment that teachers usually find in their schools.

A task-based assessment method, allows the participants the freedom to complete the task in any way they wish, as long as the task requirement is fulfilled. It means that, if the task asks for an appropriate learning aid to be created which includes an image and a video, the participant is free to use whatever computer applications that they feel comfortable to use, to edit the pictures, create videos and other digital learning aids. As long as the task requirement is fulfilled, the task is considered complete. Task-based tests allow the participant to demonstrate acquired knowledge capacity and an ability to correlate tasks with the theories or concepts learned previously. Instead of judging knowledge acquisition through a series of multiple choice selections or self-evaluation, task-based assessment forces participants to place knowledge into a context that can be understood and explained (Teachnology Inc 2011). Task-based assessment also allows the participants to show what they know, instead of just telling what they think they know. It is considered as the best method for this new ICT-literacy assessment instrument as it shows the participant's actual ICT ability.

4. THE METHODOLOGY

This study was conducted in three phases: Phase-1 preliminary review; Phase-2 expert judgement on ICT-literacy indicators; and Phase-3 instrument validation and testing. In Phase-1, review of the literature was conducted, where it involves drawing on the existing literature on ICT-literacy; ICT-literacy standards; existing ICT-literacy assessment instruments; and the Malaysian Smart School (*MSS*) requirements. Eleven ICT-literacy indicators were identified in this first research phase. In Phase-2, the identified ICT-literacy indicators were evaluated by a specially chosen panel of experts (PoE). Two Delphi interactions were then conducted where the first was to evaluate the ICT indicators, and the second was to validate the *draft ICT-literacy TBA instrument.* In Phase-3, the *draft ICT-literacy TBA instrument* was validated and tested through two pilot tests, and finally the instrument was tested on a larger number of participants for its final instrument trial.

The Delphi technique and the Rasch IRT model were applied for the qualitative and quantitative parts of this study, respectively. The Delphi technique was chosen as the most suitable philosophical/research approach for conducting the *expert judgement phase* (Phase-2) of this study.

For the quantitative part of this study, the Rasch IRT model was employed. The Rasch IRT model is assumed to be invariant across different groups within a research population and across populations (Hambleton & Murphy 1991; Swaminathan 1999). It requires that both the test-items and participants conform to the Rasch IRT model before claims regarding the presence of skill or ability can be considered valid. Therefore, under this Rasch IRT model, mis-fitting responses require a reason for the misfit, and may be excluded from the data set if they fail to address the expected skill or ability. The Rasch IRT model also provides a way of measuring the quality of the test-items by confirming their suitability for participants and how well they measured participants' abilities (Wu & Adams 2007).

The Rasch IRT model generally utilises the response pattern. It assumes that participants with a low attribute have little chance of guessing the correct answer and participants who achieve a high attribute will almost certainly choose the correct answer (Nunnally & Bernstein 1994). Central to idea of the Rasch IRT

model is the *probability principle*. A person's response to a particular test-item is never certain. It is always influenced by human error. Thus, a probabilistic approach must be employed. In the Rasch IRT model, probabilities are introduced through consideration of the odds that a person would give a correct response to a test-item. This is known as *logit***.** The *logit* is a mathematical model that converts both difficulty and ability into the same units. The *logit* is a $\log_e$ of the odds of a correct response given. The Rasch dichotomous model equation used in the Quest analysis describes the probability of observing a specific score x_{ni} as (Adams & Khoo 1996):

$$P(X_{ni} = x_{ni}) = \frac{\exp(x_{ni} w_{i1} (\beta_n - \delta_{i1}))}{1 + \exp(x_{ni} w_{i1} (\beta_n - \delta_{i1}))}$$

Where x_{ni} is person *n*'s response to item *i*, β_n is the ability of person *n*, w_{i1} is the score assigned to one step in item *i,* and δ_{i1} is the difficulty of the one step in item *i*.

The validation and testing process showed that the *ICT-literacy TBA instrument* is valid and reliable when tested on its intended participants, and the instrument is ready. The instrument provides information with regard to each participant's area of weakness in ICT.

5. THE PARTICIPANTS

There were two categories of participants for this study: 1) the qualitative study participants (the PoE members); and 2) the quantitative study participants (the Malaysian trainee teachers).

5.1 Qualitative Study Participants – PoE Members

There were seven PoE participants for the qualitative study and they were selected based on their educational and occupational backgrounds. The PoE members were three academics in the field of educational technology, and one officer from the Malaysian Ministry of Education, and three teachers from the *MSS*.

5.2 Quantitative Study Participants – Malaysian Trainee Teachers

One of Malaysia's public universities, the *Sultan Idris Education University* (UPSI), was chosen for the location to conduct the research. This is the only teachers' university in Malaysia with the sole purpose of training pre-service teachers. For this study, the participants were undergraduate students who were currently enrolled in a Bachelor of Education degree at UPSI. The university has eight faculties offering both undergraduate and postgraduate degrees. The students are generally between 20 to 30 years old, and of mixed ethnicity (Malay, Chinese, Indian, Indigenous and others). Participants from the same semester across eight different faculties were invited to take part.

Different participants were used for each of the three activities (pilot test-1, pilot test-2 and final instrument testing) in this third phase of the ICT-literacy TBA instrument development. During the pilot testing-1 session, 16 trainee teachers were randomly chosen and were willing to participate. Twenty (out of the 50 invited) trainee teachers from the Faculty of Business and Economics participated in pilot testing-2. For the final instrument testing process, 148 (out of the 382 invited) trainee teachers from the semester-four batch, representing all faculties in the university, agreed to participate.

6. THE FINDINGS

There were three parts of findings which was based on the different phases of the study. As previously explained, Phase-1 involved identifying suitable ICT-literacy indicators to be used to evaluate trainee teachers level of ICT-literacy. The findings from Phase-2 and Phase-3 are discussed below.

6.1 The Findings from Phase-2

The seven PoE participants reached consensus after two Delphi-rounds have been conducted. They agreed that there were twelve ICT-literacy indicators that should be used to evaluate trainee teachers' level of ICT-literacy. The twelve indicators were:

Table 1. List of finalised ICT-literacy indicators

Identified ICT-literacy indicators : Finalised	
1. Navigation and search;	7. Manage;
2. Production and analysis;	8. Create;
3. Plan / define;	9. Communicate /collaborate;
4. Access;	10. Reflect;
5. Integrate;	11. Understanding and handling ICT tools.
6. Evaluate;	12. Assess

The PoE participants also validated the *draft ICT-literacy TBA instrument* where the ICT-literacy indicators was transformed into ICT-based tasks which were common for teachers. For evaluation purpose, each of these tasks was divided into a few test-items.

6.2 The Findings from Phase-3

The *draft ICT-literacy TBA instrument* underwent a continual validation and testing process in a series of pilot studies, before it was tested on a larger population of trainee teachers in the *final instrument testing* process. The Rasch IRT model and the Quest *interactive test item analysis system* (Adams & Khoo 1996) was implemented as the data analysis tool for these performance data validation and testing.

For the *final instrument testing,* all 148 participants completed all six tasks in the *ICT-literacy TBA instrument*. The responses for the *ICT-literacy TBA instrument* were coded by the researcher into an electronic data file using Microsoft Excel. A text file was then prepared for the Quest analysis (Adams & Khoo 1996).

The Quest analysis produces a *Kidmap* of an individual participant's performance in terms of depicting their correct and incorrect response patterns, according to the Rasch IRT model's expectations. The Kidmap locates each test-item on a vertical scale according to its difficulty from easiest to hardest and then separates the test-items horizontally (left or right), according to whether the participant answered them correctly or not. Importantly the map locates the participant's ability on the same vertical scale.

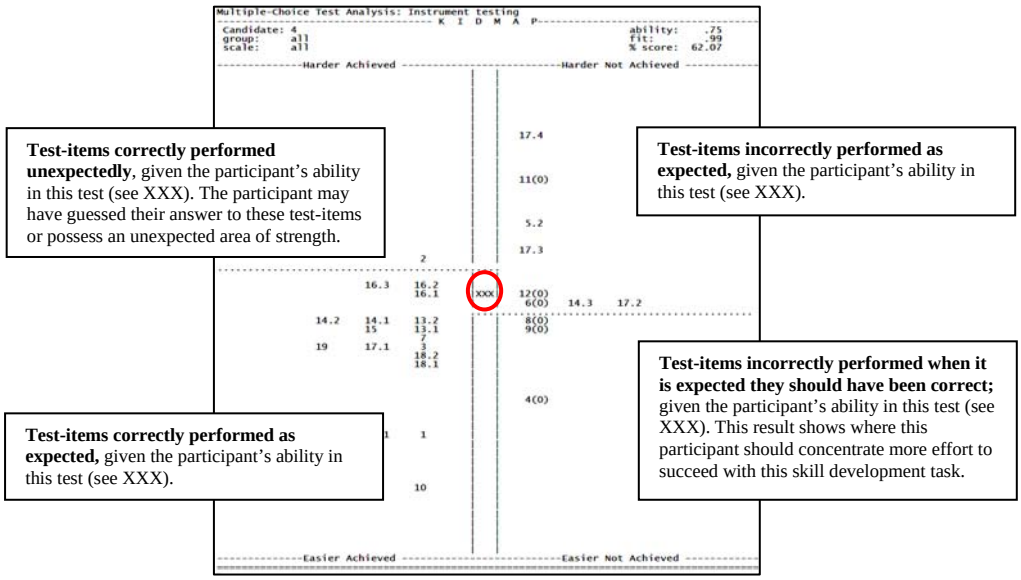

Figure 1. Kidmap – showing an individual's performance

Based on the Kidmap findings, a graph of achievement summary of all the candidates was produced using the data. Figure 2 showed the level of the participants ICT literacy ability based on their achievement for each test-item. For each test-item, the achievement were grouped into four level of competency: 1) Easier Achieved (EA), 2) Harder Achieved (HA), 3) Easier Not Achieved (ENA), and 4) Harder Not Achieved (HNA).

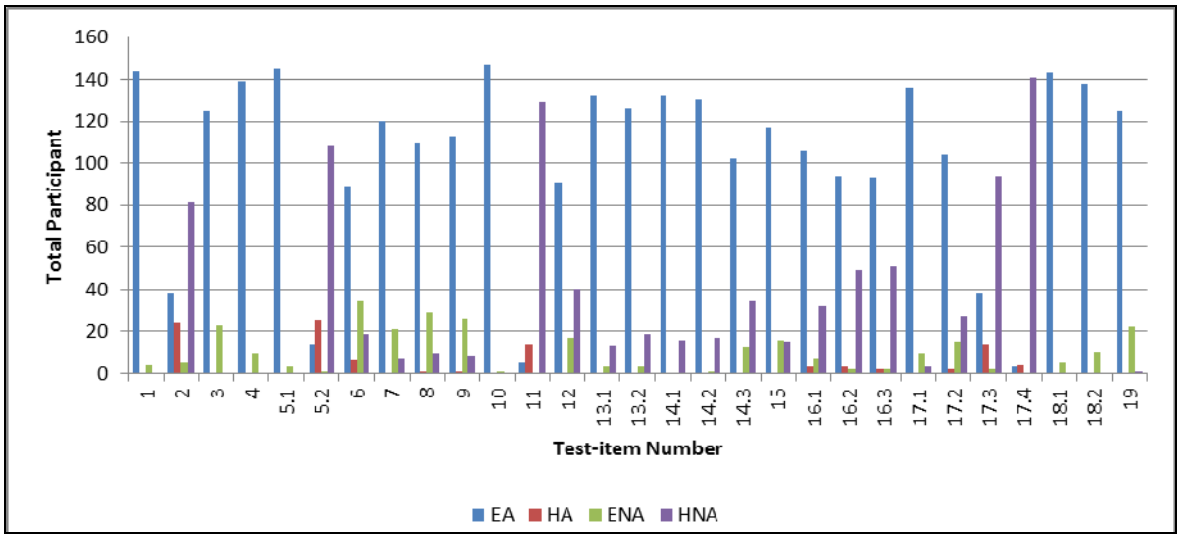

Figure 2. Achievement summary graph

This group of participants proposed that test-item 5.2 (using basic spreadsheet formula to assess student grade), test-item 11 (reflect/judge credible website) and test-item 17.4 (knowing how to evaluate credible webs) were the hardest test-item with EA value less than 10% of total participants. This finding demonstrates that this group of participants lack the skills involving the use of a spreadsheet application and also the skills and knowledge needed that would enable them to identify and judge credible websites. These skill and knowledge is exceedingly important for trainee teachers who are going to be teaching in a Smart School environment. Definitely we do not want the teachers to be teaching the school children with resources which are unreliable or hearsay.

Aside from that, the findings also indicated that the learning domain tested below were easy for this group of participants, where none of the participants scored these items as HA or HNA (Table 2).

Table 2. Learning domains with no Harder Achieved or Harder Not Achieved score

Item no	Learning domain tested
1	manage
3	basic ICT capabilities
4	basic ICT capabilities
5.1	assess
10	Internet navigation & search
18.1	perform analysis & producing appropriate document
18.2	perform analysis & producing appropriate document
19	basic ICT capabilities

Figure 2 also showed more than 10% of the participants scored ENA on five test-items. The learning domains were:

Table 3. Learning domains with Easier Not Achieve score

Item no	Learning domain tested
3	basic ICT capabilities
6	perform analysis & producing appropriate document
7	plan & define
8	access
9	manage

Rasch model suggested that these learning domains (Table 3) should be easy to the participants. However, more than 10% of them were unable to correctly complete the tasks. The reason might be because of carelessness, or might even be because of their over confident attitude they misread the task requirement and wrongly executed the tasks. It might also be because the already had the knowledge but they had forgotten how to execute them, due to uncommon use of the task in the participants' daily work. Whatever the reasons, the participants needed to revisit this group of tasks immediately and resolve the problem.

7. CONCLUSION

Based on this findings, the ICT-literacy TBA instrument identified that this group of participants suggested that the *assessing* information; *integrating* information from multiple sources; and *evaluating* the information that they have, as the hardest ICT-literacy skills. These skills however, were among the most important ICT-based skills that a teacher must have.

The ability to pin-point to the exact ICT-literacy ability that the trainee teachers lack might help them and their institution of higher learning in providing necessary intervention or additional skills to these trainee teachers. Their training can target their specific area of weakness, and redundancy in training information can be avoided. This in turn can save a lot of trainer's time and cost.

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PEER TUTORING IN THE CIS SANDBOX: DOES IT WORK?

Mark Frydenberg
Computer Information Systems Department, Bentley University, Waltham, Massachusetts, USA

ABSTRACT

This paper reports on a student-created and facilitated peer-tutoring activity to assist first-year students in preparing for their final exam in an introductory information technology course. Tutors at the CIS Sandbox, a collaborative learning lab at an American university, offered a series of "Crunch Sessions" to their peers. This paper examines how these sessions model characteristics of peer tutoring, and describes how social media and Internet-based collaboration tools support a blended learning environment where an in-person event is aligned with a web presence. Interviews with student tutors and participants suggest that the peer relationship between tutors and tutees was conducive to an open exchange of questions and answers among participants, and that the sessions contributed to student learning for those who attended. Implications for designing and researching online peer learning activities in higher education contexts are discussed.

KEYWORDS

Peer Tutoring, Informal Learning, Collaborative Learning Community, Learning Environments, ICTs

1. INTRODUCTION

The Computer Information Systems Learning and Information Technology Sandbox (CIS Sandbox) opened as a collaborative computer lab during the fall 2011 semester at Bentley University, a business university in the United States. Staffed by 24 undergraduate and graduate student assistants, also referred to as tutors, the facility since has become a valuable campus destination for learning about and with new technology, through the in-person peer tutoring services and online resources it provides. In that context, peer tutors are student tutors who have taken courses in which they tutor other students. Most of the tutors receive compensation through federal work-study or the university's student work program for their services. Undergraduate tutors work approximately 7 hours per week; graduate tutors work approximately 20 hours per week.

Results from the initial phase of this research (Frydenberg, 2013) showed that students from IT 101 (Introduction to Information Technology and Computer Concepts), a course required of all first-year students at the university, were consistently the largest cohort using the CIS Sandbox in any given semester. As a result, many students had developed relationships with some of the tutors, who provided assistance on homework assignments and clarification of course concepts. Tutors recognized an opportunity to leverage students' comfort in the CIS-Sandbox to provide them with an informal experience to prepare for their final exam (common across all sections of IT 101), and in turn, improve the impact of peer tutoring services offered by the CIS Sandbox on student learning outcomes.

As part of ongoing efforts to create a collaborative learning community in the CIS Sandbox, this paper reports on a student-created and student-facilitated peer-tutoring activity called a Crunch Session to assist first-year students in preparing for their IT 101 final exam. Many students who visit the CIS Sandbox during the semester seek tutoring assistance from their peers, so a student-driven end-of-semester review session was a natural extension of the collaborative pedagogic approach that is a guiding principle of the CIS Sandbox and its tutors. Three Crunch Sessions took place during the final night of the fall 2011 semester, when students begin studying for final exams. With 14 sections of the course offered to approximately 691 students, and a facility with a capacity of 50 students in person, the tutors and the author discussed ways to create a student-centered learning experience that relied on Internet-based collaboration tools (ICTs) in order to enable students to attend and participate in person and online.

This practitioner study reports on a second phase in the evolution of the CIS Sandbox, describes a peer-tutoring activity, presents a model for its implementation, and qualitative evaluation results that indicate its effectiveness in promoting student learning.

2. SOCIAL MEDIA AND PEER TUTORING

Peer tutoring and other aspects of peer learning have shown to be effective model for learning and engagement (Jackson & Bruegmann, 2009), (Topping K., 2005). Distinctions among styles and implementations of peer learning exist in the literature. Peer tutoring is an approach in which one student instructs another on material in which the first is an expert and the second is a novice (Topping, 2005).

Most peer educational techniques are structured around carefully defined social roles and procedures (Damon & Phelps, 1989, p. 10). While Damon and Phelps recognized this was the case for primary school learning environments in an age where Internet access in classrooms was unlikely and online social networks were not invented yet, their observation that peer learning has a social component can be extended to incorporating social media and collaboration tools in higher education learning spaces as is evident today. Previous practitioner studies have investigated peer tutoring and instruction through video podcasting (Frydenberg M. , 2008), blogs (Davi, Frydenberg, & Gulati, 2007) and collaboration tools and social media (McLoughlin & Lee, 2007), (Rourke & Anderson, 2002), (Wheeler, 2009). Approaches to peer learning in the CIS Sandbox build upon these techniques.

"Peer tutoring emulates the traditional teacher-student relationship in which one party transmits expertise to another. The teaching party knows the answers and, through explanation and drill, tries to communicate them to the learning party." (Damon & Phelps, p. 11)

Peer tutoring is beneficial to those who are tutored as well as to the tutors themselves. (Topping K. J., 1996) Entrusting tutors to work with students "imparts to them a message that is likely to bolster their enduring confidence in themselves and interest in intellectual achievement." (Damon & Phelps, p. 17) Jackson and Bruegmann (2009) found that knowledgeable and skilled individuals increase the skill and knowledge of those with whom they interact.

With the introduction of distance education and online communities, software for managing peer learning, and intelligent tutoring systems, "…information technology has begun to permeate peer learning" (Topping K. , 2005, p. 642). Research in higher education contexts shows that contributing to learning communities through social media tools such as collaborative editing is becoming "a 'new' learner-centered pedagogy" that promotes learner-driven content creation and collaborative knowledge building (McLoughlin & Lee, 2008).

Milne (2007) claims that from the ubiquity of social media, the Internet, and other technology developments has emerged an "interaction age" where collaboration is expected, and both formal and informal learning spaces must be designed to support these interactions. Such collaborative peer learning extends outside the classroom using ICTs to enhance dynamic peer-peer interactions in addition to peer-tutor interactions. These increased personal and virtual interactions can sustain and nurture a learning community (Nunes, McPherson, Firth, & Gilchrist, 2002).

Taking these prior research findings forward, the integration of social media and ICTs in a CIS Sandbox-sponsored Crunch Session prior to final exam week would contribute to refining our pedagogic possibilities and help sustain a collaborative learning community.

Given alternatives in peer tutoring techniques and approaches, and student desires to be active participants in their own learning, these questions emerged as part of this study to design, implement and evaluate a student-facilitated peer-learning session:

- Will attending a student-centered, peer-tutor facilitated Crunch Session help to prepare students for their final exam?
- How can the use of Internet-based collaboration tools create a virtual collaborative learning space to support an in-person peer-facilitated learning session?
- How will tutors and attendees react to such a student-centered, peer-facilitated learning session?

3. CREATING AN IT 101 CRUNCH SESSION IN THE CIS SANDBOX

IT 101 (Introduction to Information Technology and Computing Systems) is a first-year required course for all students at Bentley University, in Waltham, MA. The course introduces students to technology concepts such as using the World Wide Web, hardware and software, operating systems, storage, creating web pages, wireless networking, multimedia, and problem solving skills using Excel. Bentley University offered 14 sections of IT 101 during the Fall 2012 semester to approximately 691 students, as evidenced by the number of final exam scores on record.. This is the number of students for whom a final exam score is on record. In addition to specific assignments created by their instructors, students across all sections complete ten standard assignments during the semester and take a common final exam.

The CIS Sandbox is a computer lab aligned with an online presence. Prior research focused on its physical renovation and use of social media tools to create an open, social, and collaborative learning space (Frydenberg M. , Aligning Open, Physical, and Virtual Spaces in the CIS Sandbox, 2013). The facility features several collaborative work areas, a lounge area with soft seating for informal conversation, a wall-mounted Google TV and gaming equipment, an interactive whiteboard, a large projector to facilitate group-learning activities, and bright colors painted on the walls that create a warm atmosphere. This facility replaced a traditional computer lab, whose layout included dozens of computers flanked around the perimeter of a dark room in a basement corner of an academic classroom building (Frydenberg, 2013).

During a brainstorming conversation about ways the CIS Sandbox tutors might assist IT 101 students in their final exam preparation, one tutor proposed holding three one-hour long, back-to-back Crunch Sessions in the CIS Sandbox. Figure 1 shows a Crunch Session process in progress. Students gather at collaborative stations to view the student facilitator's screen also displayed on the interactive whiteboard, on each monitor in the room, and on some student laptops. The facilitators projected additional images, such as the Crunch Session logo, on the back wall, to create an immersive experience.

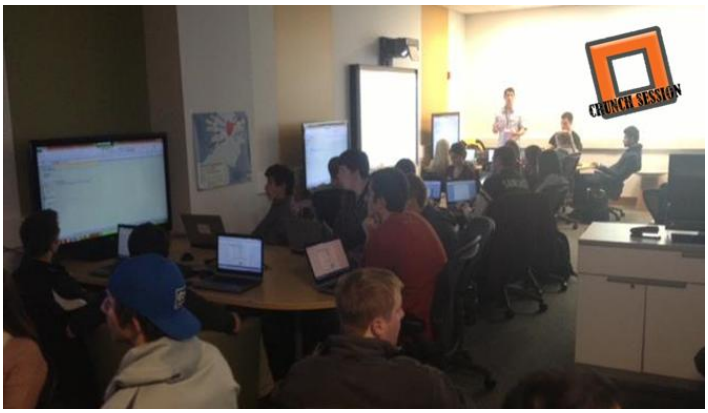


Figure 1. An IT 101 Crunch Session in progress.

In an interview after the Crunch Sessions took place, a student facilitator and organizer reflected on his pedagogic vision for this event that builds on the core tutoring services of the CIS Sandbox:

> "A first for the CIS department, and most likely the university, this session would be run entirely by undergraduate tutors and graduate students in the CIS Sandbox. Students often came to us during the semester to explain concepts that they do not quite understand. We wanted to conduct our review session for the final exam the same way. We want the session to be entirely question driven and will advertise it as such. We will prepare a series of documents to reference when answering questions as well as a reserve bank of questions in case the session goes silent."

These sentiments form the basis of the first phase (needs analysis and goal-setting) of a three-phase model for designing, implementing, and evaluating a Crunch Session process as shown in Figure 2.

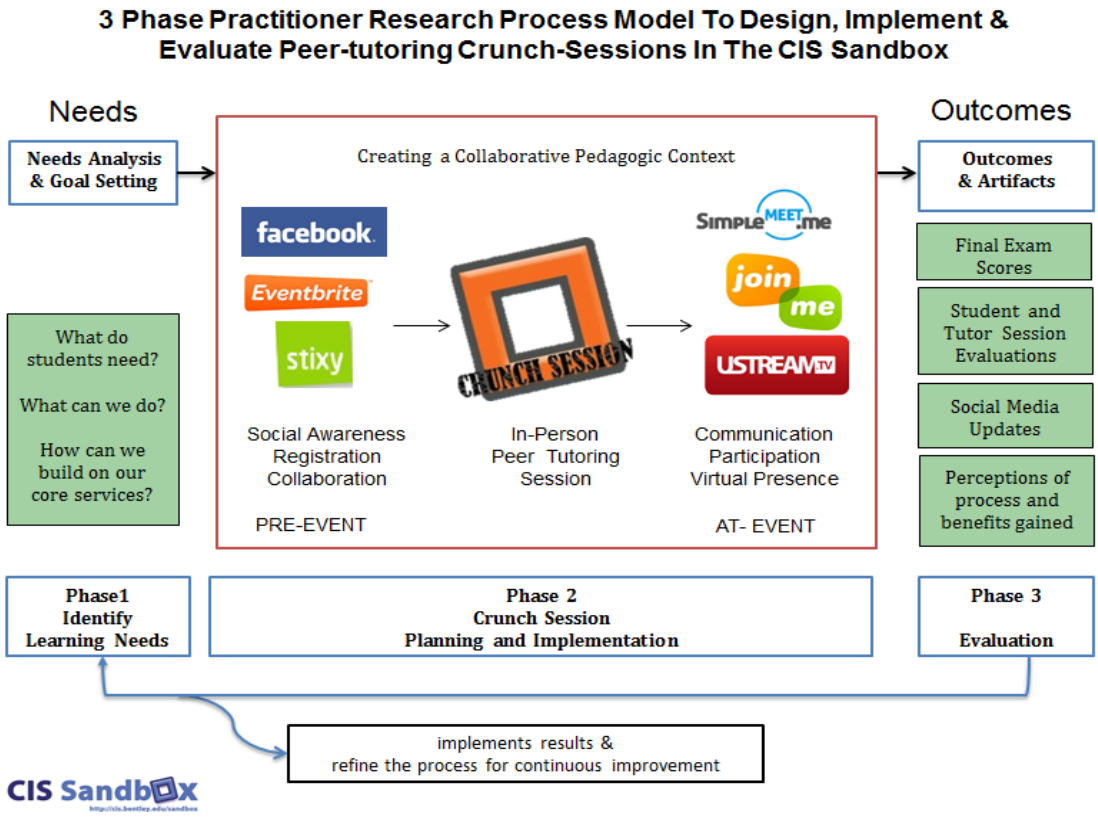
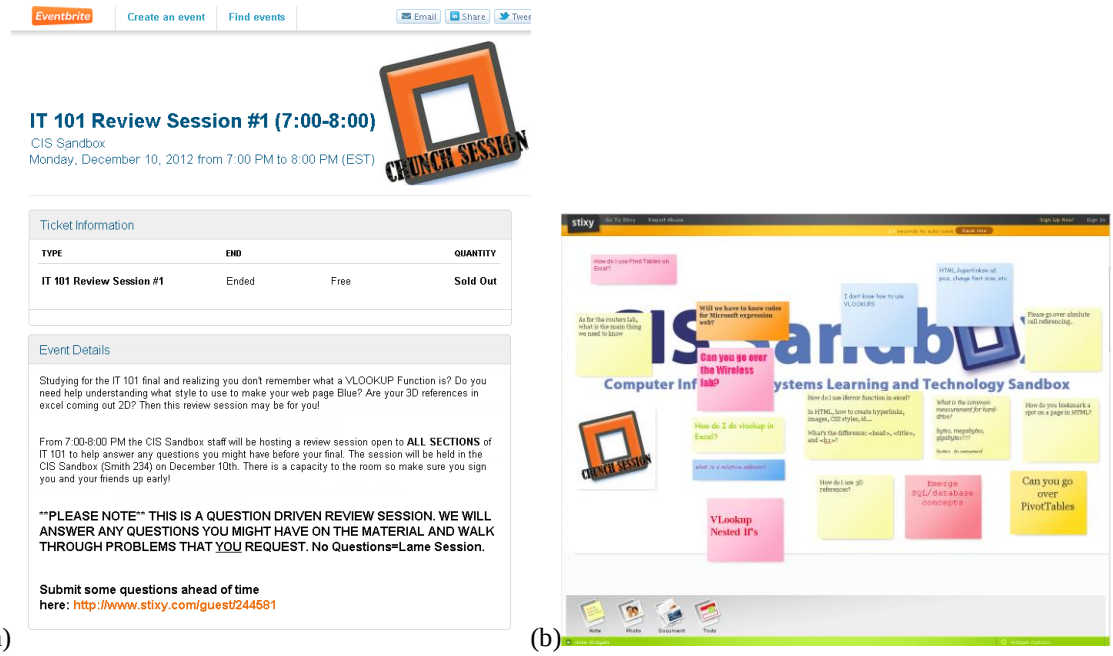


Figure 2. A Model for Planning Peer-Facilitated Crunch Sessions.

Because the tutors are students themselves, they know what types of review opportunities their peers will find most beneficial. Marketing and publicizing the sessions to generate interest was equally as important as planning their content. Promoting, facilitating, and supporting the Crunch Sessions relied on a variety of collaborative and social networking tools to engage students online and in person, before, during, and after the event. Phase 2 (planning and implementation) involved determining Internet-based collaborative and social media technologies that would raise social awareness about the event, allow students to register, and collaborate to create learning artifacts through the form of sharing questions, even before the event began. Phase 3 of the model urges students and their tutors to reflect on outcomes and artifacts of learning in order to determine the success of the Crunch Sessions. After the sessions, student tutors posted additional questions asked at the session, and photos of attendees on the CIS Sandbox blog and Facebook page.

The use of social media and Internet-based collaboration tools in peer learning situations can help to define social roles and procedures for creating and sharing knowledge. The use of social media technologies for peer tutoring extends Damon and Phelps 1980's observation that "such interactions encourage .... active involvement in reasoning, problem solving, and the social exchange of ideas" (Damon & Phelps, p. 17) into a context of socially connected networked learners. Prior to the event, student tutors promoted the event on the CIS Sandbox blog, and on Facebook. The blog linked to an events page on Facebook, where students could inform their peers that they were attending. Eventbrite, an event management service, allowed students to reigster, and managed a waiting list. The student organizers recognized the need for these sessions to be student-driven, and made these intentions clear on the Crunch Session Eventbrite page, shown in Figure 3(a), where they admonished their peers, "No Questions = Lame Session." When students registered, the Facebook and Eventbrite sites invited them to submit questions on Stixy. Stixy is a popular ICT for sharing documents, photos, links, and notes with a group. Students could review the Stixy board, see questions posted by their peers, add comments, or post their own questions anonymously before the session started. The online sticky board created a forum for students who might otherwise be intimidated about asking questions in person during the session. This also allowed the student facilitators to prepare to provide review materials related to these questions. Figure 3(b) shows a section of the Stixy board containing student questions.



(a) (b)

Figure 3. (a) Eventbrite promotes the student-driven session and encourages students to submit questions. (b) Students contribute questions on Stixy prior to the Crunch Sessions.

At the event, participants communicated with the student facilitators via simplemeet.me, a browser-based chat room. The student facilitators chose this tool because students can easily connect without needing to create an account on another messaging service. The student facilitators discussed having students submit questions and comments via Twitter using a common event hashtag, but were concerned that some of their peers might not have an account on that online social service.

To ensure that participants could see the presenter's screen throughout the session, the student organizers configured join.me, a free screen-sharing application, to share the presenter's screen on each of the large screen monitors, interactive whiteboards, and Google TV in the CIS Sandbox. They also provided the access code for students to be able to view the presenter's screen on their own laptops, tablets, and smart phones.

For the benefit of those who could not attend in person, one of the Crunch Sessions was recorded and streamed over the Internet using UStream.TV, a free web-based video streaming service.

4. PRELIMINARY FINDINGS

This section highlights preliminary findings from the evaluation, which offer an initial snapshot of the effectiveness of this approach. In reflecting on qualitative and quantitative data related to the IT 101 Crunch Sessions and CIS Sandbox usage during the fall 2012 semester, the discussion considers the following artifacts:

- a voluntary online survey, offered at the end of the semester, to all IT 101 students after completing their final exam
- attendance information obtained from student "swipe-ins" throughout the semester,
- interviews with students who attended the review sessions and tutors who planned them
- final exam grades from students in all sections of the course

This data offers a preliminary understanding of student experiences at the CIS Sandbox and during the Crunch Sessions. Students who visit the CIS Sandbox swipe in with their ID cards; 4082 swipes from 1415 unique visitors were recorded during the fall 2012 semester. Based on forms that tutors complete logging their tutoring activities, it was determined that approximately half of the tutoring that takes place is with first year students seeking assistance in their IT 101 classes.

4.1 Quantitative Reflection

The following discussion summarizes findings from student surveys. 302 IT 101 students (132 female, 170 male) completed an end-of-semester survey asking about their use of the CIS Sandbox during the Fall 2012 semester. Of those, 200 students came to the CIS Sandbox seeking help with IT 101. 82 students said they never went to the CIS Sandbox, citing the most common reason that "I didn't need help, I knew what I was doing" (61 students) or they got help from classmates or friends.

116 of the students who responded revealed that they sought help on their Excel exercises; 89 students sought tutoring on their web assignment. 120 students say they visit once or twice a semester; 56 students visit at least monthly; 18 students visit at least weekly.

Online registrations from Eventbrite showed that 120 students enrolled in IT 101 signed up to attend a Crunch Session in person. Usage stats showed that the video received 40 views. Of those who attended the Crunch Sessions, all students who responded to a survey strongly agreed that they attended because they thought doing so might help them get a better grade on the final exam. 83% said they brought their computers to work through the problems that the peer tutors presented.

A first examination of final exam scores of students who attended the Crunch Sessions compared to those who did not shows that students who attended had a slightly higher average and median score over those who did not attend. 75.68% of session attendees scored in the 80% to 100% grade range on the final exam, compared with 66.23% of those who did not attend, whose final exam scores were in that grade range. 67.25% of all students who took the exam scored 80% or higher. It is important to note this difference is not statistically significant for a variety of reasons: Students self-selected to attend or not to attend the Crunch Sessions based on their subjective perceptions of whether or not attending would be useful to them. Some did not attend because they felt they were good students and did not need additional help. Others who considered themselves "good" students may have chosen to attend for more social than academic reasons. Finally, the capacity of the physical space in the CIS Sandbox could not accommodate all students to attend in person, even if they wanted to, creating unequal review experiences for various groups.

4.2 Qualitative Reflection

Student tutors and student participants participated in interviews regarding their experiences as facilitators and attendees of the Crunch Sessions shortly after the sessions were held. One tutor described how he prepared to facilitate a Crunch Session, citing how he researched the most commonly asked questions from reports of peer tutoring sessions in the CIS Sandbox that tutors complete throughout the semester:

> "In preparation for the session, we carefully observed trends in tutor reports that were submitted throughout the year to see what concepts most students were coming in for. In the case of Excel, we would start with explaining the concept of a VLookup function, which often was difficult for students to grasp. We reviewed the example that they were used to from their classroom experience and also created an entirely new example and walked through it until there were no more questions."

Rourke and Anderson (2002) have identified roles for establishing a teaching presence in peer-led online discussions, including instructional design, facilitating discourse, and direct instruction. Comments from a student facilitator sharing his sense of the room as the sessions began recognized these roles:

> "The room was packed and it definitely had the feeling of an informal learning session. With the chat widget on the white board and not a professor in sight, students were relaxed and more prone to ask questions that they might have thought someone would ridicule them for in a classroom environment. Often times you could see students move forward in their seats during certain questions as if they were waiting for someone else to ask it, and not a single student snickered or laughed; there were no wrong questions here. Everyone was in the room to learn from students who were currently in the class or who had already taken the class.
>
> The sessions all began awkwardly, with moments of silence. Because we were students ourselves we knew what it was like to be at a review session, not wanting to appear 'stupid' for asking a question that was probably covered in class... After the first example, however, students were much more apt to ask a question or look for a clarification. The remainder of the session ran quite smoothly until there were no more questions. Usually as time went on students became more focused and attentive. As students see the value that their tutors bring, they are much more likely to treat us as a resource as well as a peer, unlike

the student-professor relationship. Also, because there is the mentality that 'we're all in this together,' students felt like they were being fed secret details or inside information because they were learning from other students like themselves."

Finally, tutors reflected on how they might know if the sessions were successful: "We weren't looking to teach new concepts or to make students unlearn something and relearn it a different way. We were looking to clarify areas where students had a small gap in their knowledge, or needed something explained again. There were very few questions at the conclusion of the event. We saw students work through problems and obtain the correct answers. We were satisfied."

5. DISCUSSION AND NEXT STEPS

ICTs played a role in all aspects of the Crunch Sessions. The Crunch Sessions' success relied on motivated and tech-savvy tutors who were able to introduce the use of ICTs to facilitate interaction among participants before, during, and after the sessions.

Prior to the in-person session, students relied on social networking applications to get information and sign up. They prepared by taking online quizzes, reviewing resources on the CIS Sandbox blog, and submitting questions anonymously to an online sticky board.

During the sessions, to accommodate a large number of students in a small space, students entered their questions in the chat window as demos took place. Presenters returned to those questions to ensure they answered them adequately. The chat window served as a "parking space" for students to ask questions as they thought of them, without disrupting or interrupting the demonstration in progress. The use of web-based communication tools helped to create an in-person environment that was immersive, inviting, and conducive to learning.

After the sessions, a video posted online allowed students who wanted additional review, or who were unable to attend in person, the opportunity to learn at their own pace.

While designed for technology-based courses, the Crunch Session approach extends to other areas such as mathematics, where problem solving in small groups is beneficial. Screen sharing technology is beneficial in courses that rely on students gaining proficiency in software applications, while the use of chat, and ICTs for promoting the sessions and gathering questions ahead of time are applicable across several disciplines.

The success of the first IT 101 Crunch Session inspired other tutors to offer similar review sessions to their peers for additional courses in future semesters. After hearing about the sessions, CIS instructors weighed in on ways to improve them, and tutoring in general, in order to promote critical thinking and problem solving. One instructor commented on the potential value of frequent review sessions:

"I've heard about the IT101 review session and I'm very happy for student-led efforts in learning. We have to be careful though not to reduce it to 'here's how you do your next homework' type sessions. There are several practice problems that we do in class, sometimes quite a few students don't manage to finish those…What if the [tutors] ran regular sessions helping students either finish the practice problems from class, or even doing another practice problem?"

6. CONCLUSION

Students found the format, timing, and ICTs used in the Crunch Sessions to be helpful and engaging, and that the use of social media and Internet-based collaboration tools contributed to the learning experience. These students' remarks were typical: "the IT 101 Crunch Sessions really helped. I liked the idea of chatting, where people could ask questions to assistants." Said another student, "The review session was really helpful and went over the things I didn't know how to do."

The IT 101 Crunch Sessions met an identified student need, and aligned a three-phase participatory research process model with the goal of building a collaborative learning community in the CIS Sandbox by involving students as co-designers of pedagogic practices. Students worked to create a peer-facilitated learning environment that extends their roles as peer tutors. Based on these encouraging early results, it appears that the model works. Further research will be necessary to ascertain the impact of peer tutoring combined with the use of ICTs at future Crunch Sessions for information technology students.

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E-COMPETENT TEACHER AND PRINCIPAL AS THE FOUNDATION OF E-COMPETENT SCHOOL E-EDUCATION, THE LARGEST SCHOOL INFORMATIZATION PROJECT IN SLOVENIA 2008-2013

doc. dr. Magdalena Šverc, mag. Andrej Flogie, Maja Vičič Krabonja and Kristjan Perčič
Institute Antona Martina Slomška, Vrbanska cesta 30, 2000 Maribor

ABSTRACT

During the years 2008-2013 Ministry of Education in the Republic of Slovenia prepared largest project of informatization of educational institutions. One of the main goals of the project E-Education is the development of the standard E-Competent Teacher, School Principal and IT Expert. The standard E-Competent Teacher, Principal and IT Expert defines the key e-competencies that every teacher, pre-school teacher or teacher in a student residence needs in order to work with their students; every school principal or deputy school principal needs in order to manage their school; and every IT expert or IT co-ordinator needs in order to successfully collaborate in planning school work and classes by using ICT. The second part shows the individual indicators of the e-Education project.

KEYWORDS

e-Education, e-competence way, informatization of educational institutions, didactic advice.

1. THE OBJECTIVES OF THE E-EDUCATION PROJECT

In 2007, the government of the Republic of Slovenia approved the Strategy for Development of Information Society in the Republic of Slovenia – si2010, which defined the national framework for the development of information society in Slovenia. It states: "By 2013, establish an effective and fully computer-supported national education system and also by this ensure sustainable economic growth, prosperity and quality of life of all citizens of the Republic of Slovenia. At the same time become synonymous with one of the most successful societies in the world that are knowledge-based, constant innovation and rapid development. To ensure inseparable connection between all processes and content with feeding and gaining knowledge from information and communication technology; there should be no curriculum, subject and participant where this would not be present. "

The strategy includes providing suitable equipment for schools, developing e-content and training education professionals (Kreuh and Brečko, 2011). The project E-Education is based on all of these aims because the only way to build a 21st century school that can be characterized as e-competent is to create an e-learning environment, to develop suitable e-content, and – most importantly – to educate e-competent teachers who can use this content in a suitable e-learning environment.

Ministry of Education and Sports is in response to the challenges of teaching and learning in the information society offered several strategic focused projects. One of the key projects is certainly the project "e-Education", which is co-ordinated within the web portal (e-center) and consists of three sets (three projects), as follows: consultancy development and implementation and support to e-Competence schools, development and implementation of e-learning materials, development and implementation of training for e-competent teachers.

The main objective that we pursue in the course of the project "Consultancy development and implementation and support to e-Competence schools" ("e-support"), is a continuation and acceleration of the process of computerization of each educational institution, depending on their current status in management, teaching and technical fields. We're talking about counselling (for school management, teachers, school professionals), educational support in teaching and learning (for teachers), technical assistance to educational institutions.

The main goal we pursue in the course of the project "Development and delivery of training courses/seminars for e-competent teachers" is the development of proposals for standard e-competent school, e-competent teacher, principal and IT expert. In these contexts we prepare and implement training and other activities.

Our collaborators in project are teachers, principals, experts from university departments and other institutions. We are establishing closer cooperation with certain university departments and other institutions in the field of education both at home and abroad. It can be said that the project "e-Education" provides an opportunity for all educational institutions, to focus on the use of new technologies, become more innovative and efficient in their work with students, practitioners and professional associates. By training at various seminars and counsellings, conducted both live and on-line, professionals acquire new competences in teaching, which they can test in the classroom already during the seminar.

One of the main goals of the project E-Education is the development of the standard E-Competent Teacher, School Principal and IT Expert. They are the most important factors in establishing e-competent schools. The standard E-Competent Teacher, Principal and IT Expert defines the key e-competencies that every teacher, pre-school teacher or teacher in a student residence needs in order to work with their students; every school principal or deputy school principal needs in order to manage their school; and every IT expert or IT co-ordinator needs in order to successfully collaborate in planning school work and classes by using ICT. E-competent school so includes: e-competent professionals, modern developed e-content (e-learning materials) and e-learning environment.

To achieve this objective, the e-Education project developed the following content: E-competences (for teachers, principals, IT experts), Seminars (live and on-line in virtual classrooms), Counselling (experts advising to a small group of 3-5 teachers, advantage is the flexibility and adaptability of content), Technical support, Education of teacher trainers (three times annually), Slovenian Educational Network SIO - web portal www.sio.si (with education catalogue, e-communities, e-learning materials, information), e-learning materials, e-textbooks, International conference SIRIKT, Information system to support project, Evaluation, self-evaluation.

Educational institutions have decided freely if they would like to be included in the e-Education project. Being a part of the project gave them access to education, content and services.

2. HOW TO BUILD A 21ST CENTURY SCHOOL?

Because of the rapid development of digital technologies individuals require an increasing number of various skills, especially technical, cognitive and social skills, in order to perform tasks and solve problems in digital environments of their personal and professional lives (Eshet-Alkalai 2004). This also means more responsibility for teachers and other education professionals, since in the e-permeated world, ‘those who can understand and comfortably use e-facilities are significantly advantaged, in terms of educational success, employment prospects and other aspects of life’ (Martin 2005).

The aim of modern innovative practice is development of teaching methods that will improve learning outcomes for students and better prepare them to live and work in the 21st century (Vuorikari, Garoia, Balanskat, 2011). To succeed in today's society, rich with information and knowledge, students and teachers must use technology effectively. The introduction of ICT in the classroom affects in following ways: It helps students to develop the skills necessary to successfully live and work in the 21st century, to encourage teachers to improve the way of teaching in the classroom through interactive and dynamic resources offered by ICT, and provides more motivation and a richer learning experience for students (Brečko, Vehovar, 2008).

A foundation for this is course syllabi that are based on lifelong competencies. One of these competencies is the development of learners’ digital literacy. Schools are committed to use modern technology in their classrooms, but only by training of all school employees they will be able to fulfil other requirements set forth in the syllabi. E-competent principals, teachers and IT experts are the most important factors in establishing e-competent schools.

3. E-COMPETENCIES – WHY AND HOW?

The standard stems from many years of work focused on the role of ICT in education. It takes into account the findings of numerous ICT studies conducted in Slovenia and abroad, the knowledge acquired in the many years of training education professionals, the development of e-materials, and the efforts of the state to provide suitable equipment for schools. In addition, in the process of devising the standard, a number of non-Slovene standards, licenses and strategies in the field of ICT were examined. The way to the new standard is based on 6 key competencies which define all the competencies and e-competencies that help teachers, pre-school teachers, principals and ICT co-ordinators achieve digital literacy. Of course, they are related to the requirements for digital literacy of students specified in the course syllabi. Teachers and pre-school teachers should be trained to carry out the aims specified in these documents.

Every education professional can acquire e-competencies as authentically as possible: the content and examples of good practices are selected based on the subject or subject area relevant for the institution and thus directly transferable to practice; take part in "blended learning" (live and on-line) seminars in e-classrooms, which makes it possible for the participants to learn experientially and work on collaborative projects; Undergo competencies assessment in all seminars.

In 2013 we introduce independent competencies assessment, which will enable the already skilled teachers, pre-school teachers, school principals and ICT co-ordinators to assess their e-competencies or skills independently, without taking part in training seminars. We also offer consultancy services which are intended to motivate education professionals to use ICT in their everyday work and to help them choose a suitable training seminar. Post-seminar consultancy can further develop and perfect the acquired competencies. Seminar participants can also collaborate in e-communities where they exchange their experiences and learn about new developments in teaching.

3.1 Three Levels of Digital Literacy

Following the needs of today's society and the development and needs of learners, the project E-Education defines and describes the digital competencies or e-competencies that represent the basic level of digital literacy. They refer to teachers, pre-school teachers, ICT co-ordinators, school principals and deputy school principals.

Our seminars mostly focus on the first level of digital literacy since they support the development of digital competencies. Partly, the second level is also included because the blended learning seminars enable participants to put into practice the knowledge they gain on various strategies, approaches, content and materials. By doing so, they apply the acquired competencies to their professional field. However, it depends on each individual to what extent they use the new approaches in their work after the training, and only eventually (probably after years of work) can they reach the third level, i.e. the level of digital transformation that includes innovation and creativity in the use of ICT.

3.2 Personal Training Plan

The focus of the seminars on one key e-competency allows teachers, pre-school teachers and school principals to plan their way towards e-competency. Each individual should therefore prepare a personal training plan prior to the training. One of the tasks in the entrance seminar Collaboration in the On-line Learning Environment focuses on this.

Teachers should use the Slovene Educational Network web portal to choose suitable seminars from the Seminar Catalogue. Their search can be based on the subject area (for example, languages, physics, kindergartens, school principals …) or on the main e-competency developed by the seminar. For every seminar there is a description of content and aims, so the potential participants can also consider the subject matter they might be interested in. Personal training plans should be part of Institutional Informatization Plans, which are prepared by educational institutions and are consequently part of their E-Card.

3.3 Six Key e-competencies

The concept of reaching e-competency is defined in the document The Guidelines of the Standard E-Competent Teacher, School Principal, IT Expert (Kreuh and Brečko 2011) and based on the implementation of six key e-competencies (Figure 1).

Figure 1. Key e-competencies

3.4 On the Way towards e-Competent Schools through Seminars - One Seminar, One Key Competency

Our way towards e-competency is based on seminars that follow the principle 'one seminar, one key competency'. Each seminar focuses on developing one of the six key competencies. The key competencies are marked with numbers 1 to 6 (Figure 2).

The seminars for teachers, principals and IT experts or ICT co-ordinators are devised by teachers, members of various subject groups or subject area groups, and aimed at various target groups in education.

Figure 2. Key e-competencies marked from C1 to C6

3.4.1 Precondition: basic ICT skills

A precondition for achieving digital literacy and being on your way towards e-competency is basic ICT skills. They encompass six areas that include working with texts, spreadsheets and presentations, the use of the web and e-mail, as well as the use of the necessary hardware and software. By responding to our questionnaire, teachers, principals, IT experts or ICT co-ordinators can conduct a self-assessment of their basic ICT skills. Achieving basic level of ICT knowledge and skills provides participants smooth work in seminars.

3.4.2 The way from C1 to C6

Entrance seminar for professional staff

The first step on the way towards a teacher's e-competency is the entrance seminar Collaboration in the On-line Learning Environment. The aim of the seminar is to establish both live and distance collaboration. By using a wide range of tasks, teachers collaborate, communicate and learn about personal data safety in the virtual environment.

In their second step on the way towards e-competency, teachers select and complete at least four seminars. They have to take into consideration that the seminars should be chosen so that they include the first, second, third and the fifth competencies. Teachers can select the seminars from the catalogue available on the web portal www.sio.si. The following options are available: Seminars in their own subject area, seminars from other subject areas (for example, a language teacher can choose a seminar primarily meant for primary teachers or art education teachers), seminars for professional staff in general.

The range of seminars is such that it allows, for example, a secondary school specialist subject teacher to reach the standard despite there being no seminars focusing on their specific area.

Choosing seminars that focus on other subject areas provides possibilities for interdisciplinary collaboration and opportunities for the participants to learn from each other even though/because they specialise in different subject areas. The seminars selected by teachers on their way towards e-competency target four key competencies that are marked as C1, C2, C3 and C5.

The catalogue on the web portal www.sio.si allows teachers to search for seminars based on key competencies or based on subject areas, making it possible for them to easily create their personal training plans.

After successfully completing the seminars that they select on their way towards e-competency and after acquiring the competencies C1, C2, C3 and C5, teachers automatically acquire the competency C4 (Safe use of the web, ethical and legal use of information) and the competency C6 (Plan, perform, evaluate learning and teaching by using ICT).

3.5 A Principal and an IT Expert or ICT Co-Ordinator on their Way towards e-Competency

In this section, a training strategy similar to the one for teachers is presented for principals and IT experts or ICT co-ordinators.

A principal on their way towards e-competency completes four seminars targeted at principals. Every seminar has a key competency: the seminar On-line Communication in the Working Environment and Elsewhere focuses mainly on the competency C2, the seminar An Appropriate and Critical Use of Data and Information in Educational Institutions on C3, the seminar Publishing Data on C5, and the seminar Principal's Planning and Monitoring Work by Using ICT on C6.

Figure 3. A diagram presenting the way to become an e-competent principal

To fulfil the aims of these seminars and to acquire new knowledge, consultancy is also available. By working on seminar tasks, principals identify the skills that they require to run their institutions and choose the type of consultancy that best fits their needs. Such consultancy is conducted in small groups and focused on principals' work.

It is very important that principals on their way towards e-competency establish mutual co-operation, which takes place during live and distance seminars as well in the form of communication and exchange of good leadership practices among educational institutions.

An IT expert or ICT co-ordinator on their way towards e-competency completes two compulsory seminars for ICT collaboration and at least two seminars that they select depending on the subject they teach. The two compulsory ICT collaboration seminars focus on the key competencies K2 and K6, while the seminars emphasizing the competencies K5 and K3 can be selected freely.

IT experts or ICT co-ordinators follow the goal of acquiring the skills that will make it possible for them to support the ICT needs of the professionals at their institutions. They will co-operate:

- With teachers to plan ICT supported lessons,
- With principals to plan the work at their institution and introduce changes.

The competencies C1 (Knowledge and awareness of ICT, critical use) and C4 (Safe use of the web, ethical and legal use of information) are included in all seminars for principals and IT experts.

As the nature of their work requires a number of technical skills, IT experts and ICT co-ordinators will be offered additional training in this field as well.

3.6 Independent Assessment of Competencies

We are developing ways to independently assess competencies, so that the skilled self-learners will be able to evaluate their competencies and attest some of their e-competencies without taking part in the seminars. This means that they will achieve e-competency on their own, using distance learning. Independent assessment will be regarded as equal to assessment at seminars. However, since one of the basic requirements of the standard E-Competent Teacher is collaborative work, this type of assessment will not be available at any time, neither will it be completely independent. Candidates wishing to prove their competency in this way will be placed in groups to collaborate by following the instructions of the group administrator.

3.7 E-card

To monitor their way towards e-competency, teachers, principals and IT experts will be issued E-Cards. The E-Card will enable them to systematically follow the progress they make while attending the training seminars focusing on the six competencies. When the six competencies are acquired, the way towards becoming an e-competent teacher, principal and IT expert in the project E-Education is complete. The E-Card will also contain information on the role of E-Education collaborators and participation at training sessions. The E-Card represents a list of skills that belongs in the portfolio of every education professional. The latter is increasingly important since it is a record and a plan of every individual's development.

3.8 E-competent School

A contemporary school of the 21st century or an e-competent school, as such school is named within the E-Education project, is a school of e-competent teachers who sensibly use e-content in e-learning environments and follow contemporary teaching and learning trends centred on e-competent children and adolescents.

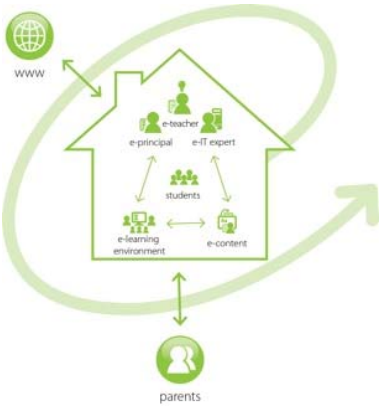


Figure 4. An e-competent school scheme

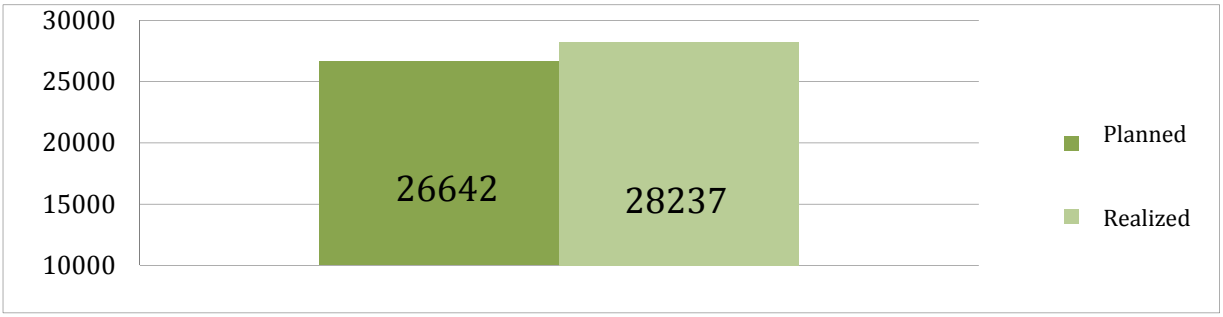
4. THE RESULTS OF THE E-EDUCATION-AN OVERVIEW OF INDICATORS

4.1 Number of New/Updated and Already Carried Out Seminars

There were 173 new/updated seminars in the period from March 2009 to the end of 2012. All of them have edited and regulated virtual classrooms with tasks and exercises that include verification of skills and competences. Each of them includes tasks of online safety. In the period from March 2009 until the end of December 2012 there were 2088 seminars carried out.

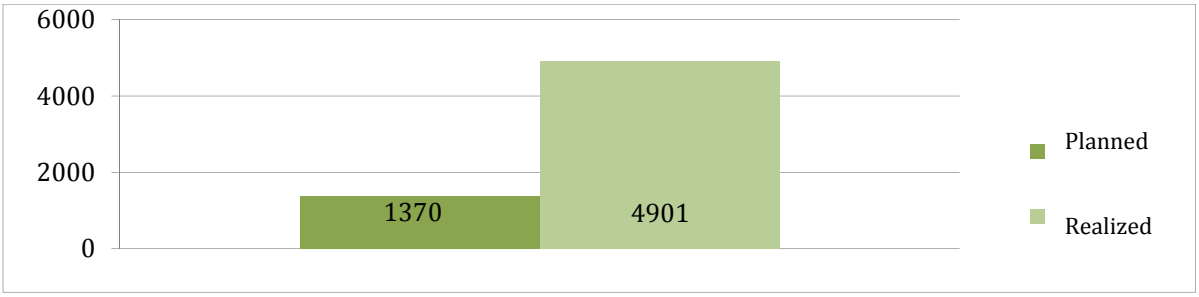
4.2 Number of Participants

The graph below shows that in the period from March 2009 to the end of December 2012, we planned 26,642 participants on conducted seminars, in fact, the seminars attended 28,237 participants.



Graph 1. Number of participants in seminars

There are 34,400 teachers, educators and other professionals of education (on pre-school, primary and secondary school level) responsible for education in Slovenia (Statistical Office, 2012). 36,495 teachers were included in counselling. So in average every teacher was involved in counselling of e-Education project. It must be taken into consideration, that some teachers attended number of different counselling. 28,237 teachers were participating at seminars. A total number of 64,732 teachers were involved in teacher trainings of e-Education project. The project involves 680 trained advisors who attended 4901 training courses for teacher trainers. We have been planned only 1370 participating teacher trainers. Obviously we succeed to include far more people.



Graph 2. Number of teacher trainers attending training coursers

4.3 Number of Participating Schools and Counselling

There were 1,780 or 99% of all schools in Slovenia included in the project from March 2009 to 31 December 2012. In average there were 8 visits of our consultants and 6 on-line counselling per school. All together we performed 14,500 live counselling and 8,501 on-line counselling. Planned number of teachers, who would be included in counselling, was 7000. Actual or realized number is 36,495.

5. CONCLUSION

We set out the path of informatization of educational institutions in Slovenia. Consequently the process of changing the traditional way of teaching and change of teaching and learning paradigm itself has begun. This is certainly the way that reflects the needs of modern society and the students in it.

The e-Education project is allowing each educational institution to decide and include itself into the project according to their needs and vision. The biggest successes of the project are: clear-cut path to e-competence of professional staff, pedagogical and didactic oriented seminars and counselling, possibility of online independent assessment of e-competencies, developed modern e-learning materials, web portal of Slovene Educational Network SIO and on-going evaluation. It is important to note that schools' demands for such teacher training exceeded our plans and availability. It is especially encouraging that the Ministry of Education has already prepared a new project aimed at 1:1 pedagogy and the development of third generation e-textbook.

The next step would be monitoring effects in schools. Only the observations done in classrooms could prove the effects of project and its impact on the way of teaching and learning.

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COLLABORATIVE TOOLS IN UPPER SECONDARY SCHOOL - WHY?

Helle Mathiasen, professor, Hans-Peter Degn, senior lecturer, Christian Dalsgaard, associate professor, Christian W Bech, head of it/learning-lab and Claus Gregersen, lecturer
Aarhus University, Denmark

ABSTRACT

The paper will discuss potentials of digital media to support student engagement and student production in Danish upper secondary education with a specific focus on group work and collaboration.
With the latest school reform, upper secondary education in Denmark has experienced an increased focus on problem-based and self-governed work of students. The paper is based on a large research project involving 800 students and around 100 teachers from 15 schools. The empirical study is based on observations, interviews with teachers and students from the involved schools and on a survey with answers from 500 students and 65 teachers. Within the period from 2010 to 2011, the involved schools have experimented with new teaching methods and integration of different kinds of digital media. Based on these empirical studies, the paper will discuss how students can utilize digital media to support group work and collaboration, including joint production of digital media. First, the paper briefly will present a system theoretical inspired approach to the key concept of communication, teaching and knowledge construction. Second the empirical method and design from the qualitative and quantitative studies, based on the system theoretical approach will be described. Third, the findings from the qualitative, and quantitative studies will be presented.
The paper concludes that the study demonstrates changes in the way group work is organised by the students using digital media, and a tendency to develop student engagement. Further more the study shows evidence of increased transparency between students and teachers, developments within student roles, a focus on new forms of assignments and potentially exams, and increased openness and sharing among students. Hence innovation trends within digital media usage and developments of teaching methods in Danish secondary education.

KEYWORDS

Teaching, learning, digital media, rethinking teacher/student roles and teaching approaches

1. INTRODUCTION

In Denmark today, upper secondary schools are facing great changes and challenges. The point of departure is based on an empirical study, which is the first in a series of four national studies with a focus on rethinking teaching methods and student activities with use of a range of digital media. The current study ran for two years in the period from 2010-2011, and the school projects covered two or three semesters depending on the schools. The objective of the studies is to examine opportunities and barriers in use of digital media in education, and to contribute to a continuing educational development in upper secondary schools.

The paper is based on the first empirical study and has a focus on the research question: What are the opportunities and barriers in digital media in relation to students' group work and student engagement? The empirical analysis' key concept is communication and the empirical study will examine technologies for communication, collaboration, sharing and production and discuss opportunities and barriers as fare it is possible in this first study. The involved schools have used a wide range of technologies and have chosen different approaches to their individual projects. The consequence is that the study shows a variety of teaching methods and technology use.

2. THE THEORETICAL FRAMEWORK

The theoretical foundation has been constructed on the basis of Niklas Luhmann's systems theory, particularly his concepts of social systems and psychic systems. This system thinking corresponds the way in which we observe the *empirical* study. The coupling of system definition and system characteristics (systems as operative closed, self-creating, self-referential and autonomous) with the concept of communication leads to a thinking, where it is impossible to work with the idea that thoughts can leave persons as thoughts and the idea that knowledge can be transferred (Luhmann, 1995). Thus thoughts, emotions, intuitions and other consciousness activities are observed in the empirical study as *communicative representations*, which have some decisive consequences for, among other things, a discussion of teaching and learning.

2.1 Communication, Teaching and Learning

The concept of communication must be understood in the system-theoretical frame in which systems are operative closed, self-referential and autonomous. Social systems operate in, constitute, reproduce and maintain themselves through communication. For instance, net-mediated discussion forum will maintain itself, if there are persons who constantly take part by writing a contribution, if not the social system (the forum) will slowly "die". Thus, communication is the minor element in social systems, and this minor element is defined as the synthesis of three selections; the selection of information, the selection of utterance, (made by the "utterer") and the selection of understanding (made by the "addressee") (Luhmann, 1992). It takes so to speak two to tango - the point of departure of the empirical study. Observation that involves distinction and indication is another central concept. (Luhmann, 1998, Spencer-Brown, 1969, p. 3). Multitasking e.g. will not be an option in this theoretical lens. All observations are system internal operations, cf. the system characteristics above. Thus, Luhmann calls his form of constructivism for *operative constructivism*. The communicator, the utterer, undertakes the selection of information and the selection of utterance, and the addressee undertakes the selection of understanding (Luhmann, 1995, p.141). The utterer and the addressee is called psychic systems, and these operate in and maintain themselves via consciousness activities (thoughts, emotions, intuitions etc.) which are activities we do not have direct access to, cf. the point that thoughts etc. are communicative representations. We have to make our own construction/interpretation of the uttered information by the utterer. This is presumably a truism for most educators, however the educational system often acts like the transfer model of knowledge is still working. Psychic systems are as well as social systems based on meaning, implying that they choose to actualise something and let other things rest. Based on the system characteristics already mentioned, the result is that in principle the individual system's unique selection decides what the system chooses to actualise. That includes us, as researchers, when we observe e.g. students' communication every observation is dependent on the observer. For instance the assumption that when a teacher has presented a lesson, all the students have understood the same is risky business in the presented theoretical frame, since the individual student often has no possibility of controlling comprehension, if all communication is one-way communication from teacher to student. Therefore it is more likely, with the systems theoretical approach, that each student has chosen his/her own understanding, which is not necessarily the same understanding as the teacher- and his/hers intention concerning the students' knowledge constructions. In short, it's all about communication and the premises for communication, when the intention is to facilitate knowledge construction. That is why we have chosen to focus on students' use of digital media and related activities concerning group work settings.

The concept of teaching is regarded as communication that intends a change of person, in the sense that the knowledge construction may be possible - not that it will happen per se (Luhmann, 1995). The teaching environment can be considered the perturbing activity with the intention of activating knowledge construction. The characteristics of the concept of teaching has to be add a very important detail, namely that teaching is a concept not only concerning a traditional teacher-student relation. Students collaboration with student e.g. in groups we will call teaching as well as feedback processes, guidance, direction and supervision. This is the point of departure when it concerns the selection of the methodological design of the empirical study and the subsequent analysis.

In this concept learning is defined as the construction of individual mental constructions, while teaching is understood as a special form of communication intended to bring about change. In brief, the result of learning is knowledge construction. According to the system's characteristics teaching and learning are two different modes attributed to respectively social systems and psychic systems and important, teaching and learning are considered mutually dependent (Mathiasen, 2008).

3. THE EMPIRICAL DESIGN

The study includes a variety of different teaching methods. In this paper we focus on students activities when they work in groups, sometimes characterised by being problem based and self-governed by the students sometimes based on tasks set up by the teacher. The different kind of group work settings gives different premises for learning activities. Hence you can approach the concept of group work as a progression from "task set up by teacher" to "self-governed problem based project work". This study will not focus on the different types of group work, but centre around communication facilitated by a variety of digital media used in the group work, seen as a superordinate term. Further more - in consequence of teaching methods involving students and the expectation of students' self-governed activities - the teacher roles changes and generation of corresponding teacher roles is observed, e.g. moderator, discussion partner, adviser, supervisor, mentor, counsellor etc. (Mathiasen, 2005). The empirical study was carried out on the basis of consecutive research design inspired by systems theory. Data collection methods: Observations, group interviews, questionnaires and questions asked in plenary sessions.

3.1 The Qualitative Part of the Study

This part includes observations of the communication face-to face and the web-mediated communication in different web-based forums used by the students during the group work. Furthermore, the empirical study includes two 45 minutes group interviews at each school, with 4-6 students and 4-6 teachers respectively. The students were selected by teachers from the school project to participate in the group interview. The criteria was to pick out students that covered a certain broadness of approaches to "being an upper secondary school student" and their use of IT in relation to the project. The researchers' school visits were organised by the same model for all school projects. A meeting with teachers in the specific project and some representatives from the management group, then observation in class, observation of communication, use of IT in different teaching settings, followed by student and teacher group interviews respectively, based on the presented research question and formed as a semi-structured questionnaire (Patton, 1990). Observation notes and transcribed interviews have – along with written comments from the questionnaires – been the qualitative foundation for the thematic analyses.

3.2 The Quantitative Part of the Study

Our study's survey design consists of a questionnaire distributed to the teachers involved in the specific school project and a more or less similar questionnaire for the students involved. The two questionnaires are developed on the basis of common guidelines and standards for survey design and construction of questions (e.g. de Vaus 2002, Bradburn, Sudmand and Wansink 2004, de Leeuw, Hox and Dillman 2008, Tourangeau, Rips and Rasinski 2000, Schuman and Presser 1996 and Foddy 1994). At first, these two questionnaires identify which IT tools have been used – and to what extent – in teaching related activities. Hereafter, the main purpose of the survey is to describe the potential for using the applied IT tools in relation to a variety of teaching methods, learning tasks etc. from student and teacher perspectives.

To ensure reliability and validity the phrasing of the actual questions in the questionnaires were tested on a test group of students and teachers. The combined test consisted of observations during the filling in of the questionnaire combined with "thinking-aloud" test and a follow up "probing" test (cf. Beatty & Willis, 2007). On the basis of the conducted test a slightly revised version of the two questionnaires were distributed via Internet (mainly e-mail) to the classes involved in the project. All the involved schools were asked to work out contact lists with e-mail addresses on the involved students and teachers.

3.3 The Applicability of the Quantitative Data

A shade under half of the informants completed the questionnaire. Due to the quite varying – and far from optimal – response rates it is obvious that we cannot generalize broadly on basis of these quantitative data. In addition to this, premises, goals and settings for the participating school projects are quite differentiated and thereby difficult to compare. Yet the quantitative data can provide us with some indications. Keeping the above mentioned points and reservations in mind it is our judgment that the survey, however, gives a useful description of the examined components for pointing out interesting tendencies to follow up upon in the upcoming second, third and fourth round of the research project.

4. NEW TECHNOLOGIES FOR GROUP WORK- EMPIRICAL FINDINGS

The study has examined teachers' and students' experiences with a range of digital media in relation to different teaching methods. The study shows a clear tendency that both teachers and students give certain types of digital media a very positive evaluation in relation to group work. In the study the theme collaboration within group work were highlighted by students and teachers as methods that are especially supported by digital media. This is both supported by the qualitative and the quantitative studies.

4.1 Technologies and Potential - Student Activities

In the quantitative study teachers were asked their opinion on the overall potentials of technologies and digital media in relation to different teaching methods. Teachers found that technologies have a large potential to support the activities of students, and that technologies were able to increase student activity.

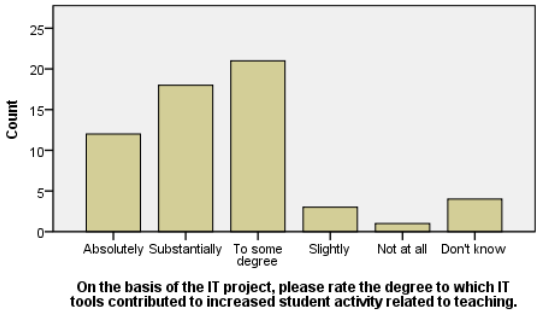

Figure 1. Teacher ratings of IT tools in support of increased student activity.

The qualitative interviews confirm this opinion from the survey. Concerning the general conclusion on the potentials of digital media to support group work of students, two teachers from different schools made the following statements: "It is evident that the technologies support collaborative working methods" and "Work similar to project work is promoted enormously". In the quantitative survey, teachers were also asked to evaluate a number of specific used technologies (such as Google Docs, TypeWith.me, Fronter, Blackboard, interactive whiteboards) in relation to different teaching methods. The teachers evaluated Fronter, FirstClass, Google Docs and Skype as the most useful technologies to support students' group and project work. Students evaluated Dropbox, Fronter, Google Docs, TypeWith.me, e-books, and Wikipedia as the most useful technologies to support their group and project work.

4.2 Evaluation of Specific Technologies

The survey asked students and teachers to rate a wide range of technologies in relation to different teaching methods. Students and teachers were only asked to rate technologies that they had experiences with in their own classes. This section will focus on the technologies that were rated as the most useful regarding group work. These were Google Docs, Dropbox, typewith.me, Facebook, and wikies. Teachers were asked to rate

each technology within each teaching method on the following scale: Absolutely necessary / Large potential / Some potential / Limited potential / No potential. Similarly, students rated the technologies based on the following scale: Always useful / Often useful / Sometimes useful / Rarely useful / Not useful.

In the presentation of the findings, we have contrasted both teachers' and students' ratings in relation to group work with the ratings in relation to individual work. Google Docs was used by a large number of schools. Findings show that both students and teachers see Google Docs as a useful technology for both group work and individual work. However, it is also evident that the potential for group work is larger. From the interviews we have learned that some of the more sceptical users have experienced problems of accessibility and speed when using and collaborating in Google Docs.

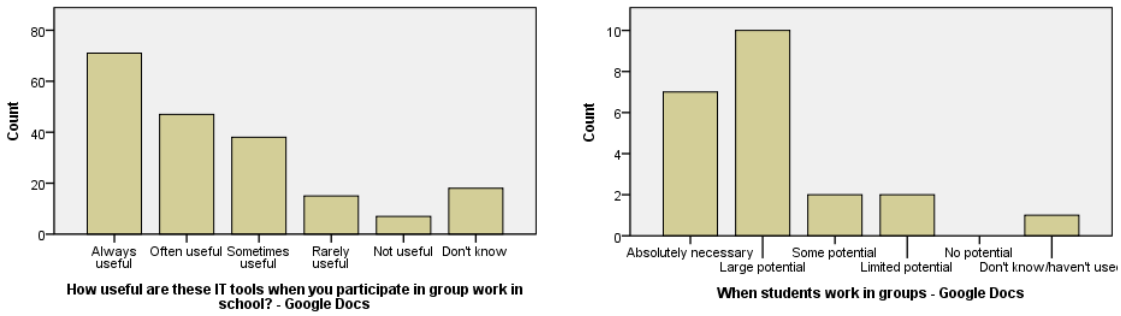

Figure 2. Student (left) and teacher (right) ratings of Google Docs, group work

The evaluation of wikis is not clear-cut, and the difference between potentials of group work and individual work is small.

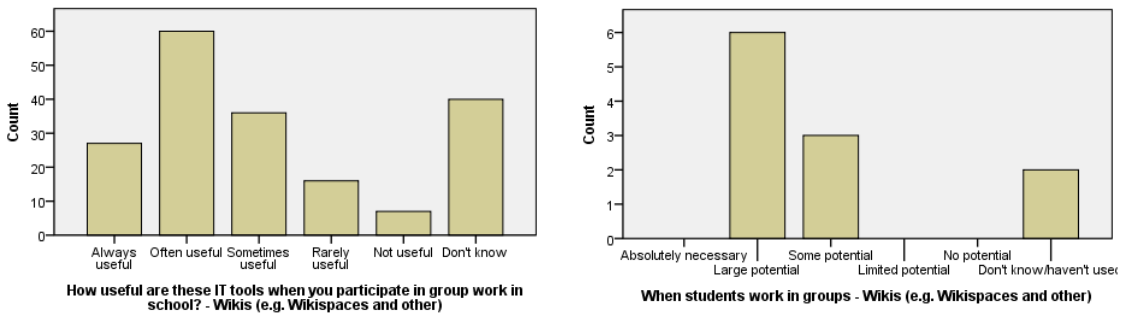

Figure 3.Student (left) and teacher (right) ratings of Wikis, group work

Dropbox has been widely used by many students and teachers. The majority of both students and teachers see Dropbox as a very useful technology both for group work and individual work.

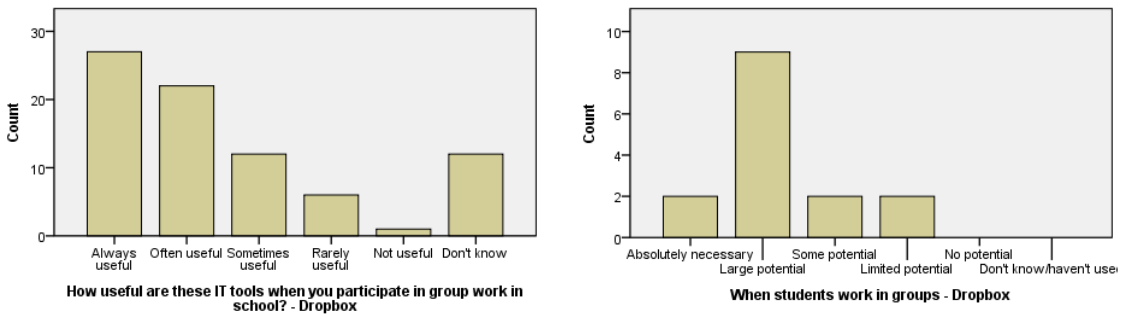

Figure 4. Student (left) and teacher (right) ratings of Dropbox, group work

TypeWith.me has been used by fewer students and teachers compared to the previous technologies, but a clear difference is seen between the evaluations in relation to group and individual work. Especially the students evaluate TypeWith.me to be very useful for group work, whereas the potential for individual work is more mixed. The same trend is seen in the teachers' assessment, however not so clear.

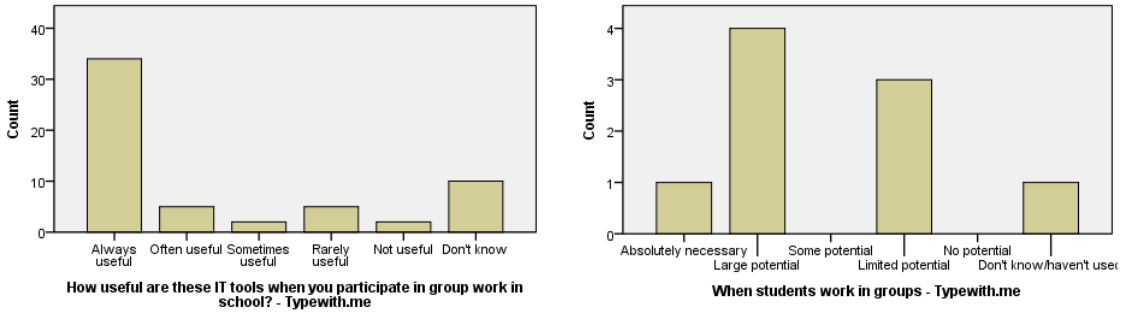

Figure 5. Student (left) and teacher (right) ratings of TypeWith.me, group work

The final technology we wish to present is Facebook. It is interesting that despite the criticism of Facebook for being a distractive element in school, many teachers believe that Facebook can be a useful technology - especially in relation to group work. The numbers from the students are more mixed, but a majority also believed that Facebook is a useful technology for schoolwork, and also among students, Facebook is believed to have a larger potential for group work than for individual work. The qualitative study confirms these findings. Although students and teachers are very aware of the distractive element of Facebook in class, it is also evident that students utilise Facebook for schoolwork both in and outside school hours.

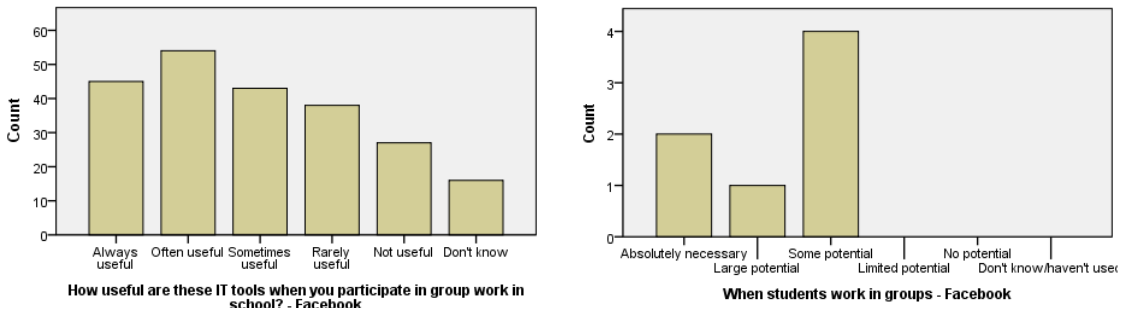

Figure 6. Student (left) and teacher (right) ratings of Facebook, group work

From the interviews we learned that both students and teachers observed Facebook as a two-edged sword, given that Facebook invites students to non-teaching activities, when the intention is to participate 100% in the group work.

4.3 How do Technologies Change Group Work?

In an interview, a teacher stated very clearly that it was his experience that the technologies helped change group work in a way that engaged the students more than usually. The prior experience was that group work invites the motivated students to do what is intended. Below we will expand on this by going into depth with the findings from the qualitative study with a focus on group work.

4.3.1 New Forms of Collaboration

Especially the use of collaborative tools (such as Google Docs and TypeWith.me) has contributed to qualitatively new ways of "contribution approaches" to group work. Several school projects have shown an extensive use of tools for student communication and collaboration. Technologies have been used both for collaboration at a distance (all students with own computer), and for group work in class. Collaborative tools

such as Google Docs and TypeWith.me have changed students' group work. Before the introduction of these tools, students would normally sit around the same computer, and one of the students would control the keyboard. As a teacher pointed out, oftentimes the consequence of this kind of group work is that several students do not participate actively in the group work.

In many of the school projects, use of collaborative tools has contributed to closer collaboration within group work, because students can work on shared documents synchronously. However, this development does not mean that division of work no longer exists. Using the same collaborative tools, some students divide their work whereas others work closely together. It is the general conclusion of the students that using the collaborative tools gives them a better insight into the work of the other group members. Further, the students have experienced that they inspires by reading the group work texts produced by fellow students in the group work. The project schools have experienced that the technology has brought new elements to group work. The collaborative tools have become a natural part of the daily work of many students. They use TypeWith.me and Google Docs, they chat and use Skype in their group work (at home and in school).

"For instance, when working in groups, we divide the work between us, and then we use our own PC and share - in this case - a spread sheet. It was great, instead of just one of us at the computer, whereas the rest of us would sit around the screen watching" (student)

A teacher stresses the same trend: "The most important advantage is that the technologies have contributed to more active group work. Without the technologies, oftentimes 75 % of the students do not contribute to the group work." A general conclusion regarding group work in school is that most students are activated in front of their own computer, and that the former trend, cf. both teachers and students, in group work that only a few students did most of the work, is reduced. Although students may still divide the work between them, all students contribute, not least because the technologies make it very visible what each student has contributed with.

4.3.2 Increased Transparency between Students and Teachers

Findings from the school projects show that collaboration and sharing tools can support transparency in students' schoolwork. The tools support new forms of transparency in between students and between students and teachers. Students' activities and products are made visible to fellow students and to teachers to a greater extent than previously. Several schools show examples of students using each other's productions and writings for reflection and inspiration. Not all students use the works of other students, but several students state that they have benefited from reading works and drafts of fellow students.

Not only final productions are made visible to the class. Also, the process itself is made transparent through the technologies. Through the sharing of documents between students and teachers, it is not only possible for students to follow the work-in-progress, but it is also possible for the teachers to take part in the process. There is so to speak new and fruitful conditions for the communication. Teachers can follow the group and individual work of students as it happens - both in school and outside school. It is made easier for teachers to take an active part in the group work and provide feedback in the process instead of afterwards. Both teachers and students have experienced that feedback during the process is more fruitful than feedback on the final product. A teacher states "Everyone can see the work from all the groups. They can see each others' work and get inspired by it". Students have the same experience, and they emphasise that the collaborative tools provide opportunities for students to get inspiration from each other - also between groups. As a student states: "It was easier to see the writings of the others and to get ideas from others, when they wrote something useful". Several students from different schools state that they have used the writings of other groups for help on how to solve new problems and assignments. They have not found the direct answers, but they have seen new perspectives on solving problems and writing assignments.

According to several teachers, an important consequence of the collaborative tools and the increased transparency in class is that it has become more difficult for students to hide themselves. The positive perspective on this is that teachers may be more likely to identify the students with academic problems. On the other hand, students who are insecure about their productions, writings and assignments do not welcome this kind of transparent group work. The involved schools have different experiences with increased transparency. Some schools have developed a transparent culture where sharing and openness is widely accepted. Other schools experience resistance from some students who do not wish to share, either because they feel intimidated by letting other see their work, or because they want to keep their supposedly brilliant ideas and points for themselves, cf. interviews with both teachers and students.

4.3.3 Working on New Forms of Products

Traditionally, group work in upper secondary education in Denmark consists of written papers and reports. Media production and IT tools thus increase the possibility of the diversification of producing presentations or reports. The result of this diversification may also be that quiet and shy students will be more active.
“The use of video supports another kind of students. Another range of students become active and is suddenly able to do a lot more, students who are not normally visible. That's quite clear” (teacher).

There is a reported valuable outcome of producing audio and video in foreign language education. As one teacher states: “Submission of audio is some kind of a revolution. It's obvious. There's no discussion about it: It's a definite improvement.” (teacher). Submission of audio and video trains and demonstrates the students' verbal skills. A Spanish language teacher concludes that the students speak more freely and fluently than in class: "It has provided a verbal freedom. They use their manuscripts as support and security but they express themselves more freely." One school experimented with using the students’ knowledge of media production in the form of video, screencasts, blogs, and websites in order to stimulate student activation and group oriented work. In two foreign language classes - English and Spanish - video production was a major part of the practical training of spoken language. In Spanish the writing and staging of a play were assigned to groups of students. As the teacher intended, the students shifted focus from reading a text to performing a play, thus creating fluency in pronunciation. A majority of the groups chose to stage their plays with puppets and with the students performing the dialogue. According to the teacher and the students the off-camera position made the students speak freely and subsequently they moved from reading to performing.

An unequivocal conclusion on the academic benefit of media production has not been reached. However, a vast majority of students state in interviews that media production e.g. screencasts, video, and websites forces them to work with and understand the substance of the curriculum. Likewise, the teachers regard media production as a success considering the activating nature of working with media.

4.3.4 A Change in Student Approach to Group Work

The qualitative study has shown that the new forms of group work bring challenges to student qualifications. It is also evident that some students do not prefer these ways of working but wanted to reduce the complexity, and preferred the traditional teacher and student roles and settings. Increased use of group work demands that students possess i.a. self-discipline and are able to carry out self-governed activities. However, it is the experience of several teachers, that successful group work has a positive influence on students’ participation, engagement, responsibility and motivation.

Several teachers have experienced that students are more likely to share their work with fellow students. In some schools this has contributed to a change in student culture towards more openness. A side effect of the open culture is that students often put more effort into their products, when they know beforehand that the products are shared with the rest of the students.

5. CONCLUSION

The study has shown that utilisation of digital media can support new forms of group work and can contribute to a higher level of student activity within group work. The quantitative survey pointed towards specific technologies that are rated very valuable for students’ group work. The paper has highlighted the potentials of digital media to support synchronous collaboration within groups and to support transparency between students - and between students and teachers – with a collaboration lens and not a control lens. The paper has also highlighted barriers that relate to transparency; some students do not like to share their work with fellow students. Finally, the study has shown that an extensive use of teaching methods based on students’ self-governed and collaborative activities demands that students possess qualifications and competences such as self-discipline, responsibility and interpersonal skills.

These conclusions tell about opportunities and challenges for future upper secondary schools. The increased focus on student collaboration and self-governed group work combined with utilisation of digital media poses a challenge for teachers' roles and pedagogical competences using digital media. The empirical study is followed by three projects of a similar nature. These projects are expected to contribute with more knowledge concerning both students’ and teachers’ roles and functions and relations between different teacher and student roles, in new forms of teaching and student activity utilising digital media.

The study points towards a number of central keywords for a movement in Danish upper secondary education with use of technology. Especially collaborative work has been highlighted as a focal area of attention. It is not only a matter of increased group work, but also a change in the form. Students are collaborating more closely, and teachers are able to follow the collaborative process of the students more closely. At the same time, several schools are experiencing higher degrees of transparency, openness and sharing among students. Hence it is about an innovative development of the educational culture.

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ADAPTATION OF EDUCATIONAL TEXT TO AN OPEN INTERACTIVE LEARNING SYSTEM: A CASE STUDY FOR RETUDIS

M. Samarakou, E.D. Fylladitakis, G. Tsaganou, J. Gelegenis, D. Karolidis, P. Prentakis and A. Papadakis
Department of Energy Technology
Technological Educational Institute (T.E.I.) of Athens
Ag. Spyridonos, 12210, Aegaleo, Greece

ABSTRACT

Theoretical education is mainly based on university text-books, which usually include texts not structured according to any theory of text comprehension. Structuring a text is a demanding process. Text should be organized and structured in order to include descriptions on micro and macro-level representation of the knowledge domain. Since this is difficult, diagnosis of text comprehension can lie heavily on the construction of the appropriate questions and dialogue structure about a not structured text. This may also affect students' performance on laboratory education. Whereas traditional educational systems infer the reasons for the student's behavior without directly involving the student, current educational systems, supported by interactive learning programs, attempt to involve students in the process of diagnosis. This paper presents the adaptation process of a non-structured text to ReTuDiS, an open interactive learning system which is being experimentally used today as an diagnostic, profiling and support system for undergraduate students.

KEYWORDS

Text adaptation; interactive learning environment; cognitive theory; student profiling; computer-assisted education.

1. INTRODUCTION

ReTuDiS (Reflective Tutorial Dialogue System) is an open interactive learning system for reading comprehension based on the theory of text comprehension Denhière & Baudet (Denhière and Baudet 1992) and dialogue theory (Collins and Beranek 1986).

The theory of Denhiere & Baudet on text comprehension (Denhière and Baudet 1992) argues that text comprehension implies the understanding of fundamental cognitive categories. When a reader tries to comprehend a text constructs a representation structure in an attempt to reconstruct the world represented in the text. In this representation the key role lies on cognitive categories, the person, the situation, events, acts, as well as the temporal, causal relations and part-whole relationships connecting these structures representation. The term "person" is being used for entities involved in the structure representation. The term "situation" describes the state of non-existence of a change over time. The term "event" describes an action that causes a change but not from humans. The event may be coincidental or caused by a non-human entity, e.g. from a machine. The term "act" is an action that causes a change but which was due to an interaction and or input of a human. The researchers argue that a reader who wishes to explain the operation of a technical system constructs a representation of the "natural flow of things", where each new event may be causally explained by the circumstances and effects of the events that have already happened.

In a survey conducted Baudet & Denhiere themselves (Collins and Beranek 1986), the effect of the structure of a technical text on the comprehension of a technical school by the students was being examined. Three different groups of students were given two properly configured texts that refer to the operation of a car's starter. The two texts are structured differently. The first of these determines the relations and states of different units together and then defines a sequence of events linking these events temporally and causally (microstructure). The second text provides a hierarchical structure of subsystems and uses between these

subsystems links expressing the purpose of these relations (macrostructure). The researchers find that the text which refers to the temporal and causal connection of units helped on the better comprehension of the text.

The theory of Collins (Collins and Beranek 1986) is related to the objectives and dialogue strategies used by instructors when students ask questions, in order to: a) the teaching of a subject and b) the teaching of scientific thinking. The dialogue is used to serve both of these two purposes of teaching. The trainers are not trying to teach concepts, but bring them within the context of the theory of a subject. According to Collins, questions that can feed a dialogue in order to achieve these objectives can follow the following strategies:

1. Selection of positive and negative examples.
2. Case (or Comparative) Selection.
3. Selection of alternative examples.
4. Production hypothetical cases.
5. Generation of forecasts / assumptions by the student.
6. Verification cases.
7. Student entrapment.
8. Detection of consequences to a contradiction.
9. Supervision when submitting questions.

2. RETUDIS LEARNING SYSTEM DESCRIPTION

The learning environment ReTuDiS includes a diagnostic and interactive section.

Diagnostic section: In the educational environment of ReTuDiS the student answers a series of questions assessing general prior knowledge (diagnostic tests) in a specific module in the subject of Informatics, choosing from the list of answers given. The questions are designed to explore, according to text comprehension theory, the comprehension of cognitive categories: people, situations and events, comprehension of causal relations between events and situations and understanding the objectives and sub-objectives of the system for which the particular system was designed for (Tsaganou and Grigoriadou 2008, Self 1993). Based on the responses of the student, ReTuDiS outputs the cognitive profile of the prior knowledge of the student (Caillies et al. 2002, Bull and Nghiem 2002).

Interactive part: Based on the cognitive profile of the learner, the interactive part of the RETUDIS provides personalized activities on one or more of the three built versions of a text, alongside with questions and possible answers, as well as feedback. The three versions of text that includes each module are R (Relational), M (Transformative) and T (Teleological).

R (Relational) text describes a document and questions which focus on simple descriptions of the part-whole relations of the system described in the document, as well as on descriptions of the processes, event and system status. (Due to its short, concise sentences and detailed text, the relational text is usually better for weaker students and beginners).

M (Transformative) text designates a document and questions which are focused on describing the sequence of events and the state to state transitions of the system. (The transformative text assumes some basic educational background but describes the system events in detail, therefore is usually more suitable for average students).

T (Teleological) text is focused on detailed descriptions of the objectives and sub-objectives for which the system has been constructed, or of the events and mechanisms which take place within a system. (The teleological text jumps to the results and conclusions without a thorough analysis of the system's events, usually assuming a strong educational background and therefore is typically preferred by advanced students).

After reading the text and answer the questions the system diagnosis / assessment is presented to the student and he/she is asked to engage in dialogue with the system in order to revise the student discrepancies or incorrect answers. The student is guided through the construction of more coherent arguments in text comprehension.

3. ADAPTATION OF EDUCATIONAL MATERIAL TO RETUDIS

The following example, on the subject of: "Computer Network Technology", describes how to adapt standard theoretical literature texts and technical documents to those required by the system RETUDIS, or other similar educational systems, for the education of informatics students.

3.1 Cognitive Category Types

In a text that describes the function of local network computers, the following categories based on the cognitive theory of comprehension Denhière & Baudet (1992) may be displayed:

Individuals are the units of the network nodes, computers, servers, allocators, coaxial cables, the operator of the site, etc. For some units synonyms are used, such as channel, pathway and pipeline crossings.

States in the local network is the "idle state" of the network, i.e. the time that no information is being transmitted, and the "transmission mode", i.e. the time during which information is being transmitted.

Act refers to the state when a node sends another message to the bus in order to communicate with another node. Pressing the "send" button by the operator to initiate the message from a sender node to another network node recipient is a human act. (Not mentioned in the text - implied act). This operation initiates a sequence of events in the sender node.

Events occurring after the act are in chronological order:

1-dividing of the message information in packets

2-attach control information in each packet

3-attempt to capture the transmission medium (channel) for transmission

4-packet transmission

5-new attempt to capture the channel after a while, if the first attempt fails

6-collision of packets sent by two nodes etc.

Random event, which it can be an unpredictable power outage or any other unforeseen event.

Temporal and causal relationships are relationships between events in a sequence of events. For example, if the attempted capture of the channel is successful (event 3), this results in the transmission of the packet (event 4) (causal, and therefore, also a temporal relationship).

Part-whole relations. To send a message, it is being divided into packets from the sender node using a specific model defined by the node. Each packet belongs exclusively to a message. Part-whole relations are those which form a sequence of events and that their integration is a new event, such as sending the entire message when finished sending the packets that were divided.

Micro-level. At micro-level, the student who reads the text regarding the functions of LAN computers, the microstructure gradually builds a representation of the text, defining the units of the network, in which situations the network operates, which events are causing the amendments to the conditions described by the text. The student also fabricates temporal and causal relationships and the part-whole relations connecting these structures.

Macro-level. The following extract of text describes how the local computer network operates: "The control information attached to a package are necessary because they allow the correct routing of the packet into the network, so as to arrive at the right destination. Finding the shortest path interconnecting any two network nodes is the problem of routing". The purpose for which the control information is being attached to a packet is the secure transmission. Finding the shortest path is designed to optimize the transmission speed. To reach an objective individual events occur in order to achieve a sub-objective. These events cause changes to the state of the network and each change is to achieve a purpose. To fabricate the macrostructure, the reader should be able to reconstruct the microstructure of situations (e.g. why the network changes from transmission to idle mode) and sequence of events (for what purpose each event occurs) and part-whole relations (why a series of individual events has to be completed) to reach the predetermined purpose (all this done with secure and fast communication in mind).

3.2 Text Structure

The structure of a text describing a technical system, such as the operation of a local computer network, must enable the reader to fabricate representations of microstructure and macrostructure of the system (Grigoriadou and Tsaganou 2007). Specifically, the text should provide the following descriptions of the microstructure:

a) description of the units that compose the system which the text describes (R)
b) description of the part-whole relations connecting the units in the system together (R)
c) description of static situations where they can find the units of the system (R)
d) description of events and complex sequences (consisting of sequences of events) and performed in units of the system (M)
e) description of causal and temporal relationships between events and changes that cause the static states of the system (M)
f) description of the part-whole relationships between events, which means the hierarchy between them (M)

Also, the text should provide the following description of the macro-structure of the representation of the subject:

g) a description of the system through a tree of objectives / sub-objectives for each transition of the system from one steady state to another (T)

3.3 Interactive Activities Structure

The following activities are structured in three categories based on the above theory of comprehension and related technical document which describe the system of the local computer network (Tsaganou & Grigoriadou, 2010, Brookshear, 2005).

1. Relational structure activities. These include descriptive questions of the: a) units which compose the system that the text describes, b) Part-whole relationships that connect the units of the system, c) the situations in which the system may be found. For example: In the text there is a description of the units of the network (e.g. hubs, cables), all individual relationships (e.g. broadcast medium connecting two nodes), a description of situations which may a network be at (e.g. data transmission mode, idle) and a description of occurring events (e.g. packetization data, attach control information, etc.).

2. Transformational structure activities. These include descriptive questions of: a) the functions which are carried out by events in the units of the system, b) the causal and temporal relationships between events and the changes which they cause to the state of the system c) Part-whole relations between events, i.e. the hierarchy between them. For example: In the text there is a description of a basic operation of the network, which is the data transmission and description of the series of events related to this, as well as the states in which the network sequentially switches to, the part-whole relationship between events (transmission ends when a series of events is completed in order to make the reconstruction of the message by the recipient).

3. Teleological structure activities. These include questions which describe the system through a tree of objectives / sub- objectives for each transition of the system from one state to another. For example: In the text there is a description of sub-objectives and objectives which need to be achieved. The aim the secure transmission and for this reason control information is being attached. Another aim is the rapid transmission and that is why packets are being routed. Another goal is to serve the greatest possible number of users with the least possible resource cost, which requires a study of factors affecting network performance.

4. RETUDIS LEARNING ENVIRONMENT: TYPES OF QUESTIONS

For each of the categories described in the previous paragraph, the following types of questions are being suggested:

1. Questions with alternative answers.

2. Question-pairs with alternative answers: The first question of the pair (regarding a position) requests the student to take a position on an issue. The second question of the pair (concerning justification) asks the student to justify his/her position on the issue.

3. Categorizing entities: The student is asked to identify the units described in the text which form part-whole relationships and make the appropriate connections so as to describe the relationship between the units. An example of a question regarding categorizing entities which refer to a text based on a relational description is as follows: "The following terms which are being encountered in the text are given. Group these terms into groups with common characteristics and name each group. The terms of each group should have a part-whole relation to each other".

4. Classifying events in a sequence: The student is asked to categorize events or functions in a sequence as some of them are misplaced causally or temporally in the list given. An example of a question requesting the classification of events which may be implemented to a text based on a teleological description is as follows: "A list is given with the steps of a functions sequence required to reach an objective shuffled. Rewrite the list following the correct events sequence.

5. Completing events in a sequence: The student is required to complete events or situations that are missing in a sequence which represents a function.

5. EXAMPLES OF ACTIVITIES

5.1 Example 1

Activity on categorizing entities which are being mentioned in relational (R) text. Title: "Recognizing the parts of a local network".

The following terms are encountered in the text: twisted pair cables, connectors, computer, coaxial cables, connectors, fiber optic terminations. Groups these terms in these categories: Nodes, Transmission, Adaptive Material. This grouping shows the relations part-whole terms with groups.

5.2 Example 2

Filling activity on events sequence which are being mentioned in transformative (M) text. Title: "LAN operation during packet transmission".

In a network channel which is at an initial state, occurs a sequence of events linked causally and temporally, as well as with part-whole relationships which are leading to the change of the state of the network. The following table shows the sequence of events that occur when sending a message from the transmission node to the receiver node, which is the system's default.

Fill in the missing events (steps 4, 6 and 8) by selecting from the list below:

1. Initial (idle) state: The network is idling before the packet transmission.
2. Act: The user of the transmission node requests the delivery of a package to the receiving node by pressing the "send" button.
3. Event 1: The transmission node divides the package into packets, based on the privileges it has according to the network configuration.
4. Event 2: ……..
5. Event 3: The transmission node checks to see whether the channel is available and no other node transmits a package, in order to avoid collisions.
6. Transmission state: ……
7. Event 5: Comparison of the delivery address of the transmitted package with the address of the first node.
8. Event 6: …….....
9. Event 7: Comparison of the delivery address of the transmitted package with the address of the next node.
10. Event 8: The delivery address of the package coincides with the address of the receiver node and the package is being copied.
11. Final state (idle): Idle network, after the transmission of the package.

Selection of answers:

1. Forwarding of the packet to the next node.
2. The transmission node attaches the destination address in each packet.
3. The network channel is free for packet transmission to both directions of the channel.

5.3 Example 3

Activity of completing the missing parts of a document which refers to a teleological (T) educational text. Title: "Sending a message in a local network – Objectives and sub-objectives tree".

In this example we have the tree of objectives and sub-objectives when sending a message via the local computer network topology bus. The corresponding events or sequences of events in order to realize these objectives may also be seen.

Suppose that the local network contains three nodes (1, 2 and 3) and the message is sent from node 1 in order to be received by the node 2. The message is broken into 2 packages. Fill the gaps in the table 1 below with events listed in the following list given, considering the sub-objective to which they relate and the causal links between sub-objectives with events and situations.

Table 1. Teleological text activity example

Objectives & Sub-Objectives (Macro-level)		**Actions, states, events (Micro-level)**
Objective: Send a message between two network nodes	Idle state	Network idle
	Action	User presses the send button
Sub-objective 1: Improvement of transmission speed	Event 1	*Blank*
Sub-objective 2: Transmission security	Event 2	Package addressing
Sub-objective 3: Control of network traffic	Event 3	*Blank*
	Transmission mode (active network)	Transmission via the free channel
	Event 4	*Blank*
	Event 5	Copy package A to node 1 if it has the required address attached.
	Or	Or
	Event 6	Forwarding of package A to node 2 if it does not has the required address attached
Sub-objective 4: Return to the original state	Idle state	Network Idle after package transmission

Selection of answers:

1. Comparison of the addresses attached to the packet A and the receiving node 1.
2. Checking if a node transmits a packet via the bus at the moment. If not, then the packet is sent, otherwise postpone.
3. Dividing the message in packets A and B.

6. CONCLUSION

In this paper the procedure for the adaptation of an educational text to an open interactive learning environment and in line with known text reading comprehension and dialog theories has been presented. Although the examples covered a specific module and questions, the method can be used for the adaptation of virtually any educational text, especially technical documents, to the environment of RETUDIS or, with adaptations, to other similar interactive learning environments as well.

Via the answers given by the students and their cognitive profile formed by the system, it is possible to offer personalized support which bases its recommendations on the performance of the student. This

approach goes beyond the common "one-size-fits-all" approach which dominates education today and can be nullified via advanced learning environments.

The methodology described in this study has been used to adapt the educational texts of the module "Computer Network Technology", which is today taught in the department of informatics and telecommunications of the University of Athens. The module adapted to RETUDIS has been successfully used for a semester with very positive results, allowing the research team to assess the capabilities of the system, troubleshoot potential problems and, ultimately, vastly improve the system. Educational material from several different modules which are taught in four different academic institutions and in two different languages is now being adapted to RETUDIS, as extensive further testing and research is scheduled to take place starting from the following academic year.

It is noteworthy to mention that an open interactive learning environment is that the student participates in the construction of his/her own cognitive model, which opens an unexplored area of research, that of open learner modeling.

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USING PODCASTS IN DISTANCE EDUCATION

Herman Koppelman
Open University of The Netherlands
PO Box 2960, 6401 DL Heerlen, The Netherlands

ABSTRACT

This paper discusses three possible ways of applying podcasts in distance education: podcasts of recordings of virtual classes, podcasts produced for specific pedagogical aims, and podcasts produced by external organizations. Through a survey we gained insight in the (until now limited) experiences of our distant students with podcasts, and also in their preferences for future applications in education. Findings indicate that students prefer podcasts that can make them study as efficiently as possible, such as podcasts with explanations of hard topics, illustrations of subject matter and feedback on assignments. Recorded virtual classes and podcasts with elective subject matter are less popular. It is claimed in literature that podcasts in which students can see and hear their instructor can reduce feelings of isolation and increase feelings of connectedness. There are no indications that our students have a distinct preference for such podcasts.

KEYWORDS

Distance education, podcasting, virtual class, pedagogical strategy.

1. INTRODUCTION

In recent years, the use of podcasts has increased dramatically in many fields, among them education. The most basic use in higher education is to capture live lectures in face-to-face education, and to upload them as podcasts. But podcasts can serve several other educational functions, as one can read in research studies and practitioners reports.

The focus in this paper is upon the potential use of podcasting in distance education. There are claims that podcasting can have considerable benefits for distance education students. In the cognitive domain, podcasts can be effective for clarifying and enhancing understanding of subject material, especially because it is believed that a combination of different communication media can be beneficial for the learning process of many students (Fernandez et al, 2009). Very promising, especially for distance education students, is the claim that use of podcasting also can have positive effects in the affective domain. It could reduce feelings of isolation and make students feel more connected to fellow students and instructors, and thereby increase the students' motivation (Lee & Chan, 2007).

The objective of this paper is to identify current and potential uses of educational podcasts as a medium in distance education. The results could assist educators in making decisions where and how to best use podcasting in their courses. This paper focuses specifically upon two questions:

- What are promising ways of applying podcasts in distance education?
- What are the experiences of distance education students with the current use of podcasts, and what are their expectations of potential uses?

In literature, one can find numerous reports describing experiences with educational podcasting, mainly in the context of face-to-face education. Based upon those experiences we identify in this paper a number of promising ways to use this technology in distance education. To answer the second question, we collected information from our students by distributing a survey among them. These students are enrolled in courses of the Computer Science department of the Open University of The Netherlands which offers only distance education. The survey asked the students about their experiences with the current use of educational podcasts and about their interest in potential applications of podcasts.

For a meaningful discussion about using podcasting in education, one needs a way of categorizing such podcasts. Several categorizations and taxonomies can be found in literature; see Heilesen (2010) for a discussion. As can be expected in a just emerging practice, they tend to be tentative and incomplete. In this paper we use the categorization of Figure 1. It closely resembles the one described by Hew (2009) which in turn is based upon the categorization of Rosell-Aguilar (2007). We chose this categorization, because it is suitable for our practical objective of structuring the domain from the point of view of educators who consider the use of podcast in education.

This categorization divides podcasts in two main categories: podcasts produced by instructors and external podcasts, produced by other organizations. The former is divided into two categories: lecture podcasts and podcasts developed for specific pedagogical functions, as assignment tips and post-assignment feedback. Examples of external podcasts are podcasts produced by (other) universities, by broadcasting organizations (for example, the BBC) and TED-talks.

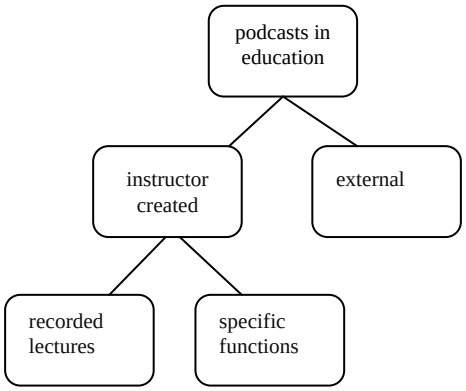

Figure 1. Categorization of podcasts (Based upon Hew (2009) and Rosell-Aguilar (2007)

We notice that this categorization (contrary to the one by Hew (2009) does not include student-created podcasts. The reason for not discussing them in this paper is that one can find in literature hardly any experiences with student-created podcasts.

2. APPLICATIONS OF PODCASTING

In this section we present several ways of using podcasts in education, and we discuss their possible merits for distance education. We also present the students' opinions about those applications.

To learn the opinions of our students, we distributed a survey among them. The survey consisted of closed questions, with the possibility to make remarks or comments in text fields. The questions measured in the first place the respondents' interest in potential applications of podcasting. The survey also included some more general questions about podcasting. If respondents had recent experiences with educational podcasts, we asked them about these experiences. Most of them have limited or no experience at all with educational podcasts.

We announced the survey in different ways, in order to find respondents with different backgrounds and interests. It was made available on the website of the department, and we also announced it to students of several, divergent courses. 41 respondents completed the survey. All of them were students enrolled in courses of the department of Computer Science.

The subsections are arranged according to the categorization of Figure 1. Therefore we present and discuss in succession: the use of recorded lectures, the use of podcasts with specific educational functions and the use of externally produced podcasts.

2.1 Recorded Lectures

The most common application of podcasting in face-to-face education is to capture lectures and make them available online for students. The benefits of such podcasts are well-documented and broadly recognized (Abdous et al., 2012; Heilesen, 2010; Jowitt, 2008). Students use these podcasts for the purpose of reviewing concepts and issues presented during lectures. There is clear consensus in literature that podcasting is extremely effective as a revision tool. Evans (2008) found for example that students perceive podcasting as a more effective revision tool than textbooks, and consider it to be more efficient than their own notes. Most popular among students is to use these podcasts just before the exams, as a kind of check whether they understood the subject matter. According to the students, this use of podcasts has several benefits compared to the face-to-face lecture, among them the ability to repeatedly access the same content and the ability to listen whenever and wherever they like (Jowitt, 2009). Another finding is that students see such podcasts as additional resources rather than as a substitute for lectures and written course materials (Abdous et al., 2012)

Podcasts in the form of recorded lectures can also be used in distance education. In our distance education university we offer synchronous virtual classes (using Elluminate) for many courses. These classes have a structure similar to face-to-face classes. The instructor gives mini lectures, introduces assignments and solves them in interaction with a group of students. Usually a group consists of about 10 or 15 students. These sessions are recorded and are available for all students who are enrolled in the course. Students who attended the virtual class can (re)view them, but also students who did not attend the class.

We asked our students about their experiences with these recorded virtual classes. Table 1 gives the results. The number of respondents is 28, because not all respondents had experiences with courses using virtual classes.

Table 1. Use of recorded virtual classes (N = 28)

Did you watch recordings of virtual classes?	
Seldom or never (< 10%)	25 %
Sometimes (about 25 %)	25 %
Regularly (about 50 %)	11 %
Almost always (75 % or more)	39 %

We asked the students about their interest for potential uses of podcasts in our courses, whether they had experience with these uses or not. Table 2 gives the results. Entries 7 and 11 are relevant for the purpose of this section; they present the students' interest for recorded virtual and recorded face-to-face classes.

Table 2. Interest for ways of using podcasts in courses in order of preference (10 pt scale)

#	**Topics**	**Mean**
1	additional explanations of hard topics	8.2
2	illustrations and examples of subject matter	7.4
3	how-to-do instructions (as using tools, giving presentation, and so on)	7.4
4	guest speakers (for example famous experts)	7.3
5	feedback on assignments	7.2
6	survey of subject matter	6.9
7	recorded virtual classes	6.5
8	motivations why topics are relevant	6.5
9	discussions between experts	6.4
10	elective subject matter	6.2
11	recorded face-to-face classes	5.9

2.2 Specific Pedagogical Functions

In the previous section, we discussed the reuse of recordings of virtual classes. Such recordings can be seen as a documentation of classes and as an extension of the practice of providing electronic versions of slides. They are a kind of side effect of giving a class. But instructors can also produce podcasts deliberately as a pedagogical tool, with a focus upon specific pedagogical functions and specific educational contexts.

We discuss some possible applications of this kind of podcasting in distance education. They are largely based upon experiences in face-to-face education.

- Podcasts can be used for structuring the study, to prepare students for the core learning activities. For example, Fernandez et al. (2009) describe how short podcasts can give students a lead-in to and an outline of each chapter of a textbook, a motivation why specific topics are included, and hints for study. Such podcasts are relevant for distance education students, because they could support them in their efforts to efficiently manage their time.
- Podcasts can prepare students for examinations. For example, the instructor can look back on learning objectives, discuss previous exams and/or summarize the main topics. From studies about the use of recorded lectures in face-to-face education we know that students view these podcasts in the first place to prepare themselves for the examinations (Fernandez et al., 2009; Heilesen, 2010; Kay 2012).
- Podcasts can give additional explanations of subject matter known to be hard for students to understand. Viewing and reviewing difficult topics is also known to be a popular way of using recorded lectures (Heilesen, 2010)
- Podcasts can give feedback to students. For example instructors can review learning outcomes, comment upon electronic discussions, or give feedback to assignments. Offering feedback by podcasts might give students a more precise and detailed understanding of the teachers' comments than offering feedback face-to-face (Heilesen, 2010). Moreover, podcasts can be viewed repeatedly, which is a substantial advantage compared to face-to-face feedback (Elliot et al., 2009).
- Podcasts can offer interviews, for example with experts in a specific field, writers of textbooks, or with different stakeholders in student projects, as clients and users in real-world projects.
- Podcasts can explicitly be meant to promote students to be active while learning. Students tend to view educational podcasts in a relatively passive manner, which has been denoted as receptive viewing (Kay, 2012). It is therefore a challenge to find ways to use podcasts to promote active student engagement, especially in distance education (Abdous et al., 2012). One of the possibilities is to adapt a common practice in face-to-face classes: to alternate mini-lectures and student activities. In distance education, the mini-lectures of the instructor can be replaced by podcasts covering the same subject matter. To persuade students to become active, each of these podcasts could result in an explicit invitation to solve an assignment or to start discussions about the subject matter. There are other examples of the use of podcasts in face-to-face education to promote student activity that possibly can be adapted to distance education. One of them is the use of podcasts in step-by-step procedures to solve specific problems, for example in mathematics (Kay & Kletskin, 2012). Another is the use of podcasts in the 'inverted classroom', in which all in-class lecturing is replaced by podcasts and class hours are used for student activities (Heilesen, 2010).

In the survey we asked the students to score their interest in podcasts with the following functions:

- survey of learning unit
- additional explanation of hard topics
- illustrations and examples
- feedback on assignments
- motivation of importance of subject matter.

Table 2 gives the results in entries 1, 2, 5, 6 and 8.

We conclude this section with two observations. First, many of the pedagogical functions mentioned can also be realized with other media, for example with texts only. But Fernandez et al. (2009) report that students believed that a combination of different communication/learning media (voice, text, pictures, etc.) could improve the results of their learning processes, because they allow students to learn in different ways.

It has been claimed and suggested that podcasts can not only have benefits in the cognitive domain, but also in the affective domain (Kay, 2012). An interesting example is using podcasts that are produced by the actual instructor of a course. By viewing these podcasts students see and hear their instructors, which could add to the feeling of proximity and presence of the instructors. For distance education students this might be a very interesting feature of podcasts, because it could increase students' motivation. We will discuss this topic in section 3.

2.3 External Podcasts

On the web one can find numerous potential educational resources, which can be used for all kinds of purposes. Several universities provide complete courses (Massive Online Open Courses or MOOCs), TED offers numerous interesting talks by well-known experts, YouTube and other sites offer practical how-to-do podcasts. There are resources that can be linked directly to specific subject matter and learning goals, other resources can be used to motivate and inspire students. Examples of the second category in the domain of Computer Science are well-known monologues of Steve Jobs and Randy Pausch.

The survey asks the students to score their interest to see podcasts with

- guest speakers, for example famous experts
- relevant discussions between experts.

Table 2 gives the results; see entries 4 and 9.

A tricky point in using external podcasts is that they are licensed under different terms. The fact that a podcast is freely downloadable does not mean it can be used in any way. It can be a complex matter to find out if and how specific podcasts can be used for educational purposes.

3. FEELING PROXIMITY AND PRESENCE

Lack of interaction is a key problem for distance students. Distance education is often experienced as a lonely activity. As a result many students are confronted with motivational problems. They feel isolated and less member of a group, compared to students in face-to-face classes. They have fewer possibilities to interact with fellow students and faculty, which can decrease their motivation and enthusiasm (Lee & Chan, 2007).

A relevant question is whether instructor-made podcasts can play a role in alleviating those problems of distance education students. For example, could the ability to see and hear the instructor and fellow students increase their motivation? There are suggestions and claims that podcasting indeed can be effective in reducing feelings of isolation and in promoting a sense of belonging to a community, and therefore is able to increase distance students' motivation. Fernandez et al. (2009) provided students in an online course with podcasts of instructors presenting surveys of relevant topics. One of their major findings was that these podcasts increased the feeling of proximity between students and teachers, because students had the feeling of a permanent presence of their teachers. As a consequence, the podcasts enhanced students' motivation. In a review study Hew (2009) it is suggested that the use of podcasts could create a greater sense of rapport and intimacy, realism and motivation. Lee & Chan (2007) found that instructor-made podcasts were effective in reducing isolation-induced anxiety and in promoting a sense of inclusivity and of belonging to a learning community for distance education students.

Our survey included questions about who the students like to see in podcasts. Some of the respondents had some experience with seeing their instructor, because they had some experience with seeing their instructor, because they had viewed podcasts of virtual classes. Table 3 gives the results.

Table 3. Who do you like to see in podcasts? (5-pt scale, 1=disagree, 5=agree)

I would like to see famous experts in podcasts.	3.6
It is a plus if you can see your instructor in podcasts.	3.0
I don't care who speaks, more important is that he/she has a convincing story.	4.2

4. GENERAL QUESTIONS

The survey included some general questions about the use of podcasts. First we asked the students who watched podcasts if they proved to be useful. The response can be found in Table 4.

Table 4. Usefulness of podcasts (N=22, 5-pt scale, 1=disagree, 5 =agree)

The podcasts I watched proved to be useful.	3.6

We asked the same students if they experienced problems using the podcasts. Table 5 gives the results.

Table 5. Experienced problems (N = 14, 5-pt scale, 1=seldom, 5=often)

Did you experience problems with podcasts?	
Could not watch podcast.	1.7
Podcast lasted too long.	2.3
Visual quality was bad.	1.6
Sound quality was bad.	1.9
Podcast had no clear relation with subject matter.	1.9

What role should podcasts play? One of the findings in face-to-face education is that students see recorded lectures not as a replacement of face-to-face lectures, but as an additional facility (Fernandez et al., 2009; Heilesen, 2010). In the survey we asked the students a similar question (Table 6).

Table 6. Role of podcasts

What role should podcasts have?	
Podcasts should introduce no new content, only same content in another way.	86 %
Podcasts might introduce new content that is not available in another form.	14 %

Finally, we asked the students if they felt the university should increase the use of podcasts in courses (Table 7).

Table 7. More podcasts? (5 pt-scale, 1 = disagree, 5 = agree)

University should increase using podcasts in courses	3.2

5. DISCUSSION

According to the preferences that are ranked in Table 2, our students prefer podcasts that are to-the-point, and directly related to the subject matter they have to study. This holds for 4 of the 5 top rankings of Table 2: additional explanations of hard topics, illustrations or examples of subject matter, how-to-do-something demonstrations and feedback by the instructor. This preference is for many distance educations students in accordance with their situation, in which family obligations, work and study compete for attention. For such students a natural tendency is to strive for tools and methods that can support them in their endeavor to study optimally and efficiently, without wasting time to superfluous activities. This preference of our students is consistent with the findings of Fernandez et al. (2009). Their study showed that one of the most important ways that podcasts helped their (distance education) students was by allowing them to efficiently manage their time. The podcasts gave them the feeling that the concepts of the course were easier to assimilate.

From the instructors' point of view, creating podcasts that are tailored to the needs of distance education students can be difficult and time consuming (Carvalho et al., 2009) A cheap and easy alternative is to record virtual classes (or face-to-face classes) and make these available as podcasts for all enrolled students. Students in our department have experiences with such podcasts. According to the survey, some of them watch these podcasts frequently, others only occasionally. From Table 2, which contains the preferences for podcasts, we can see that their interest in recorded classes is in line with their experiences. Such podcast are appreciated by some, but by and large they don't rank high. Recorded classroom sessions are not aimed at emphasizing time on task, and Fernandez et al. (2009) suggest that that could be a reason why recorded classes do not score high among distance education students.

The benefits of recorded lectures for distance education students remain yet to be proven. Just uploading any recorded lecture might not be the best thing to do. For example, Sebastian Thrun, one of the pioneers in the field of Massive Open Online Courses (MOOCs) sees recorded lectures as deeply flawed. Lectures are in general "boring," he says, and recorded lectures are even less engaging: "You get the worst part without getting the best part." (Carr, 2012).

Maybe the use of such recordings can become more attractive if instructors adapt them slightly. One issue is the length of such podcasts. Usually a virtual class session lasts for about an hour or more, and usually several topics are covered within such a session. From literature, it is well known that students prefer short podcasts about demarcated topics. Table 5 shows that our students scored the length of the recorded virtual classes as the largest 'problem' with podcasts (although still not as a big problem). It is not possible to give an optimal length, because this presumably depends upon the subject, the presentational qualities of the speaker and the attitude of the student (Hew, 2009). But in general, podcasts of 5 or 10 minutes are popular. Therefore, it seems advisable to break up long podcasts in smaller, coherent segments. Another, more laborious adaptation, is to punctuate the short segments by on-screen exercises and quizzes. 'Peppering' students with questions might keep them active and involved with the content, while providing the kind of reinforcement that has been shown to strengthen comprehension and retention (Carr, 2012). It is a challenge to devise types of podcasts in a distance education context that stimulate students to be active.

Many students are positive about using external podcasts, for example podcasts with famous guest speakers. Such podcasts usually do not match seamlessly the subject matter of a corresponding course. To give optimal support to students that strive for maximal study efficiency it is advisable to thoughtfully integrate such external podcasts into the (other) course materials. This can be done by offering clear and exact information about what they can expect from each podcast: its length, the topic it does support, its exact relationship with the topic, and its relevance. In this way, every student can make a well informed decision whether or not to use it.

It has been claimed that podcasts can add to the feeling of proximity and presence of the instructors, which could increase student motivation. Up to now our students have not indicated they expect much of the possibility to be able to see their instructors in podcasts. This is consistent with the finding that recorded classroom sessions have not high rankings in Table 2, with the preferred uses of podcasts. But it has to be stressed that these opinions are based mainly upon expectations, not upon experiences. Practice, of course, may be different from the students' expectations.

Currently, our students see podcasts in addition to written course materials, not as a substitute of these. This is in line with one of the main findings of Fernandez et al. (2009), who found that podcasts are perceived as a complement to traditional resources of a course, not as a substitute for them.

Overall, the respondents have rather mixed opinions about the use of podcasts in education. On the question whether the university should increase using podcasts, the mean score is rather neutral (Table 7).

6. CONCLUSIONS

We distinguished three categories of applications of podcasts in (distance) education:

- podcasts of recordings of virtual classes that are made available for all students who might have an interest in them
- podcasts that are produced with a specific pedagogical function in mind, for example instructors summarizing or reviewing a topic, giving feedback or explaining hard topics
- podcasts produced by external organizations, for example guest speakers of famous universities.

We identified some topics students like to view as educational podcasts. The respondents preferred podcasts that are to-the-point, directly related to the subject matter they have to study, and that can make the difference to study efficiently. On top of the list of preferences are podcasts that are produced with a specific pedagogical function in mind. The first three are: podcasts with additional explanations of hard topics, illustrations or examples of subject matter and how-to-do-something demonstrations.

An inherent characteristic of podcasts that are tailored to the needs of students is that producing them usually is time-consuming. Instructors have limited time, and they must be effective and efficient. Therefore, they might consider using recordings of virtual classes. A cheaper alternative is to use recordings of virtual classes. But in the ranking of preferred podcasts they do not score high, perhaps because they are not enough focused upon time on task. Nonetheless, a considerable number of students appreciate such podcasts highly, so they should certainly be offered if they are available. Besides, it is possible to increase their attractiveness, for example by dividing recordings in small pieces.

Students have an interest in external podcasts. For example, many of them like to see famous experts. It is advisable when using such podcasts to give enough information about them, for example about their exact relation with the subject matter and about the length of them. Provided with such information, students can make a well informed decision whether or not to use them.

We did not find much support for the claim that podcasts can support distance students by adding to the feeling of proximity and presence of the instructors. Our students have not indicated they expect much of the possibility to be able to see their instructors in podcasts.

It has to be stressed that the opinions of the students are largely based upon expectations, not upon experiences. Practice, of course, may be different from the students' expectations. In future research, we would like to find out if the actual use of different kinds of podcasts leads to the same results.

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Short Papers

BIG DATA & LEARNING ANALYTICS: A POTENTIAL WAY TO OPTIMIZE ELEARNING TECHNOLOGICAL TOOLS

Olga Arranz García and Vidal Alonso Secades
Universidad Pontificia de Salamanca
C/Compañía, 5, 37002 Salamanca

ABSTRACT

In the information age, one of the most influential institutions is education. The recent emergence of MOOCS is a sample of the new expectations that are offered to university students. Basing decisions on data and evidence seems obvious, and indeed, research indicates that data-driven decision-making improves organizational productivity. The most dramatic factor shaping the future of higher education is Big Data and analytics. Big Data emphasizes that the data itself is a path to value generation in organizations and it is, also, a critical value for higher education institutions. The emerging practice of academic analytics is likely to become a new useful tool for a new era. Analytics and big data have a significant role to play in the future of higher education. This paper attempts an analytical practice about the use of e-learning technological tools to generate relevant information, for the teacher and the students who try to optimize their learning process.This combination of data-processing and analytical learning is an aid to improve significantly higher education and mark the path to follow in the new educational era.

KEYWORDS

Learning Analytics, Big Data, Technological Elearning Tools, Learning Management System, Educational Data Mining.

1. INTRODUCTION

Nowadays, there is a huge amount of data from the students that are accessing Learning Management System (LMS). The increase of students in the new educational systems in distance learning is causing a new trend in the world of education. The recent emergence of MOOCS (*Massively Open Online Courses*) is a sample of the new expectations that are offered to university students.

This trend leads to a role change in the behavior of the different educational agents, where both, teachers and pupils, must conform to the new methods and change their traditional methods of teaching[11]. In this phenomenon nor is it beyond the role of academic institutions that are in the obligation to modify its structures and their information systems to meet the students needs in order to have access to their academic offer.

Is there anything we can do with the vast amount of data provided by students to improve the educational system? Until recently, there were no storage techniques that enable the analytical study of the information present in the Learning Management Systems. Now there are more and more new analytical methods that allow us to deal with the study of these data and infer trends of the use that the students make with respect to the tools available in platforms. The implementation of these analytical methods is possible through the use of powerful new technologies such as Data Mining or Big Data that enable the processing of large amounts of information by searching discover new knowledge that is present in the data.

It is in this context that this paper is framed, reflecting, through the analytical study of the data current on a LMS the use of that students make of the tools that are available in a learning platform. This study provides relevant information that will allow teachers to optimize the use of the tools, to deal with in depth of the learning strategies that are currently applied to the university teaching.

2. BIG DATA/DATA MINING: TECHNOLOGY FOR DATA ANALYSIS

The use of technological tools in education in general, and in all levels of the individual learning, has followed such a rapid pace. If something has marked the progress of advanced societies, over the past few decades, has been the remorseless development and massive use of technological tools to manage all kinds of tasks[1]. The processing of the large amount of existing data in the field of education has been made possible thanks to the development of new Information and Communications Technologies (ICT). This development has led to diverse educational institutions carry out an analysis of existing data from the interactions of its students, and draw conclusions that will improve the working environment.

To analyze this immense amount of information is beginning to use, increasingly, two treatments or processes known as Data Mining and Big Data. Data Mining, also known as KDD process (*Knowledge Discovery Databases*), is a process that allows you to discover hidden information in large volumes of data. In the course of the process it works with data subsets, looking for similar patterns of behavior or predictive models that can be inferred from the processed data.

While its use began with economic purposes, their multiple possibilities have allowed us to extend its use to the field of education. The main methods used and their key applications are[2]:

- *Prediction*: Develops a model to infer some aspects of the data. It is used to emulate the behavior of students in function of their previous activities and to predict the possible outcomes.
- *Clustering*: Looking for classifying data into groups with the same characteristics. Lets you know common patterns for students who are in the same group.
- *Relationship Mining*: Discover relationships between variables. Allows you to discover associations of activities that can induce a sequencing of the same. It also highlights the most effective pedagogical strategies in the learning process.
- *Visualization:* Allows you to discover trends in the use of educational platforms that are outside of the average of students, known as data noise.

However, with the irruption of MOOCS the online information storage is growing in such a way that the processes for managing this information begin to stay small, causing a serious problem not being able to exploit the data with the necessary guarantees. In order to be able to process such information is necessary to have new methods, being Big Data the last to be applied to the learning area. The term Big Data generates even confusion and is used to associate concepts relating to large amounts of data, sociological analysis, data management capabilities and recently, also, in the education area.

Big data can be defined as the digital convergence of structured data found inside databases, and unstructured data flowing from new sources like social networks, mobile devices, sensors, RFID, smart meters and financial systems[6]. Otherwise, the *Mckinsey Global Institute* defines big data as "*datasets whose size is beyond the ability of typical database software tools to capture, store, manage and analyze*"[8]. This method allows, today, that organizations can capture and analyze any data, regardless of what type, how much, or how fast it is moving, and make more informed decisions based on that information[9].

We recognized that there is still got a lot to learn about how to work with big data, just like everyone else. But one thing we know for sure is that the traditional ways of working with data will not lead to success in big data analytics[12]. The variety of information sources, the volume of information, latency of processing, even the basic business models are often all different in the big data space. Someone who recommends using the same old tools under these new circumstances is someone who is outside of the data analysis.

3. WHAT IS MEANT BY LEARNING ANALYTICS?

It is undeniable that the technological E-learning tools have come to play a decisive role in the dissemination of the knowledge. The LMS allows you to capture explicit data through the activity carried out by students from any device and provide a clear knowledge of what is really happening in the learning process in order to be able to meet and enhance the care and the needs of the students. The importance of the LMS has done that many countries are investing their effort in educational systems in order to address the challenges required. In its review they are using academic analytics working with large data sets and predictive models to practice an institutional data mining to produce intelligent actions.

The intelligent actions generated from statistical analyses of different data sources can guide a more efficient use of tools, processes, organizations and institutional culture. In the same way, academic analytics has the potential to create actionable intelligence to improve teaching, learning, and student success to predict which students are in academic difficulty or focusing on specific learning needs[4]. Higher education has traditionally been inefficient in its data use, often operating with substantial delays in analyzing readily evident data and feedback. Organizational processes often fail to utilize large amounts of data on effective learning practices, student profiles, and needed interventions[7].

Something must change to improve the efficiency and quality of higher education. Analytics in education must be transformative, altering the existing teaching, learning, and assessment processes, the academic work, and administration tasks. Analytics provides a new model for university leaders to improve teaching and learning processes and will serve as a foundation for changes. But using analytics requires that we think carefully about what we need to know[5]. Richer data sets, new ways of extracting and organizing data, more sophisticated predictive models, and additional research will drive the evolution of analytics.

One of the in demand changes is provided by the use of Learning Analytics. Learning Analytics means "*the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs*"[10].

Learning Analytics focus on the learning process, using the data provide by the LMS, in several ways: analyzing the discussion messages posted to identify the student's risks, transforming the university system or the academic models and giving recommendations to students to improve their habits.

This process of learning analytics provides very useful information to both teachers and students. Teachers will also let them know, in real-time, performance of the students and respond, immediately, to the most urgent, as well as, plan better their teaching activities. To the students, on the other hand, allows them to have knowledge of their progress and see if their academic activity is enough to achieve the raised objectives.

It should be noted that the use of analytics to describe learning won't be easy, because we are in the early stages of implementation and experimentation. As the practice of analytics will be refined, universities can place better information into the hands of a greater number of people, enabling informed decision-making.

4. A CASE STUDY

Therefore, it seems to be useful and prudent focus on the realization of an analytical study, about the employment that teachers have made at one of the platforms of teaching online. In this case study has been taken into consideration the need to evaluate the use of the tools used in the teaching/learning process in an interaction environment related to the combined method of learning known as "*Blended Learning*", that integrates, in a balanced manner, the classroom studies with virtual learning. The target in this analytical study is to improve the prospects of the teachers, not only with training actions, but also in orienting the use of the virtual educational tools most appropriate, in order to develop innovative educational strategies.

4.1 An Analytical Practice in a Spanish University Center

In September 2005 the process of implementing the Moodle platform began in Educational degrees in the area of education taught in a spanish university center of studies of medium size, following a "*Blended Learning*" system, which develops an educational process that adapts to the pace of learning for the students at a time and in the place you prefer[3].

Using a rigorous and accepted statistical model, on a representative sample, we have analyzed the use of technological tools that offers the platform Moodle in order to propose to teachers appropriate strategies to create spaces for interaction effective to get the best results in the teaching/learning process.

From the analysis of the subjects studied to obtain the teacher's degree, it is possible to find out the total number of accesses made, during the academic year 2010-2011, to each one of the technological e-learning tools which are in the Moodle platform. This total number of accesses is shown in Figure 1:

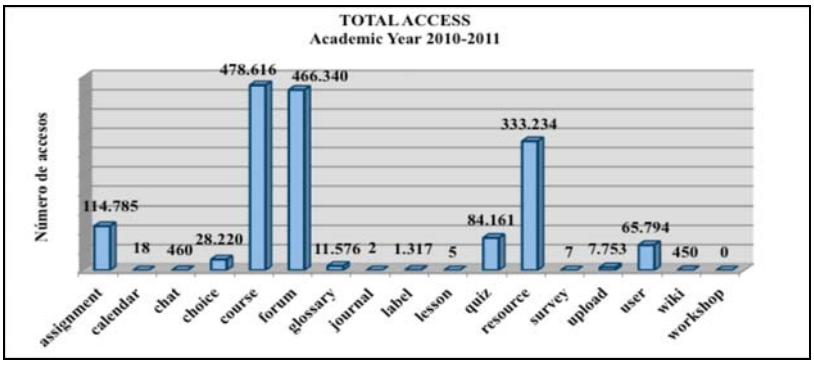

Figure 1. Total number of accesses to the Moodle tools.

As we can see, in the sample that has been obtained, there are many different types of tools. So, it is necessary to establish an organization or classification of the same in categories to work with an adequate number of parameters. In response to the use of the tools, and to the indications that it facilitates the own platform Moodle, we performed a classification/organization into four categories (*Storage*, *Collaboration*, *Communication* and *Assessment*) that are displayed, then, in the Table 1:

Table 1. Classification of the tools by tools groups.

	Classification Tools Groups
Storage	Label, Resource, Upload
Collaboration	Forum, Glossary, Wiki, Workshop
Communication	Calendar, Chat, Journal
Assessment	Assignment, Choice, Lesson, Quiz, Survey

Once established this classification/organization in tools groups, an analysis has been made by tools groups to learn about the average number of accesses for each student to the different groups that were used to teach the curriculum described of the reference center. This average number of accesses to each student by tools groups is reflected in the Figure 2.

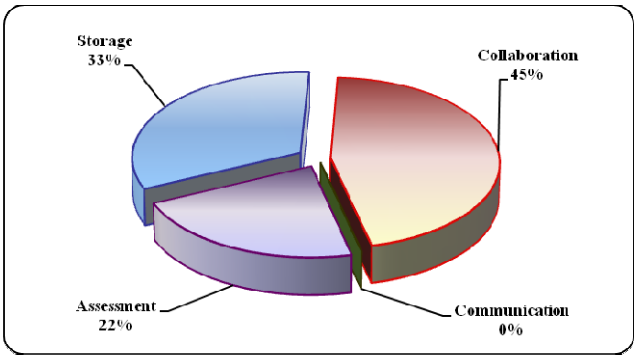

Figure 2. Average number of accesses by tools groups.

According to available data, the tools groups most commonly used are those of *Collaboration*, *Storage* and *Assessment* that correspond respectively with the tools *Forum*, *Resource* and *Assignment* which are most commonly used as can be seen in Figure 1. On the other hand, the *Calendar*, *Chat* and *Journal* tools, belonging to the group of *Communication* tools, they are hardly used.

Conducted a statistical analysis of Chi-square with the sample data for the academic year 2010-2011, we find that all the groups of tools have variation. The tools group that is experiencing a higher variation in the average number of accesses per student and per tools group, is the group of *Collaboration* tools (Chi-square value 199.131).

If it also performs a statistical analysis of the dependence or independence between the different pairs of groups of tools during the period 2010-2011, it can be concluded that, all pairs of groups of tools have dependency between them. The greater dependence is between the pair of *Storage* tools group with the *Assessment* tools group (value Chi-square 148.01). In contrast, the less dependence is given between the *Collaborative* tools group with the *Assessment* tools group (value Chi-square 35.08).

After the analytical process we can see that dominate the access to the of *Collaboration* and *Storage* tools. Otherwise the access to *Assessment* tools group always involves an access to *Storage* tools group.

5. CONCLUSION

Facing the great amount of data that we collect from online learning the field of education is seen in the need to process all the information available to improve their benefits. The combination of Big Data with the learning analytics are a good tool for the processing of these data, which will enable us to guide the necessary reforms to adapt to the new educational circumstances, despite being two areas of recent introduction.

From this study may be inferred a series of information that enables us to advise teachers to improve, both, the learning process and the teaching process. Note, that the most frequently used tools are the corresponding to *Collaboration* and *Storage* tools, which implies a large amount of data when they are handled by both the teachers and the students. These data must be intelligently organized to obtain their maximum performance and to get new improvements and optimization of learning methods.

Likewise, it can be inferred from the use of *Assessment* tools the need for teachers to define new forms of evaluation to increase the accesses to these tools. Instruments such as the headings of evaluation can be an alternative for the improvement of this type of tools. Highlight, in addition, the need for this improvement due to the high dependence shown in the survey with respect to *Storage* tools.

Lately, higher education is beginning to worry about how to improve its learning methods and about how to increase its quality, finding, in the data processing new technologies and the analytical methods, valid tools to achieve its aim.

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CRITICAL FACTORS IN MOBILE LEARNING: A QUASI-SYSTEMATIC REVIEW

Sergio Assis Rodrigues, Rodrigo Pereira dos Santos, Lucas Arnaud, Jano Moreira de Souza
COPPE – Federal University of Rio de Janeiro, Rio de Janeiro, Brazil

ABSTRACT

The advance of mobile industry and research has expanded e-learning in order to support an efficient and effective educational process. However, the promised benefits are as much attractive as the existing difficulties and barriers. In this paper, we intend to identify and summarize the critical factors in mobile learning through a quasi-systematic review. Preliminary results are grouped on categories defined in previous studies accomplished by the researchers.

KEYWORDS

Mobile learning; e-learning; systematic review; empirical studies.

1. INTRODUCTION

The management of information over massive volumes of distributed multimedia data, and the participative and universal access to knowledge for citizens have contributed to the Web development in 90s, with a special interest in the educational domain (Santos et al., 2012). The goal is to propitiate an environment to make the Information and Communication Technologies (ICTs) closer to the called "international" citizens – out of the traditional physical barriers to the teaching and learning process. On the other hand, the establishment of the "Web Era" underpinned "Mobile Era" in 2000s. In the beginning, mobile devices were focused on telecom domain. However, these devices have been used as processor-based technologies and have become a large part of people's daily lives. Due to the growth and practicality of smartphones, these were the ones chosen for the development of the mobile learning systems (Pettersson et al., 2010).

Mobile learning is a type of e-learning, i.e., the use of technologies and tools to facilitate the teaching and learning process (Girão et al., 2012). The difference is its support by mobile devices as a complement to distance education (Wains and Mahmood, 2008). Thus, the mobile learning research explores issues related to bringing education to mobile devices and vice versa (Pettersson et al., 2010), and also shows a diverse field with a plethora of theories and practices implemented in a variety of projects (Frohberg et al., 2009). For example, *on the technological side*, a challenge consists in supporting devices with variable capabilities, which impacts learning activities themselves to provide a personalized path for every student, *on the application side*. Finally, as discussed by Allan (2010), mobility itself should be investigated, e.g., how to manage and leverage context changes. These challenges are beyond the traditional systems and devices' projects and designs.

In the Brazilian case, for instance, the 2010 census had shown 194 millions citizens and an interesting fact: this number is lower than the number of mobile devices – 202 millions (Teleco, 2011). Based on the governmental efforts as well as the facilities in using mobile Internet, the mobile learning can be the technology to support improvements in education. Our research group has contributing to this global (and national) challenge through the mapping of bandwidth world status and an application of mobile learning in negotiation domain. However, the promised benefits of mobile learning are as much attractive as the existing difficulties and barriers. In this paper, we intend to formally identify and summarize the critical factors in mobile learning through a quasi-systematic review. Preliminary results are grouped on categories defined in previous studies accomplished by the researchers. This initial study will base our initiatives in supporting negotiation learning through mobile and Web platforms. Besides this section, the paper is organized in the following: Section 2 presents the quasi-systematic review and Section 3 concludes the paper.

2. MOBILE LEARNING: A QUASI-SYSTEMATIC REVIEW

This section presents a quasi-systematic review to formally identify and summarize the critical factors in mobile learning through an item-based protocol as following. Using the GQM (Goal/Question/Metric) approach (Basili et al., 1999) to **define the research focus**, the approach goal *is* to analyze mobile learning systems *for the purpose of* classifying *with respect to* identify critical factors (including those related to the act of negotiating) from the Computer Science researchers' *point of view*, *in the context of* each publication. The **research question** (RQ) could be established as: **RQ –** *What are the critical factors in mobile learning?*

2.1 Review Plan

The review steps can be structured through a plan (Biolchini et al., 2007). The steps for executing the quasi-systematic review were pointed out: (i) ***search string***: define the string based on keywords (or synonymous) obtained from PICO (**P**opulation, **I**ntervention, **C**omparison and **O**utcome); (ii) ***source selection***: define the libraries where the primary studies will be searched for; (iii) ***studies selection***: define the process of selecting the relevant studies based on quality criteria; (iv) ***data extraction***: define and extract which data should be collected from the selected studies in order to answer the RQ; and (v) ***result summarization***: analyze the information and group the studies aiming at effectively answer the RQ.

In the step (i), the **population** is the group that will be observed by the intervention; in case, *publications on mobile learning*. The **intervention** consists in what will be observed in the context of the study; in case, *mobile learning systems*. The **comparison** focuses on analyzing some specific parameters in order to show contrasts and other kinds of differences; in case, *critical factors, including those related to the act of negotiating* (this was considered due to the future work). The **outcome** is the metrics used to measure the effect, i.e., the types of results expected in the end of the study; in case, *it is the same of intervention* and the goal is to provide a *classification based on the critical factors found in the included studies*.

Considering the step (ii), the scientific libraries selected for the search were *IEEExplorer*[1], *Scopus*[2], and *ScienceDirect*[3]. The studies language should be English and they must be available at Internet, since the search is done in Web engines. In turn, the step (iii) has established the **studies inclusion and exclusion criteria**: the studies must present mobile learning systems and a discussion of critical factors (including those related to the act of negotiating). The procedure consisted in: running the search string at the selected Web engines; joining the abstracts of the initial set of studies and reading them in order to evaluate according the mentioned criteria; and reading the full text for included studies.

The reasoning related to steps (i) and (ii) generates an initial search string with many synonymous for "mobile", i.e., *mobility* and *mobile device*, as well as for "systems", i.e., *program*, *tool* and *decision making support*; the word *negotiation* was included due to the future interest in using mobile leaning for negotiation. However, the number of results was almost one thousand papers, because these synonymous had contributed to retrieve researches about networking and communication. Thus, the search string was refined and its final structure is the following:

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(negotiation) AND ("mobile learning" OR "mobile ecosystems") AND (system OR software)
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2.2 Review Execution

Since the review plan was finished, the search string was formally executed at the selected Web engines and the results are shown in Table 1. First of all, 234 files were originally retrieved from the Web engines, including 5 repeated papers. After removing these papers, the set has been reduced to 199, which were analyzed by the researchers, considering titles and abstracts. 75 papers were selected from this step to read the full text. Finally, 28 papers were effectively included to the data extraction. So, the step (iv) described in Section 3.1 was executed. The researchers focused on extracting the following five types of data previously included in the review plan:

[1] http://ieeexplore.ieee.org
[2] http://www.scopus.com
[3] http://www.sciencedirect.com/

- Year of publication;
- Vehicles of publication: *journal* or *event* (i.e., proceedings);
- Focus of the paper: *model* (e.g., framework, architecture etc.), *tool* (e.g., prototype, infrastructure etc.) or *case study* (e.g., observational case, interviews etc.);
- Type of negotiation scenario: *business case* (i.e., negotiation in a commercial scenario) or educational case (i.e., negotiation in teaching and learning activities);
- Critical factor for mobile learning (i.e., research contribution).

Table 1. Results from the refinement process

Web engines	Results	Duplicated papers	Analyzed papers	Selected papers	Included papers
1. *ScienceDirect*	49	0	199	75	28
2. *Scopus*	60	5			
3. *IEEExplorer*	125	30			
Total	234	35			

2.3 Data Extraction and Result Summarization

From the 28 papers included after refinement process, the researchers extracted the data based on the scope, as shown in Table 2. Finally, the step (v) could be completed. As the RQ requires, the Table 2 shows the critical factors in mobile learning (last column). First of all, (1) the papers were published in the last ten years, *more than a half of them from 2011 and in journal vehicles*. A reason for this can be the fact that mobile learning research is growing based on the establishment of the "Mobile Era", and many case studies were executed since it consists in a real and large application of recent Computer Science research. Thus, researchers used real scenarios and domains in order to verifying models and tool, and also generating indications and/or evidences in mobile learning empirical research. Moreover, the empirical basis can explain the number of papers related to proposition of models such as ontologies, frameworks, architectures, context-aware structures, user experience techniques etc.

Table 2. List of quasi-systematic review results and extracted data

ID	Reference	Year	Vehicle	Focus	Type of Negotiation	Critical Factor in Mobile Learning
1	Alvarez et al.	2011	Journal	Case Study	Educational Case	Tablets PCs strengthen collective discourse
2	Arroyo et al.	2008	Journal	Model	Educational Case	Context-aware information based on calendar
3	Basit and Matskin	2011	Event	Model/Tool	Educational Case	User Model, User Experience and Places/Spaces
4	Bollen et al.	2004	Event	Model/Tool	Educational Case	Communication based on sending short messages
5	Botick et al.	2011	Journal	Model	Business Case	Collaboration and groups creation
6	Chung	2012	Event	Model/Tool	Business Case	Communication patterns and protocols (reality)
7	Darabant and Todoran	2006	Journal	Tool	Business Case	Data synchronization using wireless technologies
8	Fachrunnisa and Hussain	2013	Journal	Model/Tool	Business Case	Trust in industrial digital ecosystems
9	Fallahkhair et al.	2005	Event	Tool	Educational Case	Television and mobile phone assisted language
10	Feijó et al.	2009	Journal	Model	Business Case	Different origins/cultures and diversity of content
11	Gerosa et al.	2010	Journal	Case Study	Educational Case	Mobile notifications for better forums
12	Infante et al.	2009	Journal	Model/Tool	Educational Case	Single Display Groupware with Multiple Mice
13	Kallenback et al.	2010	Event	Case Study	Educational Case	Learners' stress (heart rate and skin conductivity)
14	Khan and Matskin	2011	Event	Model	Educational Case	Spaces/Places in multi-agent systems
15	Lan et al.	2011	Journal	Model/Tool	Business Case	Imprecision and uncertainty (fuzzy systems)
16	Lan and Sie	2010	Journal	Case Study	Educational Case	Communication comparison (SMS, e-mail, RSS)
17	Lan et al.	2012	Journal	Case Study	Educational Case	Online asynchronous discussion (feedback)
18	Li et al.	2011	Event	Model	Educational Case	Augmented reality
19	Liu et al.	2007	Event	Tool	Educational Case	Shared display groupware (tete-a-tete-oriented)
20	Nguyen and Pham	2012	Event	Model/Tool	Business Case	Context-aware mobile learning architecture
21	Pimmer et al.	2012	Journal	Case Study	Business Case	Integration to social network sites
22	Su et al.	2011	Journal	Tool	Business Case	Data mining (clustering/decision tree approach)
23	Trifonova and Ronchetti	2004	Event	Model	Educational Case	Context discovery and mobile content adaptation
24	Tsai et al.	2011	Journal	Case Study	Business Case	Evolve business environment to be mobile-based
25	Tsai et al.	2012	Journal	Case Study	Business Case	Realistic and close-to-real-life information
26	Wang et al.	2002	Event	Tool	Business Case	e-marketplace based on agents and mobile agents
27	Zhao et al.	2010	Event	Model	Educational Case	Learners get instant help from other participants
28	Zurita et al.	2007	Journal	Model/Tool	Educational Case	Domain context and physical proximity

Second of all, (2) *more than a half of the papers* has focused on mobile learning-based negotiation considers the educational case – the actors are students and teachers, the platform is a web and/or mobile-based infrastructure, and the artifacts are the learning activities, contents, discussions and notifications. This indicates that negotiation leaning should be more explored in a business perspective, in specialized platforms and infrastructures. Finally, (3) the main critical factors of mobile learning can be summarized in ten categories, as shown in Table 3. These categories were elaborated by the researchers considering the studies (Rodrigues et al., 2011) and (Girão et al., 2012). The main five categories are: *human and business aspects*, *medias integration*, *communication*, *context-aware* and *collaboration*. However, it is important to observe that the other categories correspond to new initiatives to explore mobile learning in negotiation, considering the new practical trends in this decade (e.g., augmented reality and social networks).

Table 3. Categories of critical factors mobile learning

Categories	List of references (ID)
Place and Space	3, 14
Groups creation	5
Medias integration	7, 9, 12, 19
Data mining	15, 22
Augmented Reality	18
Social Networks	21
Human and business aspects	8, 10, 13, 24, 25, 26
Collaboration	1, 17, 27
Communication	4, 6, 11, 16
Context-aware	2, 20, 23, 28

3. CONCLUSION

Since Computer Science has been established as the “third pillar” in a transition from Web Era to Mobile Era, many approaches for mobile learning are emerging in the last years. So, this paper formally identifies and summarizes the critical factors of mobile learning as the main contribution. A quasi-systematic review plan were established and executed in order to preliminary discuss data extraction and results summarization. The results were grouped based on categories defined in previous studies accomplished by the researchers. As a future interest, we observed that mobile learning-based negotiation is being a topic in the last ten years, especially from 2009. Thus, a deeper analysis of the results should be done as well as a complete systematic review focused on Web- and Mobile-based environments aiming at comparing the results with this initial research in mobile. A list of tools will be generated to compare them considering the mentioned categories in order to establish an environment to supporting negotiation learning based on Web and mobile platforms.

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ANALYSIS OF INSTRUCTION MODELS IN SMART EDUCATION

JaeHyeong Park, JeongWon Choi and YoungJun Lee
Korea National University of Education
Chungbuk, Korea

ABSTRACT

Development in the smartifacts and wireless network has brought changes in the approaches and usages, as well as producing and sharing of the information. The learners are changing into independent provider from consumer of information. In order to teach the students effectively with this trend, changes in the education is inevitable. In Korea, SMART education has been implemented to fit into the trend. SMART education can be understood as the change in the paradigm which grafts newly developed technologies onto education to meet the changes and the developments in the school systems. There are various instruction models for ideal education in the changed academic environment. This research analyzed the SMART education used in Korea, and suggests that there is a need for further research on the instruction models.

KEYWORDS

Smart Education, Instruction Model.

1. INTRODUCTION

Development in the twenty-first century high technologies and information technologies has a great effect on the educational system today. Especially, the development of smartifacts connected to the mobiles, the ubiquitous learning environment has been established for learning, unlimited of time and place. Also the strong networking function which allows collaboration allowed the various activities such as participation and sharing. With these functions, the students gained the choices over various forms of educational data and information; they are becoming independent information providers. Also the instructors now hold a combined role as enforced facilitator and coordinator who operates and choose the information technologies. These changed in the paradigms of educations need new instruction models. Therefore, this research examined SMART instruction models and offers directions for further developments.

2. SMART EDUCATION

2.1 Definition and Characteristic of SMART Education

The definition of SMART education ranges from microscopic perspective to macroscopic perspectives depending on the scholars; education that uses smart technologies to change in the paradigm of education for the future. However, the definition of SMART education proposed by the Ministry of Education, Science and Technology (2011) is explained in terms of more macroscopic perspectives; its purpose of overall changes in the education systems. In the other words, it is defined “SMART learning is an intelligent, tailored instruction-learning supporting system, in which the demands of the 21st century information technology society are met with changes in the overall education system such as pedagogy, curriculum, assessment, and teacher. It is a combination of human centered social learning and adaptive learning, based on the best network communication environment.” The Ministry of Education, Science, and Technology explains the SMART education with its acronym (Table 1).

Table 1. Characteristic of Smart Education

Initial	Feature	Details
S(Self-directed)	Knowledge manufacturer	Change in the role of the student from the consumer to the provider, role of the instructor from the knowledge messenger to the educational mentor
	Intelligent	A self-conducted learning system with online achievement evaluation and prescription
M(Motivated)	Experience-centered	Emphasize on the experience-centered learning method in the standardized textbook based education
	Problem Solving	Aim for creative problem solving and the process-based individualized evaluation
A(Adaptive)	Flexibility	Enforced flexibility of the education system and personalized learning experience based on the preferences or future careers
	Individualizatio n	Role of school changes from delivering mass knowledge to providing individualized learning with regards to the level and the aptitude of the student
R(Resource-free)	Open Market	Based on the Cloud educational service, various contents developed by the publics, privates and individuals are applied to the education
	Social Networking	Expansion of collaborative learning using domestic and oversea learning resources using collective intelligence and social learning
T(Technology embedded)	Open Education	An open environment that offers desired learning experience regardless of time and place, and also guarantees maximum learning options with various education

2.2 Purpose and Aim of SMART Education

The aim of SMART education is to cultivate the individuals into the future global leaders using the information technologies to prepare the students with characteristics and abilities of twenty-first century. In order to achieve its aim, a total of 5 different practical assignments stimulate SMART education. Firstly, in the educational contents, a step-wise expansion of digital text book is pushed forward for effective learning of students and educational support of the instructors. Secondly, in the educational methods, the student's learning experiences regardless of the geographical difficulties are enforced through active online courses. Thirdly, in the educational environment, it creates safe donation and sharing of education contents. Fourthly, in the capability of the facilitators, it offers various training opportunities and programs for the facilitators to strengthen the instructing abilities for the SMART education. Lastly, in the foundation aspects, Cloud education service environment is achieved for easy and unlimited access to the educational contents for the instructors and students.

3. EXAMPLES AND ANALYSIS OF SMART COURSES

3.1 Smart Instruction Model

3.1.1 Idea Sharing Instruction Model

'Idea Sharing' instruction model is a class model in which the students first independently think about the proposed problem then shares the ideas with fellow classmates and the instructor using the smartifacts to examine and reshape the solutions. This instruction model is listed step-wise in Table 2

Table 2. Idea Sharing Instruction model

Steps	Activities
Come up with Ideas	Form individual ideas, write down the ideas, finalize the ideas to be shared with class
Sharing Ideas	Save and share the ideas, examine ideas
Combining Ideas	Complement individual ideas, confirm the changes

Looking at the detailed steps of the instruction, the first "come up with ideas" step is a prior knowledge based brainstorming step which requires the students to come up with and express individual ideas. The second step, "Sharing Ideas", focuses on the main activity of sharing, saving, and examining the ideas (such as concepts, processes, opinions, etc.) with everyone else on the network. Finally, "Combining Ideas" step offers the opportunities to examine other individuals' ideas and complementing one's own ideas, as well as extra information searching opportunities if needed.

3.1.2 Research Activities Centered Instruction Model

'Research Activities Centered' instruction model is based on the research activities in which problem is solved through following steps; gathering information on the internet or database, critical analysis, and rational decision making. The step-wise instruction model is shown in Table 3.

Table 3. Research Activities Centered Instruction Model

Steps	Activities
Planning	Create a question relative to the search (or provided by the instructor), Consider how to conduct the investigation
Search and Gathering	Collect the information by searching the internet or database, confirm the credibility of the information/data, sort and analyze collected information
Presentation	Present the results, give feedback, and reflect

Looking into the detailed instruction steps, the first "Planning" step heavily weighs creating a relative question to the research topic in order to decide what to search for. The second step, "Search and Gathering", is a step in which information credibility is decided upon searching the internet and the database, and collected information/data is sorted and analyzed accordingly. In the last step, "Presentation," a simple, to-the-point, accurate presentation that answers the research topic prepared by the instructor is required.

3.1.3 SMART Activity Based Instruction Model

SMART activity based Instruction Model is not limited to the details of the previous instruction models; it is based on the various SMART activities that can expedite the capabilities of the 21 century students. The detailed instruction model is shown in Table 4.

Table 4. SMART activity based Instruction Model

Steps	Activities
Introduction	Have a critical mind, problem deduction
Activities	SMART activities using various academic supporting equipment to expedite the 21 century academic capabilities
Conclusion	Feedback and Evaluation on the activities, formative evaluation on the academic activities

In the "Activities" step, following SMART activities are implemented to accelerate the capabilities of 21 century learning. (Table 5)

Table 5. SMART activity and Use of Supplementary Equipment

Activities	Use of Supplementary Equipment
Collaboration	Writing a scenario or group report using Google Drive Presentation after group work using Prezi
Communication	Sharing opinions, and rewriting through SNS(Twitter, Facebook) Group discussion and Instructor consultations using Google Hang-out
Thinking	Reconstitution of the data using one-note, ever-note Drawing mind map using x-mind
Creativity	Brain Writing using Sticky Producing creative animations using StopMotion, Animating Touch
Research and Experience	Research activities using the map and measurement apps

3.1.4 Analysis of SMART Instruction Model

First, the 'Idea Sharing' instruction model aims to provide activities such as participation and sharing using the smartifacts. However, these activities are available with previous classroom environment through presentations or discussions. On the other hand, there is a risk of creating a 'quiet classroom' with the use of smartifacts. Therefore, 'Idea Sharing' instruction model can be further improved by having the students to prepare to share the newly gained knowledge or ideas in the class for the following class period.

Secondly, 'Research activity centered' instruction model has merit of searching and using the information real time. However, it depends more on the internet and database search rather than on the students' critical thinking development; also time can be wasted focusing on putting presentation together using the computer, rather than being spent on the academic contents. Therefore, it is important to secure enough time to analyze and communicate the gathered information and spend less time on the search and gathering.

Thirdly, 'SMART activity centered' instruction model allows the students to present the results in various forms such as group report and animation, which was harder to do in previous classroom environments. However, when the focus is on the activities, the students may be distracted using the applications causing less academic achievement. Therefore, it is important to induce the students to have more interest in the academic evaluation or feedbacks rather than in the activities.

4. CONCLUSION AND RECOMMENDATION

SMART education can be seen as the change in the paradigm which brings in the smartifacts of the twenty-first century digital media environment to offer activities such as search, sharing, communication and application to improve classroom experiences. Various instruction models are being developed with SMART education introduced, and analyzing this trend, it was found that SMART education allowed various real time data search, communication, and presentation to be possible; with previous instruction models, such activities were not easily granted. However, if the spotlight is on the usage of smartifacts in the activities, the SMART education will not be practical. Therefore, there is a need for continuous research on the instruction models to increase the students' capabilities and better class instruction methods. Clearly indicate advantages, limitations and possible applications.

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THE HISTORY HARVEST: AN EXPERIMENT IN DEMOCRATIZING THE PAST THROUGH EXPERIENTIAL LEARNING

William G. Thomas and Patrick D. Jones
Department of History, University of Nebraska
612 Oldfather Hall, Lincoln, NE 68588-0327 USA

ABSTRACT

The History Harvest project (http://historyharvest.unl.edu) is an open, digital archive of historical artifacts gathered from communities across the United States. Each year, The University of Nebraska-Lincoln Department of History partners with local institutions and community members within a highlighted area to collect, preserve, and share their rich, but often hidden, histories. Advanced undergraduates, working as a team and with the guidance of faculty members and graduate students, "harvest," digitize, and curate the artifacts and stories they collect. The History Harvest project is rooted in the belief that our collective history is more diverse and multi-faceted than most people give credit for and that most of this history is not found in archives, historical societies, museums or libraries, but rather in the stories that ordinary people have to tell from their own experience and in the things - the objects and artifacts - that they keep and collect to tell the story of their lives. The History Harvest, then, affirms the importance of local people, local communities and everyday experience in the broader narrative of American history by providing an innovative opportunity for ordinary people to share their historical artifacts, and their stories, for inclusion in a unique digital archive of what we are calling the "people's history." This new public resource is then available for educators, students and anyone else interested in engaging U.S. history from this more democratic, or grassroots, perspective. This short paper on our work-in-progress examines the experiential learning basis for The History Harvest project and its rationale for democratizing history in a digital age.

KEYWORDS

History, Experiential Learning, Authentic Learning, Digital History, Digital Humanities

1. INTRODUCTION

In The History Harvest, an experiential learning initiative led and organized by University of Nebraska-Lincoln to collect, preserve, and digitize the people's history, we propose a community-based model for experiential learning in the undergraduate history curriculum. In this short paper we provide the rationale and background for our work-in-progress. The project has been featured recently in *The Chronicle of Higher Education* (December 2012) and the American Historical Association's magazine *Perspectives on History* (January 2013). Overall, the History Harvest project aims to create a new model of undergraduate learning in the humanities that is team-oriented, student-led, community-based and integrated through digital technologies. Furthermore, the History Harvest project seeks to democratize history by creating public conversation about the materials of history and their meaning, as well as through the creation of an online public archive, which makes available new material -- the artifacts of everyday life -- for historical study, K-12 instruction, and life-long learning. To date, we have run four "harvests" with both undergraduate and graduate students in 2010-2012.

2. MODELING EXPERIENTIAL LEARNING IN DIGITAL HISTORY

Grounded in the pedagogy of experiential learning, The History Harvest places advanced undergraduate students in a class designed to plan, run, and execute an on-site community digitization effort. Students work with and within the community, undertake interpretive analysis of the materials harvested, and curate these objects in a web site archive using widely accepted metadata standards. Led by faculty experts and supported by graduate students, undergraduates read secondary works about the major historical subjects relevant to the community's history, and they continually reflect on the process of doing history as they work through the steps of planning, organizing and executing the History Harvest event, then processing and archiving harvested materials. In addition, each "harvest" seeks out opportunities for students to work with local historical societies, museums, schools and other organizations to further the broad goals of the project, support community-based historical organizations and generally cultivate a broader and more sustained interest in historical preservation and knowledge. For instance, students worked with the Great Plains Black History Museum in North Omaha to rehabilitate important archival materials that had been damaged and the Making Invisible Histories Visible summer history program for "at-risk" middle school and early secondary school students. (Teaching Tolerance 2012, Jonassen et al. 2003).

The benefits of experiential and authentic learning seem clear to researchers. Marylin Lombardi has defined "authentic learning" as focused on "real-world, complex problems and their solutions using role-playing exercises, problem-based activities, case studies, and participation in virtual communities of practice." Students immersed in these activities cultivate important skills, including "synthetic ability" to recognize patterns, "patience" to follow long arguments, and "flexibility" to work across disciplinary and cultural boundaries. (Lombardi, 2007) Although aimed primarily at K-12 teaching and learning, David H. Jonassen's comprehensive research on experiential, constructivist pedagogy stresses the importance of uncertainty and complexity in learning scenarios. (Jonassen, 2005) He emphasizes the concept of computers as "mindtools" or "cognitive tools" and through which students develop "multiple mental representations, including structural knowledge, procedural knowledge, reflective knowledge, images and metaphors of the system, of strategic knowledge as well as social/relational knowledge, conversational/discursive knowledge and artifactual knowledge." (Jonassen, 2011).

But historians have been slow to adopt such pedagogies, despite the opportunities that digital technologies afford. In an essay on the future of digital history and undergraduate education, Edward L. Ayers recently called for students to participate in a cycle of "generative scholarship." (Ayers, 2013) He suggested that students build their work alongside ongoing research projects so that their contributions are assessed, validated, and preserved. The fundamental question humanities faculty face is: how do we reconstitute our classroom practices--literally what students do--for the digital age?

A number of digital humanities scholars and leaders, including Ayers, have suggested that we need to experiment with new models of undergraduate education in the humanities. Founder of the Perseus Digital Library, Greg Crane has recently drawn attention to the need for "a new culture of learning" not only for the field of classics, but also more broadly for the humanities. According to Crane, "we need to engage our students and our fellow citizens as collaborators. We need a laboratory culture where student researchers make tangible contributions and conduct significant research." Crane argues, "the crush of data challenges us to realize higher ideals and to create a global, decentralized intellectual community where experts serve the common understanding of humanity." (Crane, 2012b).

Crane's critique of the humanities deserves quoting at length: "Defenders of the humanities claim a special role in training citizens for a democratic society and often have deeply felt convictions about democratizing knowledge and including new voices. The mainstream of humanities research has, however, focused upon virtuoso scholarship, published in subscription publications to which only academics have access, and composed for small networks of specialists who write letters for tenure and promotion and who meet each other for lectures and professional gatherings. Students in the humanities remain, to a very large degree, subjects of a bureaucracy of information, where they have no independent voice and where they never move beyond achieving goals narrowly defined by others." (Crane, 2012a, Crane 2012b).

The History Harvest project is one effective model to achieve these ends. In the project, we attempt to reorganize the learning process for undergraduate students and to provide standing for community members to have a voice in what Crane calls "the republic of learning." The lesson in almost every digital history project has been that people have materials to contribute, and they also have expertise. At each "harvest,"

community-members are invited to bring and share their letters, photographs, objects and stories, and participate in a conversation about the significance and meaning of their materials. Each artifact and the story told about it are digitally captured and then shared in this free web-based archive for general educational use and study. Caring about everyday people's histories - their stories and their objects - validates their experience, which, in turn, has often resulted in an even greater appreciation of, and engagement with, history. (Crane 2012b).

The History Harvest on-site event features student-run digital imaging and filming tables for documents, letters, diaries, photographs, art, and 3-dimensional objects. To date, community members have shared remarkable documents and objects including: homestead family letter collections, railroad timetables, Civil War letters, rare commemorative silver sets, slave-owned cups and coins, church records, business records, rare music sheets, broadsides, pamphlets, uniforms, photographs, and posters. As we turn to the largely invisible archive in family and community collections, we see not only an opportunity to supplement our other archival records, but also to connect what have been long separated domains of historical understanding. Over time, as the digital archive grows and more people in different locales conduct harvests, exciting new opportunities will emerge to work with these materials and create new resources and tools for historical exploration, from curriculum, to audio and video programs, to networked exhibits that link materials across the many harvests.

In the 1990s the animating spirit behind much of the work in digital humanities was democratization. At that time, a small group of like-minded librarians, scholars, technology professionals, and students saw early on that the World Wide Web opened up new possibilities for scholars to communicate not only with one another but also with the public, with an audience largely unmediated by traditional gatekeepers. Their ambitions then were to transform the way history was understood by changing the way it was produced and accessed. In fact, we cannot change the way history is understood without changing the way it is produced and accessed. The History Harvest project seeks to recover this animating spirit in a time of increased privatization and commercialization of the sources necessary to do history and to make good on the promise, long articulated, but rarely achieved, that digital technologies might yet transform the way history, as well as the broader humanities, is taught and learned. It is precisely the hybrid formulation of this approach, blending elements of traditional classroom-based teaching, with more recent calls for innovative, student-led and community-oriented approaches, along with digital and other technology-based methodologies, that has proven so powerfully transformative for teachers, students and local communities.

Finally, as communities explore their common heritage, students and participants recognize the real consequences of history for today. Some communities have had their histories expropriated and abused for generations by state powers, large institutions, including universities, and political organizations; distorted by mainstream media outlets; or simply ignored or minimized by the majority. The History Harvest seeks to address these deficiencies in the mainstream historical record by empowering communities, encouraging dialogue, and enabling preservation without appropriating the past or taking material objects.

In the next phase of the project we will run distributed History Harvest classes at the same time at three institutions. Students in the three sites will build the digital archive, and work across institutions on interpretation, curation, and analysis of sources related to a particular theme. We will conduct research to evaluate the way History students can be trained to work with technical scripting and the way Computer Science students can be trained to evaluate and interpret data in historical context. This interdisciplinary nexus of skills, habits of mind, and communication lies at the core of several unanswered research questions. How do students effectively collaborate across disciplinary boundaries? What sequences of skill and habits of mind work most effectively in each domain? What technical scaffolding is necessary to support such work? Using social media, high-speed Internet connectivity, mobile devices, and social networking tools, we anticipate a high rate of adoption and adaptation of The History Harvest concept. As the project grows, the interactive, collaborative possibilities are virtually limitless.

3. RESULTS AND SUMMARY

Our results, measured qualitatively with student exit interviews and community participant responses, indicate the following: that students undergo a profound transformation in their understanding of history and its meaning, and develop a range of core skills along the way, which are applicable within a range of potential future professional pathways; that there is strong and enthusiastic support from most local people and community organizations for this sort of innovative "people's history" effort and that the History Harvest project often engenders broader local discussions among community partners about the value and meaning of their history; and that digital cameras, scanners and other similar technologies allow for rapid, accurate, and efficient capture of historical materials on site, while the online environment provides a new and widely accessible way to organize and share this "people's history." (see http://historyharvest.unl.edu/multimedia).

Through this experiential learning project we have the opportunity to make previously inaccessible materials visible and usable. Just as important, we see the History Harvest as a way to open up and make more accessible who is included in our history. Alongside this ambitious goal we propose reorganizing the undergraduate experience in the humanities by building a collective research project for undergraduate contribution. Taking advantage of the new technologies for digitization and new media for the presentation and analysis of historical sources, The History Harvest serves as a prototype for a model of undergraduate e-learning in the humanities: one that is experiential, student-led, team-oriented, networked, community-based, "generative," and interdisciplinary.

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CHALLENGES OF MONGOLIAN E-LEARNING AND AN IMPROVEMENT METHOD OF IMPLEMENTATION

S. Baigaltugs PhD[1], B. Munkhchimeg[2] and J. Alimaa
[1]*Computer Science Department, Computer Science and Management School of MUST*
[2]*Virtual Technology department, E-open School of MUST*

ABSTRACT

The Internet has brought about, a revolution in education, more precisely with regards to online learning. Online education has helped remove many barriers which traditionally hindered access to education due to its relatively low price and high flexibility in how and when courses and paces courses are taught.
In this study, we carry out a survey of the need of e-learning for students at the Mongolian University of Science and Technology to find out about their learning preferences.
E-learning, if used effectively can help address the many short-comings of the traditional education methods as well as the inherent problems the classroom teacher is faced on a daily basis with a classroom of learners with different learning. We therefore propose a model for e-learning that provides adaptive tutoring using technology-enhanced learning. An important aspect of Learning Management Systems is their ability to offer collaboration tools to build a community of learners.
The aim of this document is to provide support for the cost-effective use of e-learning technology and content in education and training by setting out a national framework for the education system.

KEYWORDS

e-learning, challenges of e-learning, readiness of students for e-learning, an e-learning framework

1. INTRODUCTION

Mongolian higher education system currently has 101 universities, 15 state universities and 81 private own universities. Every year, about a thousands of students apply to enroll into these universities now the number of students are 173 000 [1].

Over the past 10 years the number of higher education institutions has increased to 178, of which 135 are private. Enrollment at private higher education institutions has more than doubled over the past 4 years. According to data provided by the Ministry of Education, Culture and Science of Mongolia, the national education system benefitted US$110,000,000 in grants during the period of 1997-2008 and US$55,000,000 in loans for 1997-2011.

2. THE CURRENT ISSUES OF E-LEARNING IN MONGOLIA

E-Learning in Mongolia began in the late 1990s and since that time has accumulated a lot of experience. Several projects developing e-learning in Mongolia were implemented with support from UNESCO in 1992 – 1997, 1997 – 2001.

Given Mongolia's relatively small population of 2.7 million people and with US$ 165,000,000 in external aid, the national authorities should be able to ensure adequate learning opportunities for all citizens. However, during a Conference of educational methodologists from remote aimags (provinces) raised concerns about the lack of text books, especially those required in minority languages, lack of infrastructure and pointed out discrepancies between the investment in high-tech, consultant services and the outcomes at the grassroots level.

The National Center for Non-formal Distance Education had an estimated value of US$300 million from the central budget from 2002-2010.

There was no meaningful link found between schools and industry, nor was there adequate financial support in place for the implementation of e-Learning systems, simply because many universities failed to allocate sufficient funds for e-Learning.

E-learning initiatives in Mongolia are being undertaken mainly by universities, colleges and business enterprises. The main players of e-learning are private and public institutions of higher education as well as local and multinational corporations.

The main challenges we are currently facing are:

- Lack of specialists
- Insufficient financial aid
- No standards
- Incomplete common learning management system
- Insufficient preparation of e-tutors. There is a strong requirement to develop e-learning framework suitable for specific country to solve the problems. E-learning frameworks are developed by a number of specialists adapting their country's condition.

The main objective of our research is to propose an e-learning framework for Mongolian higher education system according to the universities based on the e-learning development and implementation training program developed by the German International organization GIZ and Inwent.

In this paper, we carry out surveys with students at the 10 different branch schools of Mongolian University of Science and Technology to find out about their readiness for e-learning according their own preparation, and their perceptual styles that help them learn best.

700 students responded to the survey over a two-week period at the end of May 2011 from 10 branch universities.

1st grade students – 231, second grade -166, 3rd grade 183, 4th grade – 93, 5th grade - 21

Students have permanent internet connection made up 79.2% of the total respondents. Of these, the different types of connection available to students were: home 42%, university 19%, internet café 32%.

48% of respondents were aware that it is now possible to use a internet connection 1-2 hour a day, 24% of them use 3-4 hour a day.

Which subject will you learn online?

History and social study-190, Computer- 284, **Physics and mathematics-**85, **Special course-**252, **Foreign language-** 304

	Strongly disagree	2	3	4	5	Strongly agree
I think I would be able to read and learn, or follow the direction on a computer screen to accomplish a task	56	61	96	111	279	5
I would able to take notes while watching a video on the computer and would able to have read online or in books	28	40	127	135	257	2
I think that I would be comfortable having several discussions taking place in the same online chat even though I may not be participating in all of them	31	65	106	148	231	1
I think that I would be able to use online tools (e.g email, chat) to work on assignments with learners who are in different time zones	36	49	125	156	204	1
I would rather listen to a lecture than read the material from a computer screen	38	44	98	68	133	2
I would rather find out information using a computer than from a teacher or lecturer	74	94	72	74	59	2
I cannot learn using only computers, I need the teacher/student contact	49	58	95	107	269	4

Would you like to learn online instead of face to face training via the internet?

I will study online if it available	I think face to face learning would be rather than online	I'd like, but I am not able to use internet everyday	I'd like, but I don't have own computer	I will not attend online training because of weak computer literacy	I will not attend online training because of weak usage internet
318	179	143	82	24	22

What kind of learning materials do you prefer?

Learning material	Strongly disagree	2	3	4	5	Strongly agree
Printable book, learning materials	22	61	73	61	120	257
CD, DVD materials	74	60	84	105	87	113
Handbooks and reading books	28	40	83	86	120	192
Downloadable materials	62	48	72	72	70	238

Do you think the lecture is most important tool of training?

Training tools	Strongly disagree	2	3	4	5	Strongly agree
I prefer the online training rather than lecture	153	65	74	88	47	101
Lecture is very important tool of training	19	38	75	74	92	238
Lecture would be efficient with workbooks	26	33	76	88	103	184
I think the blended learning would be efficient	35	34	79	65	97	213

Do you complete the task on time during face to face learning? Yes -165, sometimes – 449, no - 65

3. A FRAMEWORK FOR E-LEARNING DEVELOPMENT AND IMPLEMENTATION

In recent years there has been significant progress in the development of technology to support education and training. This has included not only the development of simulators and interactive e-learning products to support learning, but also new learning management tools to test, record and report individual progress.

The purpose of the e-Learning Framework is to help organizations to take the next steps in developing e-learning. The adoption of e-learning is a key element in improving the delivery of quality education.

The aim of this paper is to provide support for the cost-effective use of e-learning technology and content in education and training by setting out a national framework for the education system. The e-learning Framework for education sets out:

- The national vision for the development of e-learning;
- How users can find details of current products and those which are being developed;
- How organizations, professional bodies and individuals can participate in identifying future priorities for product development; and
- The roles and organizations at different levels of the education which play a role in supporting the development of e-learning.

The Eight component framework for e-learning is global instructional design method designed by Badrul H. Khan. This framework is more complex, convenient for whole education system.

Design, development, implementation and evaluation of open and distributed learning systems require thoughtful analysis and investigation of how to use the attributes and resources of the Internet and digital technologies in concert with instructional design principles and issues important to various dimensions of online learning environments.

3.1 Stage 1

E-Learning management refers to the management of eLearning projects. From a business studies point of view, it refers to guidance and control. As for eLearning, ‘management’ is mostly concerned with the **planning, implementation and assessment** of eLearning projects.

This statement, one of the core features of a project as it states the importance in project management of defining a clear objective. It is paramount, however, that the overall goal is **clearly defined and communicated** to everybody from the very beginning.

3.2 Stage 2

In this stage the necessary steps to draft the concept for a course from vaguely formulated educational needs to be developed..

The process of instructional design should result in a course that enables the learner to reach a certain objective. Methods and media have to be planned to support the objectives in the best-possible way.

3.3 Stage 3

This stage will develop eLearning material for eLearning courses and need answer following questions.

- How to develop added value (multimedia, animation, graphics, interactive audio, video, simulation units) for eLearning content?
- How can learning progress be checked in an eLearning course?
- How can you give learners helpful feedback and keep a record on the learning objectives individual learners have reached at any given time?
- How the designs of technical sheet look like?

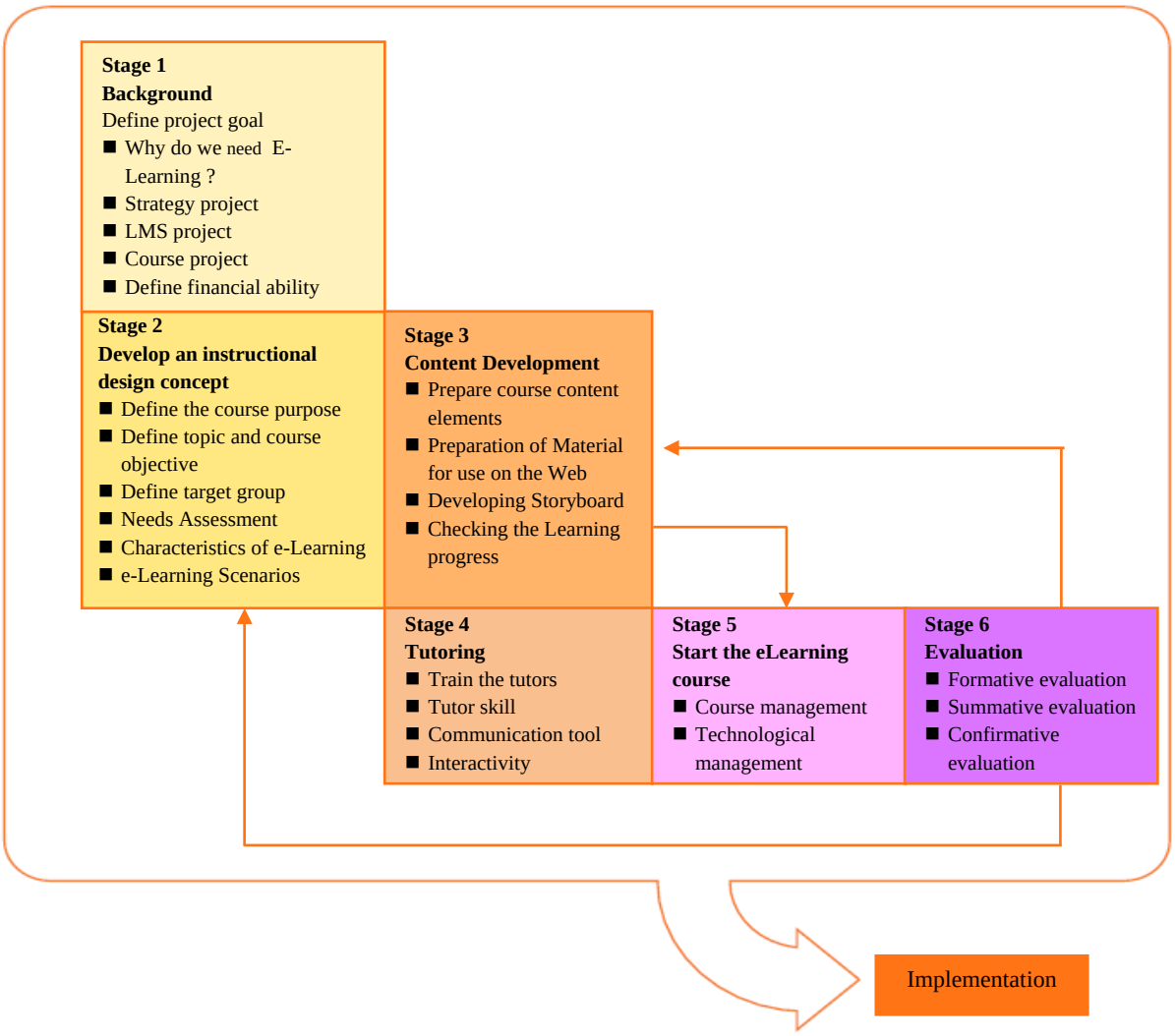

Figure1. A model for e-learning development and implementation

3.4 Stage 4

- What possible interactions can be integrated in eLearning and what should you be aware of while planning interaction in an eLearning package?
- Why is tutoring an important tool of eLearning, and what are the requirements and tasks a tutor needs to fulfill?
- What are the tools a tutor can use to fulfill these tasks? What are their specific features, and how can they be used?

- What forms of feedback are there, and what rules do tutors need to bear in mind when writing feedback?
- What are the factors defining a culture, and what are distinguishing features of cultures?

The idea of using e-learning systems was focused around the ability to connect with external and distance education students and provide greater access and flexibility to these students. However, e-learning has now become a core component of the education experience for many students in higher education and an ever-increasing combination of face-to-face (F2F) learning and e-learning is now occurring. This learning, referred to as blended learning, uses technology to expand the physical boundaries of the classroom, providing access to learning content and resources and enhancing the instructor's ability to receive feedback on learners' progress.

The most significant factor in the study was that of structure and user experience. It highlights the need to design computer supported collaboration tools that encourage student interaction to produce collaborative knowledge building through communities of practice.

The new generation of LMSs will not focus only on learning content creation, delivery and assessment, but will try to include collaborative learning and teaching methods. This new approach guarantees the rise of students' motivation for learning and leads to the better results. All learners taking an LMS-based course, regard-less of their knowledge, goals, and interests, receive access to the same educational material and the same set of tools, buffered with no personalized support. Students passed the exam from the first try with quite high average mark.

4. CONCLUSION

It's indisputable that the e-learning is the most efficient and sufficient learning method based on technology.

Now our immediate problem is how to get it accustomed correctly to our learning environment.

E-learning framework we present you is based on the most efficient and expedient e-learning practice organized worldwide. German organization "Invest" is conducting learning in this direction uninterruptedly since 2005 and has prepared many tens of specialists.

We carried out a study of 700 students from University of Science and Technology and intended to show that our learners are disposed or not for e-learning. And now it's important to study our purposed group before introducing e-learning to expose which learning method is suitable for present education organization.

Collaborative online learning is successful, because it requires continuous active participation during the academic year and more personal responsibility and concentration when learning. In that way, this approach to learning reduces the time needed for preparing the exam, contributes to successful passing of the exam and ensures deep level learning.

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TOWARDS A TRUST MODEL IN E-LEARNING: ANTECEDENTS OF A STUDENT'S TRUST

Woraluck Wongse-ek, Gary B Wills and Lester Gilbert
School of Electronics and Computer Science
University of Southampton
United Kingdom

ABSTRACT

When a student is faced with uncertainty in the trustworthiness of a learning activity to meet their intended learning goals, it may cause a student to have a state of anxiety and a lack of confidence in the teaching activity. A student's trust in the teaching agents' ability to provide an appropriate teaching activity is needed to reduce the student's uncertainty. In this paper, we present a conceptual trust model for an e-learning transaction. The trust model quantifies how much of the student's trust should be given to a teaching activity by using a learning outcome-based trust and a reputation-based trust technique. A possible utility of a teaching activity is estimated in order to calculate the degree of a student's trust in an outcome-based trust technique. It is hoped that the trust model presented in this paper could help a student choose the trustworthy material without any recommendation from an expert.

KEYWORDS

E-learning, trust, trust in e-learning

1. INTRODUCTION

Uncertainty presents a difficulty for students when choosing appropriate teaching activities and materials, especially for their self-study. A student's uncertainty can be resolved by building their trust in the teaching activities and materials in e-learning. For example, trust can be determined to choose appropriate learning resources from different providers in recommender systems, or used to explore people's experience to find out suitable groups of collaborative learning. However, the research of trust in e-learning is still lacking in terms of the evaluation method of trust in e-learning/teaching activities (Yingchun; Youli 2010). This paper is aimed at proposing a new conceptual trust model that can be used to calculate the student's trust, which is the degree of trust in a teaching activity within an e-learning transaction, from the perspective of the student. The model aims to support a student's decision-making when considering trust in teaching activities and materials. The paper is organised as follows. The related work for our trust model is given in Section 2, followed in Section 3 by the proposal of a conceptual student's trust model. Finally, conclusions are drawn in Section 4.

2. RELATED WORK

An e-learning transaction is defined as the consideration of a situation in which a teacher and a student are attempting to achieve the same outcome in a specific context (Gilbert & Gale, 2008). An e-learning transaction model is composed of three units: an intended learning outcome (ILO), a teaching activity and a learning activity. First, an ILO is a statement of what the student is expected to know and will be able to do at the end of an applied learning process. An ILO must be clear in order to support the delivery and assessment planning, such that students can recognise what is happening and understand how to cope with their learning and assessment (Macdonald, 1999). The general statement of an ILO is presented as, "By the end of the course, the student will be able to *X*, where *X* is a performance" (Gilbert and Gale, 2008). For example, in an e-learning lesson, an ILO is defined as "the student will be able to analyse target audience characteristics by

listing those characteristics pertinent to the e-learning under consideration". The performance is defined as "…to analyse target audience characteristics by listing …". The intended learning outcome consists of two primary elements: subject matter and capability. Second, a teaching activity is defined as an intentional activity of a teacher whose aim is to bring a learning activity (Hirst, 1971). The design of a teaching activity is considered in two parts: pedagogical content knowledge and types of teaching activity. The pedagogical content knowledge in teaching is sourced from teachers' own subject-matter knowledge of taught materials (Even & Tirosh, 1995). Several kinds of teaching material are used to represent the pedagogical content knowledge or the subject matter, such as an assignment in a book, an example in a video or a definition on a website. There are four types of teaching activity: "showing", "telling", "asking" and "feeding back". The teacher needs to decide which teaching activity is appropriate for the student based on the student's prior competence and the ILO. Third, a learning activity is an activity performed by the student that aims to bring about the achievement of a new competence by using an existing one (Hirst, 1971). In other words, every student learns in a unique manner and the new competence is acquired from a prior competence, such as a cognitive ability.

3. TRUST BASED ON LEARNING OUTCOME AND REPUTATION (TOR)

In a learning outcome-based trust technique, the antecedents of trust are derived based on the schema of intended learning outcome (sILO). In details, the sILO is a direct acyclic graph of ILOs (Tangworakitthaworn et al., 2013). The sILO is given by an expert to connect tasks between the teaching and learning activity. If we know exactly how an expert achieves ILO by their own knowledge, it is then possible to estimate any teaching activity's trustworthiness based on the expert's knowledge. When the schema of intended learning outcomes represents the expert's knowledge, the trustworthy teaching activity will be determined from the sILO. It is possible for students to estimate a degree of trust using their own assumption and trustworthiness information. The proposed conceptual student's trust model is aimed at helping a teaching agent provide the evidence of trustworthiness in teaching activities and materials for students. The construction of a student's conceptual trust model using a learning outcome-based trust and reputation-based trust technique (TOR) is shown in Figure 1. The antecedents of the student's trust model are grouped into three categories: a student's assumption to trust, a student's trust perception of a teaching activity, and a pedagogy context depending on the student's expectation of ILO (eILO). The details of each antecedent of a student's trust are described below.

3.1 Student's Assumption to Trust

In this work, '*student's assumptions to trust*' is defined as a notion of trust that a student considers to be true by themselves. Students have to choose an appropriate teaching activity in order to acquire or improve their technical skills or new subject knowledge. They need to develop their own opinions and make a decision to trust any new information themselves. Therefore, students need some notion of trust, so that they can estimate the trustworthiness of a teaching activity. The good assumption of trust arises from the good trust propensity and their prior competences (Bigley & Pearce; 1998 Mayer et al., 1995; Rotter, 1980).

Mooradian et al. (2006) reported that individuals with a low trust propensity perceive others as self-centred, conniving and potentially dangerous. People who have a high trust propensity believe that most people are sincere, fair and have good intentions. Trust propensity is an important factor that influences a trust antecedent in new, unusual, uncertain or unstructured situations and it is a measure of how willing an individual will be to trust someone before they have any information about that person. On the other hand, most of the time, the prior competences of a student are not enough to engage the new learning purpose or to use it to bridge new learning. Students may face difficulty in decision-making to trust in a teaching activity that will hopefully engage new knowledge. More potential of a student's related prior competences (pILO) to the teaching activity means an increase in student's trust in the teaching activity. Therefore, an analysis is needed of how many of a student's prior competences are potentially relevant for acquiring new knowledge. The teaching agent in e-learning should recognise the knowledge schema to understand students' background knowledge, and use the knowledge schema to bridge between student's prior competence and new learning. Therefore, the student's trust propensity and the student's prior competence are needed, especially when the trust prediction has little or no information about a teaching activity.

3.2 Trustworthiness of Teaching Activity

Past research has suggested that trust from a student's perspective is their willingness to believe and have confidence in a teaching agent, such that it will take appropriate steps to help them achieve their learning purpose or the intended learning outcome (Corrigan and Chapman, 2008). The teaching activity must have the following characteristics in order to give evidence about the value of the learning experience:

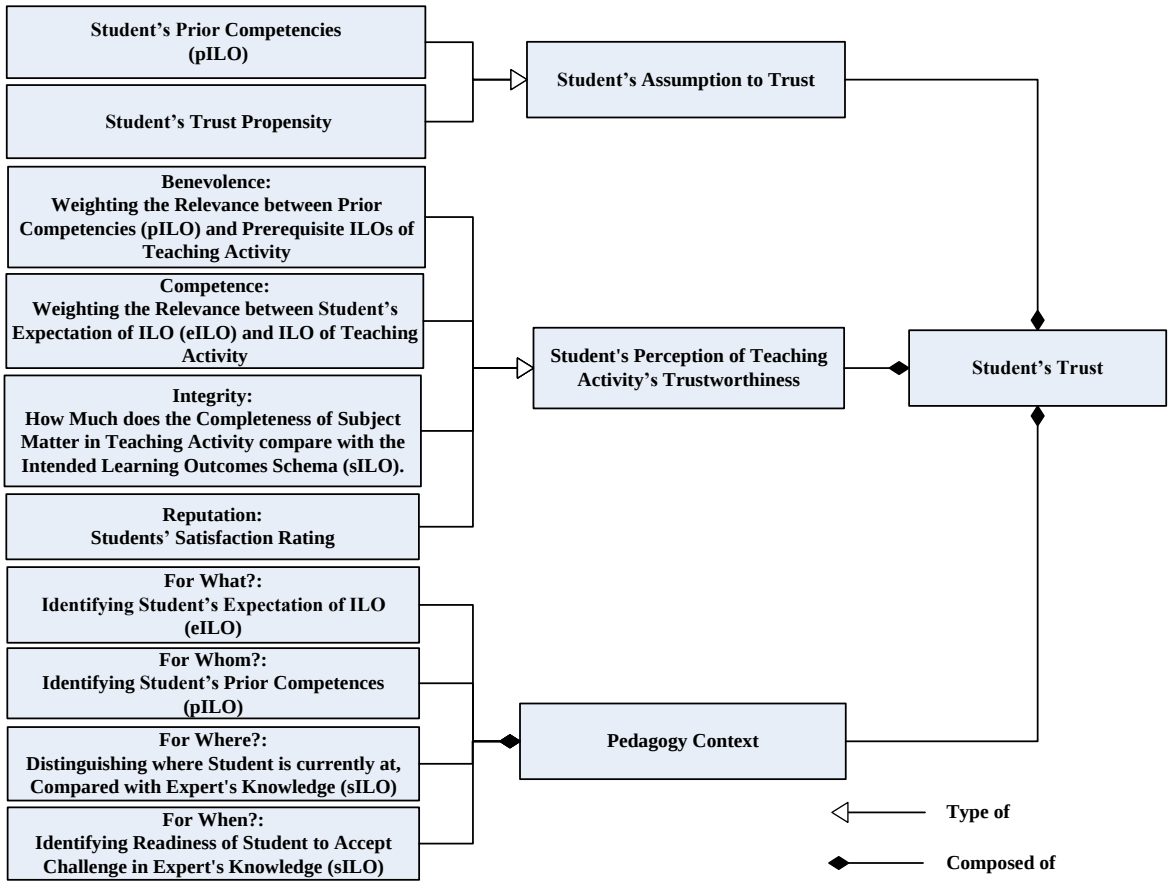

Figure 1. Conceptual model of a student's trust based on learning outcome and reputation (TOR model)

- Benevolence is the belief that the teaching agent cares about the well-being of the student. A teaching activity is benevolent if it is provided based on the student's expectations and prior competence. The benevolent characteristic of a teaching activity is measured by weighing the relevance between the student's prior competences (pILO) and the set of prerequisite ILOs of each teaching activity within the schema of intended learning outcomes (sILO).
- Competence is a student's perception that the teaching agent has the professional knowledge and abilities to fulfil its required tasks. Being competent could be measured by weighting the relevance between the student's expectation of ILO (eILO), and the ILO of each teaching activity within the schema of intended learning outcomes (sILO).
- Integrity is a student's perception that the teaching agent shows honesty with its sources of material and is honest to the student. The integrity could be measured as the completeness of subject matter content in a teaching activity compared with the schema of intended learning outcomes (sILO) and also detail of the source material used in the teaching activity, for example author details and material type, location, and modification date.
- Reputation is how much respect or admiration a teaching agent receives for giving the teaching activities, based on past transactions and interaction. Being reputable could be measured by student satisfaction ratings that focus on the importance of the teaching agent fulfilling its students' expectations.

3.3 Structure of Pedagogy Context

Literature has shown that trust formation can be improved by using context data (Jøsang 2005, Trbovich & Patrick 2004). We enhance the student's trust model by considering the pedagogy context to enrich trust estimation functions with the possibility of analysing contextual information. This research defines the pedagogy context as information that can be used to characterise the situation of a person or an object in a pedagogical environment. The pedagogy context is constructed by the teaching agent based on the student's expectation of ILO (eILO) and the expert's knowledge represented by the schema of intended learning outcomes (sILO). The pedagogy context is categorised into four parts:

- What? – What a student expects or wants to achieve. This is represented by the student's expectation of ILO (eILO) including the surrounding information and their condition.
- Whom? – Distinguishing the characteristics of a student by knowing how much knowledge a student already has (pILO) and how much knowledge a student needs in order to capture the necessary ILO in the schema of intended learning outcomes (sILO). Recognising what the trustworthy teaching activity is relevant to the student's expectation.
- Where? – Distinguishing where a student is currently at in the schema of intended learning outcomes (sILO) during the learning processes. Recognising what the trustworthy teaching activity is relevant to the potential of where that student could be.
- When? – Identify when a student is ready to learn each teaching activity. Identifying the readiness of a student to accept the challenge of the teaching activities. Recognising when the teaching activity could be delivered to the student based on the student's expectation of ILO (eILO), the student's prior competences (pILO) and the prerequisite ILO of teaching material.

4. CONCLUSION

In this paper, we present a conceptual student's trust model that shows the antecedents of a student's trust using learning outcome-based trust and a reputation-based trust technique. A student's trust is defined as the degree of trust from the student's perspective, and it shows the student's willingness to believe and have confidence in the teaching agent, such that the student will take appropriate steps to help them achieve their intended learning outcome (ILO). In more detail, the stating of learning purpose, the perception of evidence of trustworthiness and the student's own assumptions are introduced as antecedents to assign a student's trust degree in a teaching activity. The proposed trust model is aimed at estimating the student's trust degree in teaching activity even if the student has no opinion and without any recommendation from an expert. In future work, the TOR model will employ the fuzzy logic to calculate the degree of the student's trust, and be validated via a user evaluation. The accuracy and precision of the TOR model will also be quantified.

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ELEMENTAL LEARNING AS A FRAMEWORK FOR E-LEARNING

John V. Dempsey and Brenda C. Litchfield
University of South Alabama, UCOM 3800
Mobile, AL 36688 USA

ABSTRACT

Analysis of learning outcomes can be a complex and esoteric instructional design process that is often ignored by educators and e-learning designers. This paper describes a model of analysis that fosters the real-life application of learning outcomes and explains why the model may be needed. The Elemental Learning taxonomy is a hierarchical model composed of two primary types of learning: (a) elemental learning composed of actual and simulated elements; and (b) synthetic learning, composed of procedural understanding, conceptual understanding, and related knowledge. The importance of iteration and intuition in learning analysis is also discussed.

KEYWORDS

E-learning models, situated learning, learning analysis, instructional design, pedagogical models

1. INTRODUCTION

A primary assumption of meaningful e-learning is the fidelity of design to learning outcomes. The focus of this paper is that the primary design of assessment and learning activities that match learning outcomes should emphasize elemental (real-life or simulating real-life) learning. The emphasis on real-life learning outcomes is proposed from the perspective of a simpler taxonomical model that with five levels that can be easily grasped by non-instructional designers and applied to the analysis of meaningful learning outcomes.

More than ever it is possible to define learning progress along a "trajectory of experience" (Greeno, 1997). For more than a century, a conceptual approach related to guiding the learning experience has been argued along a loose continuum. One approach, beginning perhaps with Thorndike's specific transfer theory of identical elements (Thorndike & Woodworth, 1901), has emphasized situated learning outcomes. This approach emphasizes task-based learning and probably because of its early association with logical positivism and 'objective' use of data has been overly vilified by the overgeneralization of early behaviorists. The other end of the continuum supports the transfer of general skills and principles to promote learning. This was characterized early on, for example, by Gestalt psychologists such as Wertheimer (1945) and Katona (1940). Because of the decontextualized nature of the general skills and principles approach, inductive learning philosophies (e.g., constructivism and connectivism) the common sense inclination of many educators is to see the merit in both positions (e.g., by De Corte, 1999). Few would argue, however, that learning activities and assessments that provide a situated context are more likely to retained in long-term memory and more able to be applied in a real-life environment. Although we keep reinventing it, the theory and research supporting these ideas have been very well-defined as early as the days of Thorndike and Dewey. The challenge is to apply these ideas in a simpler approach for analyzing teaching and learning outcomes in such a complex, information-bloated environment as e-learning.

2. LEARNING ANALYSIS AND LEARNING TAXONOMIES

Learning analyses are formal approaches to clarify the rational relationships among learning outcomes. In terms of intentional learning environments, such as higher education or technical training, two methods have been employed with some effectiveness: taxonomies and rule-based frames.

Using a learning taxonomy is appropriate when content is characterized by rational relationships. Classic learning taxonomies include those by Bloom (1956) and Gagne' (1985). The approach here is to ask in effect, "If you were to assess what the learner knows or can do, how would know?" The taxonomies of Bloom and Gagne' provide an rational way to approach that question by defining learning outcomes as abstract concepts and identifying the nature of the intentional or incidental (or unintended) learning outcomes that provide the learning as well as the relationships among the learning outcomes. Figure 1 illustrates Gagne's intellectual skills subdomain.

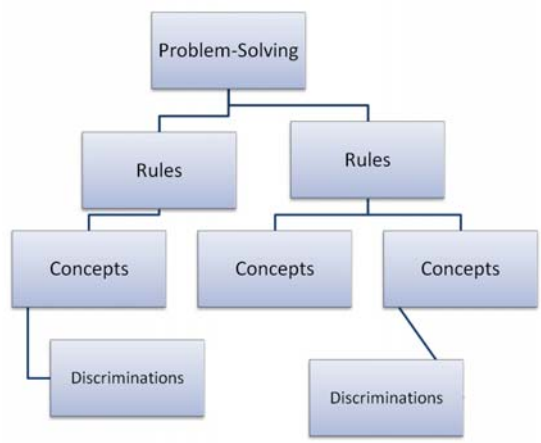

Figure 1. Gagne's Intellectual Skills Subdomain

As you can see, in this taxonomy problem-solving or higher-order skills depend on rule or procedural prerequisites; rules depend on concepts, both abstract (e.g., love or identity) and concrete (e.g., table or dog); and concepts require discriminations. This approach is hierarchical and deductive. It has been used routinely by skilled instructional designers to analyze what must be learned or assessed. It is very effective in indicating the essential prerequisites for a course or e-learning module (Gagne and White, 1978)

Another approach to learning analysis is a rule-based frame. A rule-based frame is a superb way to structure intelligent computer-based learning scenarios or examples and has increasingly been employed in computer-adaptive examinations. Figure 2 illustrates a matrix of related content that has been used for structuring question-based or declarative examples, case studies, identifying misconceptions, and so forth. When designed in rationally appropriate algorithms for computer software, rule-based frames (sometimes referred to as Type 2 Frames) identify specific classification problems, such as misconceptions or overgeneralizations) and adapt by providing classification examples that emphasize appropriate levels of discrimination (telling the difference between rationally related content) and generalization (applying to increasingly complex or divergent examples).

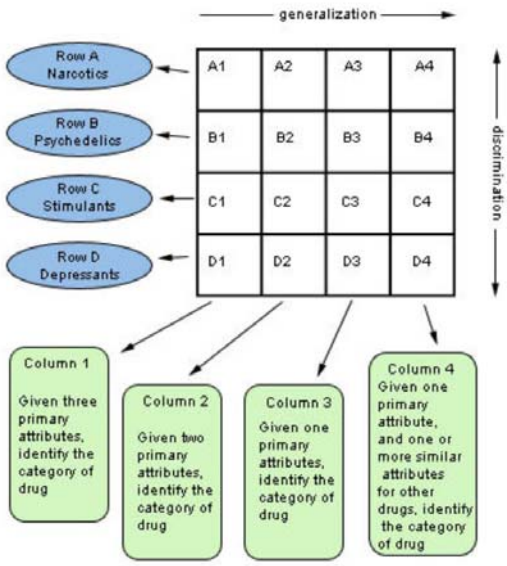

Figure 2. An example of a rule-based frame (from Dempsey & Driscoll, 1996)

The advantages of using classic learning taxonomies or rule-based frames to analyze frames are several. They provide a systematic approach to thinking about learning content for assessment or structuring rational relationships including essential prerequisite knowledge and skills. They can be empirically verified by learner responses. In addition they have relevance for advanced e-learning software applications including artificial intelligence, computer-based testing, computer-based testing, and systems-type wizards. Unfortunately, these approaches are not used at all or used ineffectively by most educators. Simply put, they are just too complicated to be easily applied by content experts and even less-skilled instructional designers.

3. ELEMENTAL AND SYNTHETIC LEARNING

Another approach to learning analysis and design is to emphasize elemental (real-life or simulating real-life) outcomes and, when these are identified, look for those synthetic outcomes that support their learning. Elemental Learning refers to the actual or real tasks applied in a real or close proximate environment in which the learning outcomes will be used. They are context- and content-specific. They can also contribute to learning similar elemental outcomes by virtue of the learner's enhanced experiential schema. An obvious example for the need for elemental learning involves the training of airline pilots. Who would want to be a passenger in an airplane in which the pilot had not experienced learning in an actual passenger airliner?

By contrast, synthetic learning outcomes are the cognitive learning outcomes necessary to support elemental learning. Synthetic learning outcomes are less context-specific, and the learner's experience is often less important in acquiring these outcomes. Synthetic here refers to forming something new (elemental) by combining other, usually decontextualized, outcomes. These are the traditional learning outcomes. In taxonomies such as Bloom's (1956) or Gagné's (1985), these are traditionally believed to be hierarchical, i.e., learning rules requires learning concepts, some basic knowledge is required, and so forth.

Figure 3 illustrates a simpler, more direct taxonomy that focuses on elemental learning outcomes. After elemental learning outcomes are identified, synthetic learning outcomes that support them are added. Elemental learning provides the context. Synthetic learning outcomes support the context.

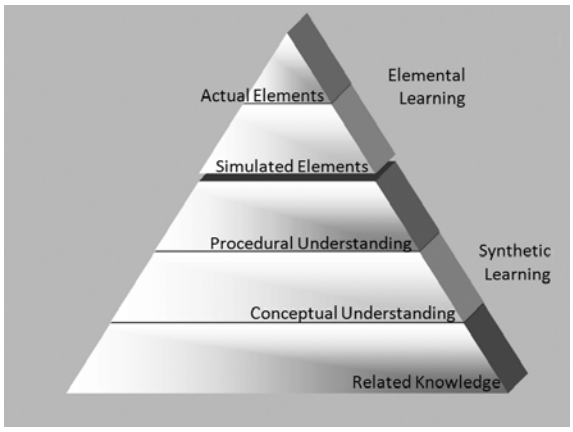

Figure 1. Elemental learning taxonomy represented as a pyramid culminating in actual elements. The top two levels are elemental learning outcomes. The bottom three learning outcomes are viewed as synthetic

3.1 Components of the Elemental Learning Taxonomy

Actual Elements are the most direct measures of the real learning outcomes required by the real environments in which the learner needs to use those learning outcomes.

Simulated Elements promote learning transfer. They reproduce reality or some version of reality "close enough" to actual elements. Although simulated elements may be lacking in some essential characteristics of reality, they retain the context of reality to some purposeful extent.

Procedural understanding requires that learners "walk the walk," not just "talk the talk." Even though procedural learning can be very complex it is missing essential features of the context. Even so, it is a "DO" learning outcome versus a "Know" outcome.

Conceptual Understanding can be abstract or physical. It can be learned (and assessed) by novel examples and nonexamples, by metaphors, and by inductive observation and reflection.

Related Knowledge associated information is intentional (e.g., from an Internet resource accessed via a handheld mobile device) or incidental (e.g., from a television program on another subject).

These categories are not exhaustive. For example, motor skills and affective learning are certainly important. Motor skills and affective learning are also contextual and almost always are highly associated with elemental learning. For example, how do we learn an attitude? One way we do is to intentionally or unconsciously emulate a human or human-like entity in our life (a mentor, perhaps) or in a simulated experience (e.g., an actor in a movie). It is the real or simulated experience that guides the choices we make that exhibit the attitude learning that has taken place.

3.2 Iteration and Intuition

Elemental learning has a theoretical foundation in the notion of spiral curriculum popularized by Jerome Bruner (1960). In a spiral curriculum, the learner revisits real or simulated learning situations iteratively and each time the learning deepens by building on prior experience (p.13). Complex learning outcomes (e.g., negotiating effectively in a foreign language in an alien culture) require the gradual scaffolding offered by iterative elemental learning scenarios. Experiential iterations of these sorts also subsume and give meaning to supportive synthetic learning outcomes. In a spiral curriculum challenge (difficulty) is increased as the learner's competence increases through iteration.

Iterative processes of elemental learning also promote "intuitive leaps." Bruner often referred to experts performing real tasks where they "leap intuitively into a decision or to a solution to a problem" (1960, p.62). In medicine and other areas, such as physics, intuitive leaps are referred to as the forward reasoning (from data to solution) applied by experts [7] versus the backwards (rigidly algorithmic) reasoning of novices.

4. CONCLUSION

The elemental learning model does not exist in a vacuum. Its goal is to provide a simpler method of analysis that result in significant learning outcomes. Established learning analysis models (e.g., Gagne's Taxonomy or rule-based framing) can be employed effectively to promote specific learning outcomes. Unfortunately, these models often result in decontextualized learning. They take some expertise to use in educative practices that result in increased learning retention. Additionally, they can be cumbersome to apply and thus the important practice of learning analysis is often neglected.

The elemental learning framework situates learning in reality (actual elements) or a mockup of reality (simulated elements), and does so iteratively to the extent that is possible. In analyzing a course or a module or some other e-learning situation, the challenge is to move beyond "giving" decontextualized knowledge and general principles (synthetic learning outcomes). The elemental learning framework provides a structure for contextual learning that is so often lacking in e-learning environments. Actual and simulated learning outcomes supported by synthetic learning outcomes create the structure without over-controlling the natural challenges of meaningful learning experiences.

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AN INTERACTIVE TRAINING GAME USING 3D SOUND FOR VISUALLY IMPAIRED PEOPLE

Hsiao Ping Lee[1, 2], Yen-Hsuan Huang[2] and Tzu-Fang Sheu[*]
[1]*Department of Medical Research, Chung Shan Medical University Hospital, Taichung, Taiwan, R.O.C.*
[2]*Dept. of Medical Informatics, Chung Shan Medical University, Taiwan, R.O.C.*
[*]*Dept. of Computer Science and Information Engineering, Providence University, Taiwan, R.O.C.*

ABSTRACT

The number of visually impaired people is increasing year by year. Although attention has been given to the needs of people with disabilities, most of the discussion has focused on social welfare, while talk about assistive technology for people with disabilities is rare. The blind need training courses for reconstruction and rehabilitation. Orientation and mobility (O&M) training is important for visually impaired people, teaching safe, efficient and effective travel skills. Skills learned from O&M training courses can help the blind walk on the street safely. Crossing the street is especially dangerous, since blind people cannot see traffic lights, and rely mostly on sound for information about their environment. Thus, learning to recognize the varied sounds of vehicles and determining the direction and speed of moving vehicles is critical. In this paper, we propose an interactive game with 3D sound that simulates a busy street environment. The proposed game tries to build a virtual environment with 3D sound to help visually impaired people learn to cross the street safely. As the proposed training game is designed for the blind, the technologies of Kinect and Text-to-Speech (TTS) are used in the human-computer interface in the proposed game, so that they can use the game independently.

KEYWORDS

Visually Impaired; Assistive Technology; 3D Sound; Kinect; TTS.

1. INTRODUCTION

Vision is the most important and natural way humans receive information from the environment. We rely on vision to handle most of our tasks every day. Those with adventitious blindness depended on vision to receive most messages from their environment before going blind, so it is difficult for them to adapt when they lose their eyes. For example, if we drop a key, we will look for the key with our eyes and pick it up. Visually impaired people, on the other hand, have to listen to the sound when a key falls. Today, the number of visually impaired people is increasing year by year. Although a great deal of attention has been given to the needs of people with disabilities, most of the discussion has been about social welfare rather than assistive technology for people with disabilities. Training courses in reconstruction and rehabilitation allow the blind to lead a more independent life.

Orientation and mobility (O&M) [1] is important training for visually impaired people. O&M is a profession that focuses on instructing individuals who are blind or visually impaired in safe and effective travel through their environment [2]. O&M training research is carried out by medical and special education researchers, however, most O&M training needs extensive space and expensive facilities. At the Institute for the Blind of Taiwan, for example [3], the trainee needs a large area in which to train. The instructor assists the blind person in learning to use a white cane or guide dog to walk on the road [4]. After training, the blind person can sense his or her location by noise, smell and sound direction. The limitation is that the visually impaired person cannot learn alone, an instructor must assist with the training. Our goal is to develop O&M training for blind people using assistive technology. We want the training to be entertaining, game-based, and easy for visually impaired people to use by themselves.

In this paper, we report the development of an Auditory Perception Re-establishment Training System (APRETS) for visually impaired people. APRETS can simulate the traffic on a busy street environment, assisting the blind to learn to cross the street using 3D sound. APRETS is simple to operate by motion detection, using the Kinect system. The rest of the paper is organized as follows. Previous work related to APRETS is presented in Section II. The state of the art in software in discussed in Section III. This is followed by the implementation of APRETS in Section IV. We had visually impaired people test our system, and report the results of the test in Section V. Finally, the conclusions of this work are given in Section VI.

2. BACKGROUND AND RELATED WORKS

APRETS uses 3D sound technology to simulate real 3D traffic sounds, which are synthesized using computerized techniques [5]. Most 3D sound techniques are based on head-related transfer function (HRTF) [6]. HRTF is based on the principles of Interaural Time Differences (ITD), Interaural Intensity Differences (IID) and the Pinna Effect to generate 3D sound [7]. In reality, if you hear one sound, the time and the intensity of the sound detected is slightly different in the two ears, allowing us to judge the sound direction. Software allows us to duplicate this effect using HRTF. As the technology improves, the sound cards already in personal computers will allow us to hear 3D sound.

APRETS uses a motion detection to operate the system. The motion detection system we used is "Kinect," introduced by Microsoft in 2010 [8, 9]. As opposed to traditional game control systems, Kinect uses body motion, allowing the player to control the game instinctively. Using the same properties, Kinect can be used in other domains, such as education and rehabilitation [10, 11]. The Kinect sensor is a horizontal bar connected to a small base with a motorized pivot and is designed to be positioned lengthwise above or below the video display. The device has an RGB camera, depth sensor and CMOS running, which provides full-body 3D motion capture.

In the Kinect development kit, we used "OpenNI" (Open Natural Interaction), a multi-language, cross-platform framework. Currently supported platforms are Windows, Mac, and Linux [12]. OpenNI has a three-layer concept. The first layer represents the interaction applications. The second layer represents the middleware components. The third represents the hardware device such as a microphone, color camera and 3D depth camera. In OpenNI, there are two types of Production Nodes; one is a Sensor Related Production Node, the other one is the Middleware Related Production Node. Therefore, OpenNI can run in three modes: (1) full body analysis, (2) hand point analysis, (3) gesture detection and (4) scene analyzer. We use these modes in our system.

Text-to-speech (TTS) is used in the human-computer interface in APRETS. The TTS system converts normal language text into speech [13]. Through many years of development of TTS, the output speech is becoming quite fluent. Different TTS engines can support different languages, but our TTS engine outputs English speech.

APRETS is an interactive game for visually impaired people, so our goal is "Game Accessibility" [14]. In general, intuitive operation in game design has three components [15]: (1) Continuous presentation, (2) Physical actions, (3) Reversible actions with immediate feedback. From the above, we can know the message present, the operating mode and the immediate feedback are game design points. For visually impaired people, our goal was to create an Audio Game, designed with the following capabilities [16]:

- Voice Navigation
- Voice can repeat
- Easy Control
- Different levels
- Objects Hint

The interactive game that we proposed has the following features:

- No special space is needed for training; APRETS can be used in anywhere.
- No expensive facilities are needed; it uses only headphones, Kinect and a PC.
- Easy to use; visually impaired people can operate it independently without help.
- 3D Sound technology is used in the game; 3D sound simulates the environment of busy street traffic, with many different vehicles simulated.
- Supports speech feedback.
- Visually impaired people can use Kinect as a special human interface.

Our system can reduce the expense of O&M training for blind people and give them higher motivation to participate in the training. APRETS uses a text-to-speech engine so blind people can accept and control APRETS easily.

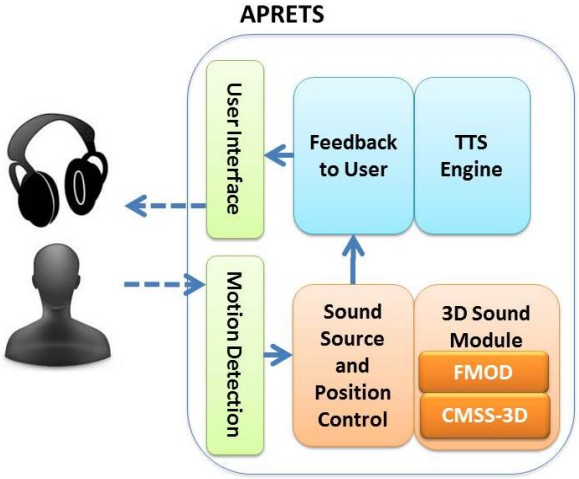

Figure 1. The system architecture.

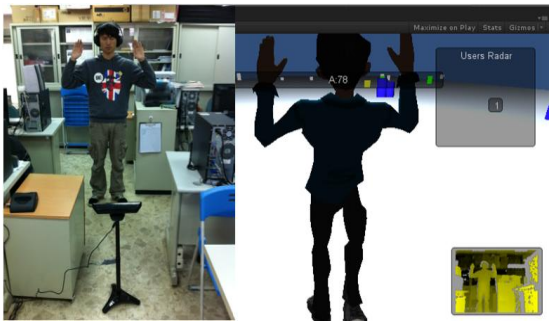

Figure 2. Hands up for calibration.

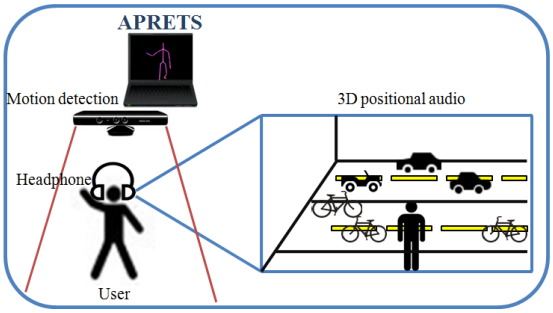

Figure 3. The game situation.

3. SYSTEM DESIGN

We developed an interactive game for visually impaired people to use Kinect and 3D Sound for O&M training. To make the game more interesting, we added music and speech.

3.1 Experimental Environment

1) Motion detection – Kinect: Nintendo's "Wii" made Motion Sensing Game gaming popular [17, 18], but Microsoft Kinect is more popular worldwide. Kinect doesn't need a controller, as your body is the controller, allowing you to play games more simply and more intuitively. We like this, so in our system we used Kinect to control the system.

2) Wireless Headphone: Our system requires 3D Sound and freedom of movement, so wireless headphones are necessary.

3) Sound Card: The sound card must support 3D sound. The Creative sound card uses CMSS-3D surround sound technology. CMSS-3D has been used to make spatial sound [19], so we chose to use the Creative sound card output for 3D sound.

4) Personal Computer: APRETS can run on any computer running a Windows platform. For convenience, we used a laptop when doing the test. *3.2 System Architecture*

In this paper, the computer is our data server. APRETS was developed on a Windows platform with four parts: User interface, 3D sound module, Motion detection driver and APRETS kernel module. The system architecture is presented in Figure 1.

1) User interface: Following voice hints, the user makes the correct pose to operate the system. Since the system is for visually impaired people, we don't need graphics on screen. In the game, we have sound hints and voice hints. The user can put his hands up and swing his arm to operate the system.

2) 3D Sound module: The system uses FMOD produced 3D Sound. FMOD is a proprietary audio library [20], a popular and powerful cross-platform interactive audio system. The FMOD software was used with the Creative sound card hardware [21].

3) Motion detection driver: The motion detection system receives skeleton information and position information. This information is interpreted by the APRETS kernel module. We exploited the software development kit, OpenNI to develop this module.

4) APRETS kernel module: The APRETS kernel module controls data transfer and training. Feedback hints from the user's motion and progression feed back to change the sound source and position.

3.2 The Flowchart of the Game

We designed a game like the classic videogame "Frog crossing." The traffic is different from "Frog crossing," in that the sounds of bike, motorcycle, car and truck are produced using 3D sound, and there are many vehicles in one game, since it is designed to help visually impaired people react appropriately in real situations. We hope to help blind people learn to recognize hints about traffic including each vehicle's direction, distance and speed using the APRETS system.

The game flow chart is simple, as we don't want to make it too hard to play the game. The game begins with calibration of the Kinect system with the user placing his or her hands up as shown in Figure 2. When calibration is completed, the system will explain verbally how to play the game.

The game situation is presented in Figure 3. There are three roadways in the game. The first roadway has only bikes, going at different speeds and appearing at different times. This is the easiest roadway, with the bikes looping three to four times. The user can cross safely after the bikes pass. In this roadway, we want the user to learn to judge the bikes' path and get used to the system. Cars and motorcycles appear in the second roadway, so the speeds are faster and it is harder to cross than the first roadway. In the second roadway, we want the user to judge both the speed of vehicles and type of vehicles. The hardest level is the third roadway, which has more cars and trucks, at faster speeds than the second roadway. Once the user is able to cross the third roadway, he or she has successfully completed the game.

When the game is over, the system will calculate the time spent playing the game and tell the user. If you are unfortunate and have a traffic accident in the game, there will be a sound of brakes, the game is over, and it will tell you how much time you spent playing the game. If you succeed, you can hear a short section of jazz music after completing the game. We want the user to feel exhilaration in playing APRETS as they learn how to navigate through traffic on the roadway as part of O&M training. Since people love games, we hope they will love this training.

4. CONCLUSION

In this paper, we report the development of an interactive training game for visually impaired people, and use of that interactive game for O&M training. The game can simulate a street environment with busy traffic. APRETS is a computer-based game that visually impaired people can play with Kinect and wireless headphones. We have designed a user-friendly interface which uses text-to-speech and voice to guide the blind user in using APRETS. After the game prototype was completed, we invited five visually impaired persons to test the proposed game. We completed a questionnaire and interview with the subjects after the experiment. Most subjects were satisfied with the training game. The overall satisfaction was 3.88. The users also gave some feedback and suggestions for system improvement. All users thought the game, played with Kinect and 3D sound, was really novel and interesting. In the future, we will extend the functions of the training game for other O&M training.

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E-LEARNING PRACTICE-ORIENTED TRAINING IN PHYSICS: THE COMPETENCE FORMATION

Alla G. Kravets, Oxana V. Titova and Olga A. Shabalina
Volgograd State Technical University,
Volgograd, Russia

ABSTRACT

The method of competences level automated management is developed for student's competences formation. An insufficient level of schools graduates in physics is identified as the modern problem of the education. Teacher does not specify which step in a solution a student can not cope with, and the student reiterates his mistake in other tasks solving. It is propose to prepare students to a physics examination by means of tasks solution competences formation. The special software for intellectual support of optimal solution of analytical physical tasks was developed.

KEYWORDS

E-learning, tasks solution, competence level, competences formation.

1. INTRODUCTION

According to Russian government program "Development Program 2020"one of the main objectives is the innovative people-centered development of science and technology sectors. For the solution of the posed problem in education the priority is given to technical and natural science disciplines.

The implemented Unified State Exam (the USE) has its goal to select capable school and university graduates. According to the results of the USE 2012 in Physics it has been found out that 26,6% (Ershov A.G. 2012) of all the school graduates got average and high grades and the rest of the school graduates (73,4%) got minimal and low grades (Figure 1).

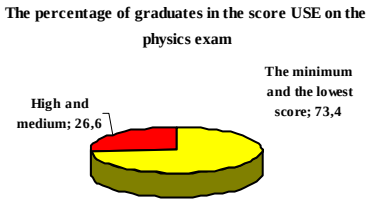
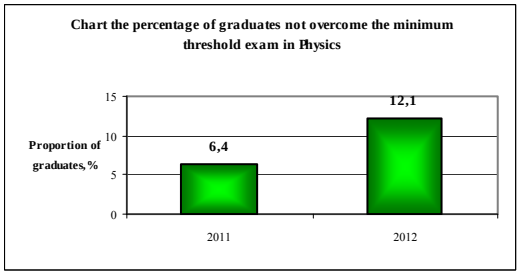


Figure 1. Results of the USE 2012 in Physics

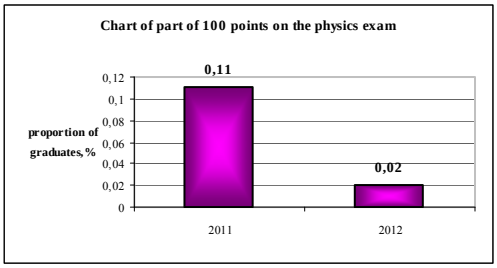
There has been observed a tendency of increasing number of school graduates who have not passed the minimum threshold (Figure 2a). The situation is no better with those who got 100 grades (Figure 2b). As a result the universities specializing in engineering technology missed out on competitive applicants in 2012.

In accordance with the requirements of the Federal State Education Standard all school graduates must be able to apply their knowledge and skills in familiar, changed and new situations. The formation of the ability to apply knowledge and skills in a familiar situation can be achieved by doing similar tasks. Application of knowledge and skills in changed and new situations requires some extra abilities.

Teachers of Physics tend to prepare students for the examination by giving them a great number of challenge tasks. Doing such tasks students acquire knowledge, the very knowledge that they apply at the examination. This preparation method is considered ineffective because one needs much time for fulfilling the tasks and nobody can guarantee that students will be able to cope with the task at the exam. That is the reason why they suggest students being prepared through the formation of task-doing competences.



a)



b)

Figure 2. a) Failed results of the USE 2012 in Physics; b) Maximum results of the USE 2012 in Physics

Due to the development of new technologies and new PC hardware in educational institutions the preparatory work should be done through automation of a teaching process.

Researchers (Cecilia Rossignoli, Maria Ferrara and Luisa Varriale, 2013, 2013; Margot McNeill, Maree Gosper and John Hedberg, 2010) propose methods of material assessment, strategies and technologies that enable the learner to embark on a learning process.

E-learning platforms are now widely used by educators to enhance the learners' interest in learning, shorten the learning portfolio, and improve the overall learning outcome (Silvia Knittl & Hans Pongratz, 2010; Said Hadjerrouit, 2013). Individual learning paths may be used and suggested to user in dependence on a given answer of an exercise (Julia Schrock et al, 2010; Stefanie Sieber & Andreas Henric, 2010; Najat Smeda, Eva Dakich and Nalin Sharda, 2010; Vangel V. Ajanovski, 2013).

However, the question of the organization the e-learning practice-oriented training remains unresolved. Accordingly, the development of the automated management method of students' competences formation is viewed to be a vital target.

2. COMPETENCES FORMATION

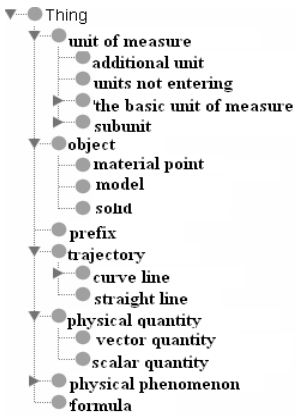
2.1 Ontology of a Physical Task

Design of a physical object model is guided by object-oriented paradigm with its emphasis on decomposition. Each object is viewed as an instance of a particular class. Concepts of physical task: object, physical phenomena, physical value, formula of the law or the physical quantity determination. These terms are defined as classes. Classes (concepts) and relationships between classes form the conceptual framework of a physical task, or ontology. Ontology of the physical task is formally described by tuple type <C, I, L, P, A, F, G>, where C — concepts (classes), I – copies, L– dictionary: $LC \cup LP \cup LI, \cup LA$, P: $V \times V$ – relations, where $V=C \cup I=\{v|\ v \in C \text{ or } v \in I\}$, $p \in P$, $p(v_i,v_j)$: v_i –domain, v_j –range, A: $V \times LA$ – attributes, F: $LC \rightarrow C$, $G:LP \rightarrow P$. In Figure 3 the part of classes' hierarchy and descriptive logic rules are shown.

The Semantic Web of key concepts of the physical task is represented as a graph. In Figure 4 the part of physical task ontology with relations is presented. Concepts "object of study" and "physical phenomenon" in the task are fundamental. The object of study is involved in a physical phenomenon. For example, the material point moves, i.e. is involved in the mechanical motion.

The theoretical material required by solving the function is included into the ontology of a physical task (Kravets A.G. & Titova O.V., 2011). The obtained functions are now task-doing competences, which are to be formed in students.

Aiming at the automation of competence level control process there have been set the tasks to control the system of practically oriented teaching in the field of natural science, within the framework of which there has been offered an idea of mathematical controlling the level of students' competences (Titova O.V. and Kravets A.G., 2013). As a result of solving the problem of the competence level control there has been obtained an optimal teaching mode. It is characterised by gradual increase in the competence level during the study process (Kravets A.G. & Titova O.V., 2012).



1. **x: ClassOfObject ⇒ object**
2. **y: ClassOfphysical_phenomenon⇒ physical phenomenon**
3. **∃object ∧∃physical phenomenon∧ ∃ *involved_in*(object, physical phenomenon) ∧ ∃*described* (physical phenomenon, formula)⇒ formula ∃ object ∧ ∃physical phenomenon ∧∃ *involved_in*(object, physical phenomenon) ∧ ∃*characterized* (physical phenomenon, physical quantity)⇒ physical quantity**
4. **∃ formula ∧ ∃*Contains_a_value*(formula, physical quantity)⇒ physical quantity**
5. **∃ physical quantity ∧ ∃*Contained_in_formula*(physical quantity, formula)⇒ formula**

Figure 3. Hierarchy of classes and descriptive logic rules.

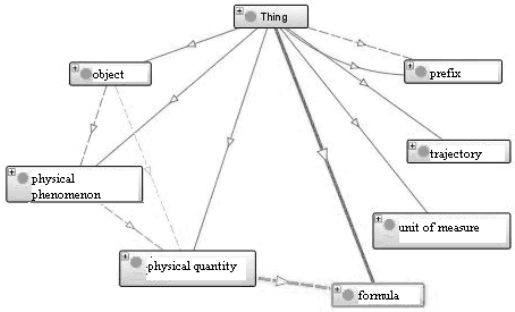


Figure 4. Part of physical task ontology.

Ontology a physical task it is created in the Protege 4.1 software supporting format RDF/OWL. In ontology the classes (concepts) hierarchy of the physical task solution on a theme "Uniform movement of a material point" is presented. The set of the RDF-statements received as a result of a relations establishment, forms oriented graph in which tops are classes and copies, and edges are marked by attitudes.

2.2 Formation of the Competence

For automated control of the competence level it is suggested that they perform a model of a student as a set of many competences: $M_s = \{ C_1, C_2, \ldots, C_n\}$,

where C_i – i-th the tasks solution competence.

With the help of the worked out method of presenting a range of competences there have been defined certain connections between the competences. It are represented the tasks solution competence in the form of sets: $C_1=\{k_1, k_2\}$; $C_2=\{k_2, k_7, k_8, k_{13}, k_{14}\}$; $C_3=\{k_1, k_5\}$; $C_4=\{k_2, k_3\}$; $C_5=\{k_3, k_{10}\}$; $C_6=\{k_5\}$; $C_7=\{k_4\}$;

$C_8=\{k_6\}$; $C_9=\{k_8, k_9\}$; $C_{10}=\{k_{11}\}$; $C_{11}=\{k_{12}\}$; $C_{12}=\{k_7, k_{14}\}$,

where C_i – competences, k_i.– elements of a theoretical material (packages of knowledge).

For controlling the level of the competences there has been worked out a method of the competence level evaluating and developing an individual teaching strategy (Titova O.V. and Kravets A.G., 2013).

The level of student competences is evaluated with the help of software developed in ASP.NET MVC 3 RTM. It allows to evaluate the competences level and to build up an individual strategy of the educational process (Figure 5).

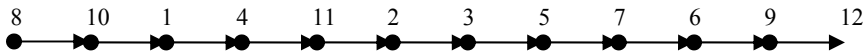


Figure 5. Individual teaching strategy.

Criterion of involving order of competence to the learning path: max ε_i , i=1,2,…,n

$$\varepsilon_i = \frac{rc_i}{n} - \frac{1}{n} \cdot \frac{\sum_{j=1}^{m} w_{ij} \cdot lk_j}{\sum_{j=1}^{m} w_{ij}}$$

, where n-number of competencies, lk_j – grade for j-th package of knowledge; w_{ij} – reentrance of j-th package of knowledge in i-th competence.

If the deviation of the competence level from the target is non-zero, then the path includes the competence. For each knowledge package the tasks set is defined.

To train the competence the special software for intellectual support of optimal solution of analytical physical tasks was developed (Figure 6). The code is written in Java using Eclipse Classic 3.7.2 Indigo IDE. The program features a graphical user interface as close as possible to the form of the solution in the student notebook. To handle the ontology Protege-OWL libraries are used.

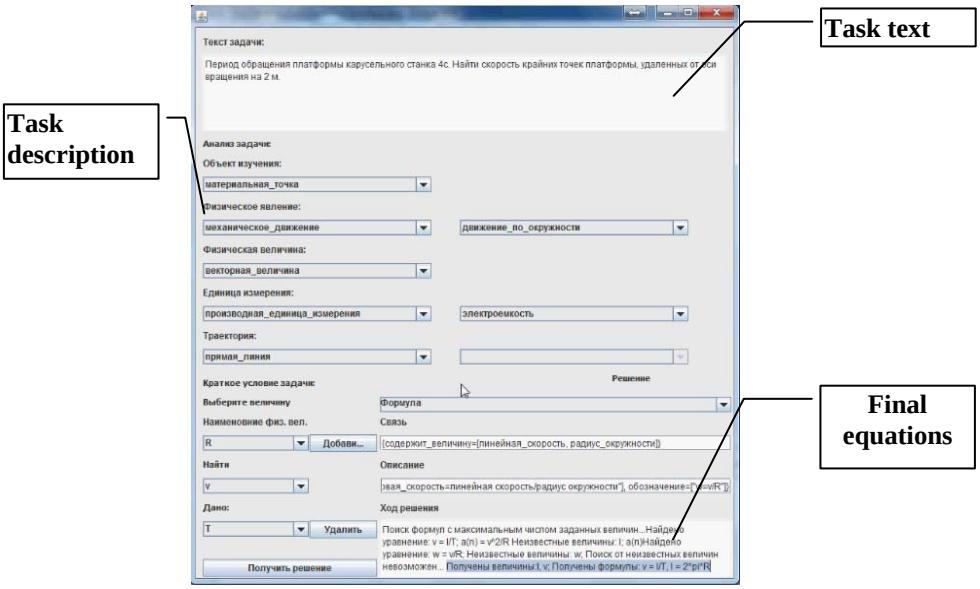


Figure 6. Software for intellectual support of optimal solution of analytical physical tasks.

2.3 E-learning of Physics Tasks Decision Competences Formation

During last 4 years the pupils and students' e-learning of physics tasks decision competences formation were performed. The Internet Consulting Center (ICC) was organized in 2004 and the new method was implemented from 2009.

The ICC education is commerce based. Without changing of the payment amount it was reduced the training time by 15% thanks to the implementation of developed methods and programs, incomes increased by 17,6%. Number of ICC site visitors is increased too (Figure 7). We compared the average level of training at the groups with traditional and experimental (with proposed methods) ways of training (Figure 8).

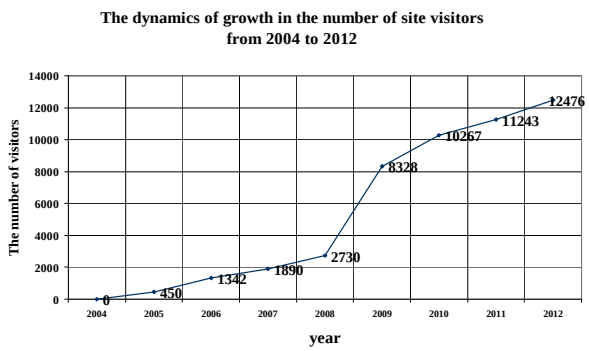


Figure 7. Number of ICC site visitors

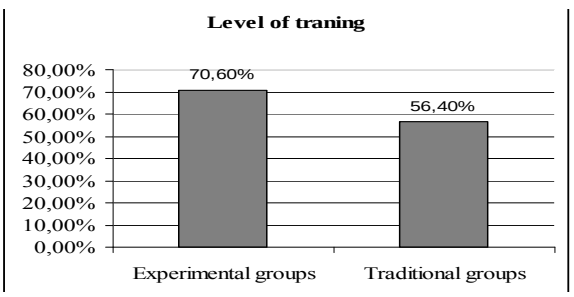


Figure 8. The diagram of training level

The level of training is higher at the experimental groups. The results of new methods implementation for students: training quality increased by 14,2%; training time decreased by 15%.

3. CONCLUSION

The designed method of the automated students' competences formation differs from the known methods in:

- The ontological model of a physical task has been the first to be developed. Ontology of a physical task is a field of knowledge, which includes both basic data of the task and the desired quantity. Solution to any task is included into this field of knowledge.
- There has been proposed a new method of the task-doing process formalization. It differs from the known ones due to the carried out the detailed task-doing process and the defined logical conclusion for completing the task from the basic data using ontology and descriptive logic.
- Software for intellectual support of optimal solution of analytical physical tasks which uses an ontology of physical tasks has been developed. The code is written in Java, development environment Eclipse Classic 3.7.2 Indigo.
- As a result, learning formation of competences of solving physical tasks found that the level of training in the experimental group is higher by 14.2% than in the control group. The implementation of methods and software has reduced training time by 15%. ICC has received economic benefits - increased revenue by 17.6%. The effectiveness of the system of practice-based learning is higher in education system with the solving tasks competences formation.

This research proposes the innovative methodology that includes ontology of physics tasks and builds the competences formation system to assist teachers to create the e-learning practice-oriented courses.

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STUDENT EXPERIENCES ON INTERACTION IN AN ONLINE LEARNING ENVIRONMENT AS PART OF A BLENDED LEARNING IMPLEMENTATION: WHAT IS ESSENTIAL?

Laura Salmi
Senior Lecturer, Laurea University of Applied Sciences, Vanha maantie 9, 02650 Espoo, Finland
tel. +358 9 8868 7466

ABSTRACT

Interaction and community building are essential elements of a well functioning online learning environment, especially in learning environments based on investigative learning with a strong emphasis on teamwork. In this paper, practical solutions covering quality criteria for interaction in online education are presented for a simple implementation using standard generally available tools. The solutions are evaluated on the basis of student experiences reported in writing in response to a qualitative survey given to adult university business students. In student responses, the importance of an active online presence by instructors was emphasised, as well as the availability of team meeting platforms. Blogs were seen as an effective way to support learning. Face-to-face interaction, both between students and between students and instructors, was seen as less important than expected.

KEYWORDS

Investigative learning, e-learning, blended learning, interaction, online presence, blogs

1. INTRODUCTION

In this paper, a description of solutions for interaction in an online learning environment for adult business students in higher education will be given. The implementation is based on a learning model using investigative learning. The focus is on online solutions, although the implementation itself is a blended learning environment. The solutions will be evaluated on the basis of student experiences and views collected from two different student groups. Some background on the learning model applied here will be given first, as the learning model itself imposes demands on the implementation.

Fitting studying with working and family life is often a struggle for adult students. Efficient and appropriate learning environments are therefore especially important in adult implementations. When students are expected to do a lot of group work and learn in a community, facilitating interaction is particularly essential. The solutions that work with adult students can, with some consideration, be applied to other student groups as well.

2. LEARNING BY DEVELOPING

The learning method called Learning by Developing is defined as investigative learning applied to development projects (Rauhala, 2006). Hakkarainen et al. (2004, 17) claim that learning is at best an investigative process. This means not only analytical information processing and assessment, but also practical experimenting and learning from experience. Wenger (1998, 73) proposes that learning and expertise are transmitted through unofficial communities of practise. These communities have common goals, exist at work or other environments, but their members are not necessarily aware of this communal structure.

One aspect of learning in a community is the sharing of the learning process and its outcomes. Sharing one's expertise provides a forum for testing that expertise and justifying one's viewpoints (Hakkarainen et al., 186). In collaborative problem solving the participants typically adopt different roles and serve their different viewpoints to each other, thus deepening their understanding of the problem (Miyake, 1986). To the individual, the community or the group provides scaffolding, permitting the individual to perform tasks more demanding than would be possible for them by themselves (Brown, 1993, 191).

In authentic situations, contrary to traditional educational environments, there are often no known solutions to the problems. The solutions are always the result of a more thorough process, including the definition, analysis and description of the problem, as well as the choice of suitable methods to be applied (Fränti & Pirinen, 2005, 37). Most of these steps will be omitted when the problem is defined and proposed by the teacher. With this approach, it is hoped that flexible and intuitive problem solving will be achieved, not restricted to specific situations and contexts. This fulfils an important requirement of professional expertise, as defined by Tynjälä (1999, 160-161).

The key concepts behind the Learning by Developing model are authenticity, companionship, an experience-based, investigative approach and creativity (Raij, 2007). Authenticity is achieved through real-life development projects serving outside partners. In practice, this means that students mostly study in teams, carrying out projects. Companionship means shared working, learning and responsibility. Practical experience is the medium through which learning and new knowledge is reflected upon and identified. The investigative approach is the way in which learning is organised, as described above. Creativity is seen in the adoption of new solutions and working methods. An online environment can be a good platform to foster investigative learning. Reeves (1999) describes how the cognitive load of the learner can be deepened by online tools, with the teacher acting in the role of coach. This corresponds exactly to the roles of student and teacher in Learning by Developing.

3. ONLINE INTERACTION AND COMMUNITIES

A sense of community and social presence has been widely acknowledged to be a factor in enhancing both the quality of learning and the motivation to study (Haythornthwaite and Andrews, 2011, 111-112). In establishing an online learning community, different types of interaction play an essential role.

Berge (2002) reminds that interaction cannot be viewed only for its own sake, but in context with the methods and systems available in the given situation. That is also the approach here; the aim is not to provide a general framework but rather to investigate the possibilities and improvement needs in a given environment. The implementation follows the same design as that presented by Berge (2002): aligning learning goals, activities and evaluation, with a learner-centred approach, designed to provide interaction between active and reflective learning. For active learning to be encouraged, interaction needs to be activity-based (Hirumi, 2002).

Hirumi (2002) identifies three levels of interaction: the interaction of the learner with himself (level 1) or with human and non-human resources in the learning environment (level 2). The third level of interaction is a meta-level and describes the interaction of the learner with the e-learning strategy enforced. Although the third level is inevitably present, this paper focuses on level 2 interactions. The second level is comprised of the human interaction between students and of students with teachers, but also of the interaction of students with the content and interface of the learning environment. Other interactions are also possible, e.g. with people outside the learning environment, such as experts or project partners. Second level interaction is the most obvious one because it is related to the most visible parts of online learning if there is to be any interaction, but third level planning is just as important, if not more so, because it is the level that is often neglected when moving instruction online from traditional implementations (Hirumi, 2002). The process of planning and evaluation on online implementations follows quite closely the procedure proposed by Hirumi (2002), with learning goals as a starting point.

4. QUALITY CRITERIA IN ONLINE INSTRUCTION AND THEIR APPLICATION TO INTERACTION IN THE LEARNING ENVIRONMENT

Karjalainen has identified a list of goals to strive for in online education, based on Herrington's three types of approaches to quality in online education: pedagogies, resources and delivery strategies (Herrington et al, 2001). Similar ideas are presented by Berge (2002). Karjalainen establishes the following check list:

1. *A clear and organised structure*. Materials, assignments and activities should be structurally clear and easy to contextualise.
2. *Goal-oriented learning*. Students should know the learning goals and be able to relate them to their own goals.
3. *Authentic activities based on real life situations*. Learning tasks should be inquiry and problem-based and provide a meaningful context for students to develop their skills.
4. *Appreciation, connecting and application of knowledge*. The students' previous knowledge should be recognised and linked to the construction of new knowledge and its application to practice.
5. *Emphasis on collaboration and interaction*. The online material and activities should encourage collaboration and interaction between students, as well as between students and teachers.
6. *Activation*. The material and activities should activate learning.
7. *Learner-centred environment*. Design and implementation should be centred on learning, rather than teaching.
8. *Integrated and well-timed assessment and feedback*. Assessment should support the learning process and feedback should be integrated into the learning activities.
9. *Self-directed learning*. The students should be able to navigate the learning process independently at their own pace. (Karjalainen)

The pedagogical criteria were used to design an online environment as part of a blended learning implementation. All criteria were analysed and broken down into factors that could be used in the online environment to promote the above goals. As the focus of this paper is on interaction, only the fifth criterion will be discussed here. The following solutions were adopted to respond to the need for engaging students in collaboration and interaction.

Establishing an online presence in the environment. All teachers' photographs are provided with study unit presentations. The students are asked to upload their own photographs on a presentations page. Photographs are also linked to an online profile, which ensures them being appended to each message a user sends in the environment, whether it be on a bulletin board or as a comment to blog posts. In addition to this, the teachers attempt to show a constant presence online by commenting on students' posts and answering messages when needed.

Teamwork. Most assignments are project-based teamwork activities, forcing the students to find ways to work together.

Teamwork infrastructure. Student teams have their own folders in the online environment, with tools provided to facilitate interaction, including a discussion board and a video chat room. Additional tools are provided when possible if students express a wish to use them.

Study unit blogs. Blogs are used to provide a forum for content and activity-related discussion (as opposed to practical arrangements, for which an ordinary discussion board is used). Students can write blog posts asking questions or seeking clarification for assignments. They can share ideas or help each other with tips or explanations. Teachers use the blog to give feedback on assignments and to give tips or guidance on activities. They also write posts on face-to-face sessions. This serves the purpose of reminding students of the important ideas discussed there and of preparing them for the next teaching sessions.

Peer assessment. Making reports visible to all students and asking the students to give feedback on other teams' reports is a way to involve the students more closely in working together and helping each other.

Virtual group sessions. An online meeting environment is used for online lectures and guidance meetings.

5. STUDENT EXPERIENCES ON INTERACTION

Experiences and comments were gathered from students from two groups: first and third year students studying Business Management. The groups have face-to-face teaching about once a month (one evening and

two days at a time), while the students work full time and do most of the studying online. Thirteen students participated. They were asked to write freely about their thoughts on online interaction and more specifically about teamwork and about the tools mentioned above. The answers were gathered through an online questionnaire, containing mostly open questions.

Some background questions were asked to establish the students' orientation towards online studies and the learning model used in this context. Most of the students described themselves as being comfortable with studying online and with doing teamwork, although one third stated that they would prefer to study by themselves rather than with others.

5.1 Experiences about Online Teamwork Tools

The students thought that both advantages and disadvantages of teamwork are magnified in online studying. The advantages associated with teamwork were the support given by teammates, the benefit of having different views into the same topic and the possibility to share the work load with others. There was mainly one negative aspect brought forward: the different goals of team members and different degrees of commitment to the project and to teamwork. Students found it difficult to find ways to control teamwork and influence the team's results if other team members had different views. They also complained about the difficulty to agree on timetables.

When asked about the tools supporting teamwork, the students were almost unanimous in praising the virtual meeting rooms and chat rooms as useful. The frequency of using them differed, however, between teams, from weekly to infrequently. Some had been frustrated by technical difficulties (usually related to microphone use) and had moved to other tools not provided by the university, such as phone conferences or other chat rooms. Several respondents stressed that speech was not a necessary element in team meetings and they appreciated written communication for its precision and unequivocal documentation. The students noted that they frequently used other communication platforms such as Facebook for teamwork.

The students were divided on the usability of virtual meeting platforms for group sessions. Some had positive experiences of them, while others thought virtual meeting rooms were only suited for a few people at a time. The importance of planning the session carefully and having a clear agenda was emphasised by many.

5.2 Blogs

One of the most useful ways of interacting online seems to be the study unit blog. The students said that the most important online interaction is content-related and the blog was well suited to this. They wished that all questions would be asked through the blogs to make them visible to all and that everyone would share their thoughts on the subjects studied, as they appreciated the different views. The most useful functions in the blogs, according to the students, were tips and clarifications to assignments, the possibility to ask questions and blog posts about past teaching sessions. Also named were feedback posts about assignments and discussions about subject matters with other students.

5.3 Interaction between Students and Teachers

When asked what kind of interaction the students wished to have with teachers, they said that teachers should above all be regularly present and active. Answering questions promptly is important, as when this does not happen the students have to start sending questions by e-mail, thus removing the benefit of having the answers visible to all. The general opinion seemed to be that face-to-face or even virtual oral interaction with the teacher was not necessary if assignments and instructions were clearly formulated and feedback was well given. The importance of precise and useful feedback came up repeatedly in other contexts as well, as did the importance of well planned activities and assignments and information given in a timely fashion.

The students also expressed some more general views about the learning environment and pedagogy. Several students wrote that in a blended learning setting, face-to-face teaching sessions should really have some added value and not be held just for the sake of meeting and discussing things. This was a little surprising, as there has been an assumption that face-to-face meetings should include some time for discussion and less formal interaction. The students' wish for structured and "efficient" teaching runs counter to the generally accepted view that constructive learning benefits from the sharing of views and at least some degree of freedom in interaction.

6. CONCLUSIONS

The lessons drawn from this are twofold. On one hand, good planning and communication of learning goals and feedback are – unsurprisingly – important. On the other hand, the importance of direct interaction between teachers and students is less important than was originally thought. Hirumi (2002) warns of the overload to instructors caused by poorly designed interaction or too much planned learner-instructor interaction. These results suggest that this overload could be avoided with adequate planning, without too much risk of students feeling a lack of interaction. This frees the teachers to possibly use more resources for the non-interactive part of online learning facilitation, such as planning appropriate activities and working on assignments and material.

However, the importance of a constant online presence, even through seemingly small and trivial actions, cannot be underestimated. Slightly surprising – and delightful – is the positive attitude of the students to between-students interaction, as this has previously been a topic of concern. One subject not much addressed here is the building of an online community. The existence of a community is, both in teachers' and students' eyes, a fact from a very early point in time. Haythornthwaite and Andrews (2001, 120-121) support the view that face-to-face meetings foster this feeling of community. This has also been the assumption in the case described here, but some of the student comments reported above contradict this. How the online community and its building are perceived by students and what factors influence community spirit the most are questions that would benefit from a more systematic investigation.

The work continues, as solutions for the best online interaction will continue to be developed and tested. The other dimensions of online instruction quality deserve similar detailed evaluation.

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USABILITY ASSESSMENT OF E-CAFÉ OPERATIONAL MANAGEMENT SIMULATION GAME

Chiung-sui Chang and Ya-Ping Huang
Department of Educational Technology, Taipei, Taiwan

ABSTRACT

To ensure the quality of digital simulation game, we utilized the usability evaluation heuristic in the design and development processes of e-café operational management game-based learning material for students. The application of usability evaluations during this study is described. Additionally, participant selection, data collection and analysis; and results relevant to usability portions of this study are presented.

KEYWORDS

Usability assessment; usabilty testing; simulation, digital game

1. INTRODUCTION

Nowadays college and university students have never experienced a world without computers. Since digital simulation game is designed more visual, interactive, and focused on problem-solving (Pasin, & Giroux, 2011). It is more attractive for students to learn the complex knowledge via digital simulation game for college students. Therefore, this study employed design-based research to examine the design and development of an educational game simulating the daily operational management of an "e-café". This study employed the principle of "usability" to determine whether this material corresponds to the above principle and whether it can meet the expectations of learners as an education resource.

2. LITERATURE REVIEW

2.1 Digital Simulation Game

Digital simulation games are used for education and training in a wide range of fields including the military, medical services, and scientific experiments. Unlike digital games, simulation games are usually less associated with fantasy. Simulation games involve players assuming roles through which they seek to resolve issues or accomplish missions (Charsky, 2010). Digital simulation facilitates learning within created scenarios while enjoying gameplay that greatly resembles situations in the real world. Following a series of game activities, learners respond to various scenarios while achieving learning objectives. Researchers have indicated that digital games with educational functions can exert a positive effect on learners with regard to motivation and performance (Tompson & Dass, 2000, Bai, Pan, Hirumi, & Kebritchi, 2012).

2.2 Usability Testing

Usability can reveal whether a given product serves the needs of users and whether the product can be operated intuitively. Nielson (1993) proposed five indicators for the evaluation of usability: learnability, efficiency, memorability, and error and satisfaction. These indicators can be used to determine whether users are able to browse a webpage without facing obstacles, whether the page can be accessed intuitively, and

whether the webpage provides information sufficient to satisfy the needs of users. The International Organization for Standardization (ISO) pointed out in 1998 (ISO 9241-11) that "Usability' refers to the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." The most common methods employed in the evaluation of usability include heuristic evaluation and usability testing. This study recruited subjects with the aim of revealing user problems, evaluating the usability of the educational simulation game, and providing the basis from which to revise teaching materials in the future.

3. METHODOLOGY

Our evaluation of usability involved both quantitative and qualitative methods, the collection of data through questionnaires, observation and interviews, and the compilation of opinions and suggestions for the design and usability of the e-café simulator. This study will expound the subjects, testing processes, and research tools as follows.

3.1 Subjects and Testing Processes

Ten participants were invited to take part in the testing of a simulation game with regard to usability. All participants were college students at a male/ female ratio of 3:2 and all were participating in this type of exercise for the first-time. Through feedback from the subjects, we came to realize the needs of users and revised the simulation game accordingly. Tests and interviews were conducted with regard to the content and usability of the game.

3.2 Testing Tools

Each participant was observed one-on-one in the usability testing process and Morae software was applied to videotape the entire process. Prior to testing, the objectives of the evaluation were outlined for participants, who were then requested to sign a consent letter. Throughout the testing process, the participants were closely observed and provided objectives (tasks) in accordance with their progress. Subjects were expected to accomplish each phase of their tasks in accordance with the statements provided by observers. Participants were expected to undertake eleven missions and observers kept a close eye to verify whether they were able to complete them on their own.

3.2.1 Questionnaire on Task Difficulty

The eleven tasks in this study were designed to determine whether the subjects were able to complete the tasks they were assigned in the digital simulation game. Questions were ranked on a scale of 1 to 5 with 1 representing "very easy" and 5 representing "very difficult".

3.2.2 Questionnaire on User Experience

This study adopted the TAM model to measure the responses of participants following completion of the simulation game. This questionnaire comprised a total of 22 questions in four dimensions: attitude, perceived ease of use, intention to use, and perceived usefulness. Questions were ranked on a scale of 1 to 5 with 1 representing "strongly disagree" and 5 representing "strongly agree".

3.2.3 Interview Outline

Following completion of the usability test, interviews were conducted to determine the feelings of participants. The four interview questions were as follows:
Q1: Did you encounter any problems when undergoing tasks in the game? How did you resolve them?
Q2: Did you better comprehend the process of running a café after completing the "e-café" simulation game?
Q3: Please outline the concepts related to business administration that you learned from the game?
Q4: Do you think the "e-café" management simulation game helped you to acquire knowledge about business administration?

4. RESULTS

4.1 Result Analysis for the Questionnaire on Tasks Difficulty

The questionnaire was meant to determine how the subjects felt about each mission. For the eleven question items, the average score was 1.8 (SD=0.93). The scale of difficulty ranged from 1 (very easy) to 5 (very difficult). The participants felt that task 8 was the most difficult to accomplish (M=2.7), followed by task 10 (M=2.2), task 6 (M=2.1) and task 7 (M=2.1). Task 8 involved adjusting the shift schedule. Task 10 required that participants organize staff training sessions. Task 6 required subjects to improve the quality of raw materials. Task 7 required subjects to devise a marketing approach to expand the customer base. In task 5, participants were required to adjust the selling price.

4.2 Result Analysis for Game User Experience

Questions were ranked on a scale of 1 to 5, with 1 representing "strongly disagree" and 5 representing "strongly agree". As shown in Table 4, the average score was 3.5 (SD=0.86), suggesting that participants had positive attitudes toward the simulation game. In the "Attitude" sub-category, the four questions averaged 3.7 (SD=1.01), implying that most of the subjects enjoyed the simulation game. In "Perceived ease of use," the five questions averaged 3.44 (SD=0.88), which indicated that participants felt the game was easy. In "Intention to use," the three questions averaged 3.9 (SD=0.85), and each sub-question reached 3.8 or more, indicating that subjects strongly accepted the simulation game. The average score for sub-question 3 was 4.1 (SD=0.74), indicating that subjects were keen to participate in simulation games. In "Perceived usefulness," the five questions averaged 3.36 (SD=0.8), indicating that participants felt the digital simulation game is useful for them.

4.3 Result Analyses of Interviews

Interview analysis was meant to reveal the experience of users and examine areas that were not adequately covered by questionnaires or observation. Interview analysis related to the questions is as follows:

Q1. Did you encounter any problems when undergoing missions in the game? How did you solve it?

Ten participants outlined problems they encountered when playing the simulation game. Three subjects did not know that the staffer's name could be clicked. Two of the participants were unable to differentiate the faces of staffer and felt that a failure to mention the names of staffers made it difficult to arrange shift schedules. One participant did not know that the page could be changed from the counter to the guest area simply by clicking and kept wondering why the coffee machine could not be clicked to make repairs. However, most of these were resolved after the subjects tried several times. Clearly, the simulation game requires the means to explain all of the game functions. Nonetheless, these observations elucidated the needs and expectations of the subjects, such that the game could be improved in the future.

Q2. Did you better comprehend the process of running a café after completing the "e-café" simulation game?

Nine out of ten subjects (except for S8) believed that the simulation game helped them to understand how to manage a café.

Q3. Please outline the concepts related to business administration that you learned from the game?

All subjects felt that they developed their skills related to business administration from the simulation game. These skills included cost control, arranging shift schedules, picking the location in which to open a shop, the management of raw materials, equipment repair and maintenance, profit, and procurement. Nonetheless, a number of other opinions were also expressed:

> *S1: It appears to me that hands-on experience would be more helpful. S2: I never took any class in business administration before, so I cannot say for sure. As to concepts, I think the most helpful ideas were about management, shift schedules, and the timing of equipment maintenance/repair. S4: I believe that cost control and customer satisfaction were dealt with effectively in the game.*

Q4. Do you think that the e-café management game was of any help to you in acquiring knowledge in business administration?

Eight subjects believed that the simulation game could be used to complement business administration curriculum. However, S1 and S8 disagreed.

S5: Yes. (The researcher asked about why.) Ugh, seems that we can have a better time in the classroom. S6: Yes, I enjoyed playing the game. S6 felt that if this game was played during class, they would not need to peruse reading materials. S8: I have never taken any classes in business administration; however, I am left wondering if this would be too simple to be fit into the real world. For example, staff affairs appeared too simplified. Raw materials, prices, and the quality of materials appeared more authentic.

5. DISCUSSION AND CONCLUSION

We conducted an examination of the usability of the "e-café management digital simulation game" as well as the test results and feedbacks from the participants. Our aim was to identify the areas corresponding to the expectations, requirements, and suggestions of users for use as a reference in the development of educational simulation games.

With regard to usability, every participant presented a positive attitude toward every dimension of the e-café simulation game. The mission observation and the scale of difficulty perceived by participants were matched, as subjects encountered difficulties in the complex missions but felt that most of the missions were quite easy. Interviews revealed that subjects regarded the game as a valuable tool in developing the skills required for shop management. We believe that the reason for the strong acceptance of the simulation game was its overall design, which accurately represented a real coffee shop. It is our hope that this study provides a valuable resource for the development of digital simulation games as an educational resource.

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SYSTEM FOR AUTOMATIC GENERATION OF EXAMINATION PAPERS IN DISCRETE MATHEMATICS

Mikael Fridenfalk
Uppsala University Campus Gotland
621 67 Visby, Sweden

ABSTRACT

A system was developed for automatic generation of problems and solutions for examinations in a university distance course in discrete mathematics and tested in a pilot experiment involving 200 students. Considering the success of such systems in the past, particularly including automatic assessment, it should not take long before such systems are widely used in higher mathematics education. The goal of this paper is to encourage such development by sharing some of the experience that was gained along the way in the implementation and application of such system.

KEYWORDS

Automatic item generation, discrete mathematics, distance education, examination.

1. INTRODUCTION

Automatic generation and grading of examinations is a promising development that may potentially save time and effort for professors within the field of technology, giving room for further improvements in the education, along with allocation of additional time for discussions with the students. Such systems may also be used for the generation of individualized examinations, decreasing the risk for plagiarism while at the same time offering each student higher flexibility on examination dates, followed by decreased grading time and increased grading accuracy (Beevers, 2000; Maple TA, 2013; NCES, 2005; Pead, 2010; Rasila, 2010).

To contribute to this development, an automatic item generator called the Virtual Mathematics Assistant (VMA) was developed by the author and launched at Gotland University (recently merged with Uppsala University, Sweden), with the ability to generate full examination papers and solutions in a distance course in discrete mathematics for computer science students. This generator is presently able to create examination papers covering 2048 courses (with 69 assignments per course occasion) or a total amount of over 100,000 unique assignments within over ten different areas of discrete mathematics. The VMA system was applied during two consecutive years totally covering around 200 students. Compared to previous examinations, the new ones succeeded in addition to reduce the grading time for each student to about one-third compared to previous years without compromising the quality of the course.

2. MATERIALS AND METHODS

The VMA system was developed in C++ using Apple Xcode (2013) for the generation of LaTex-code and TeXShop (2013) for generation of the PDF examination documents. C++ is a common programming language for development of software applications. LaTex is the standard typesetting system for mathematical documents and is often used for generation of scientific papers.

The VMA system is designed to operate in two primary modes, development and production. In the development mode the programmer is able to focus on the implementation and validation of a single model or engine at a time and to make sure that each component in the system performs properly. In production mode, the user currently sets a course index between 0 and 2047 and compiles and runs the VMA application, whereby twelve examination papers are generated in LaTex-format plus twelve papers that

include both the problems and the solutions covering a single course in discrete mathematics. In addition a number of examination papers with solutions are generated for the students to study in advance of examinations.

The distance course consists presently of three examinations (with five assignments each) which each have to be completed within a single week. The course is concluded by a 24-hour final examination consisting of eight assignments, which determines the final grade of the course and includes at least two assignments from each examination category. Each examination (including the final) is issued three times per course. To encourage as many students as possible to aim for the top grade, the workload of the students is maximized during the start, thereby giving them sufficient time at the end of the course to perform studies at a more advanced level than is required to pass the initial examinations.

The basic idea behind the design of the VMA system was to break down common problems within the area of discrete mathematics into basic elements and then recombine such elements into a more complex final result (assignments). Each area showed however to be fundamentally different from the others and many problems were in relative terms resolved by *ad hoc* solutions. The VMA system consists currently of 16 assignment generation engines, see Table 1.

Table 1. A list of the VMA assignment generation engines

Engine	Examination	Category	Models
Truth Table	1	Logic	8
Propositional Logic	1	Logic	16
Predicate Logic	1	Logic	102
Karnaugh Diagram	1	Logic	2
Venn Diagram	1	Set Theory	2
Set Equation	1	Set Theory	12
Radix	2	Numeral Systems	6
RSA Encryption	2	Modular Systems	1
Diophantine Equation	2	Modular Systems	1
Matrix Multiplication	2	Arrays	2
Proof by Induction	2	Induction	2
Minimum Spanning Tree	3	Graph Theory	4
Combinatorics - Level 1	3	Combinatorics	10
Combinatorics - Level 2	3	Combinatorics	11
Combinatorics - Level 3	3	Combinatorics	9
Combinatorics - Level 4	3	Combinatorics	14

In its simplest form, an engine or a model could in theory consist of a number generator and an environmental context generator. The number generator is here defined as the generator of the calculations involved in solving a problem. The environmental context generator is the context in which a problem can occur, typically expressed by words. By the multiplication of the numerical set with the environmental, a matrix of possible assignments can be created. Although this is a straightforward idea it showed to be difficult to implement across the board due to the great differences between the types of problems that had to be formulated and solved. Of all 16 engines the simplest to implement was the matrix multiplication engine (that was included in the course to support students who had not previously studied linear algebra), which only showed to require two generation models. This assignment was also by far the simplest to solve for the students. In such assignment, two matrices are allocated and randomly filled with small integers, such that a predefined number of elements are non-zeros to regulate the difficulty of the assignment. Matrix size is made to vary in addition to the context in which the multiplications are performed.

The most difficult engine to develop was for predicate logic, which showed to require about a hundred models. This assignment type was the only one in the course that was transformed into a multiple-choice section (three questions per assignment with eight choices per question). Traditionally in this course the students were asked to express formal language as predicate logic. The backside for the teacher was that it could take in average 15 minutes to analyze the solution for each student, to grade it and write an appropriate reply. By making this a multiple choice assignment and instead focus the effort to provide for very detailed solutions for the students to study, the average grading and feedback time for this assignment was for each student reduced to below 30 seconds and feedback from the students on the received grade was nearly

eliminated. In addition, since the generation of combinatorics problems was difficult to automate, four engines were devised, each designed to generate assignments with a fixed level of difficulty.

One of the main challenges in designing a system like VMA showed to be balancing. The level of difficulty for each assignment is for instance recommended to reside within predefined limits, else the variation between the examinations could occasionally turn out to be out of proportion. Some natural variation is expected even in manual development of examinations, but in the case of automatic generation of assignments the predictability of the level of difficulty for each individual assignment is even more important for unsupervised generation. As an example the VMA Diophantine equation engine is able to generate potentially a large number of problems, but only selects those with moderately complex solutions, thereby eliminating equations with no solution or only simpler solutions and equations that require relatively extensive calculations. Such trial and error process was used in some engines to ensure that proper level of difficulty was found, but only if it was not possible to predict the complexity of the generated assignment in advance by any other means. Another question was the relative balancing between the difficulty levels of different assignments. A basic inter-assignment moderator was developed for compilation of examinations so that easier assignments would counter more difficult ones, thereby keeping the total level for an examination paper relatively constant.

A system was in addition implemented for engines incorporating the largest number of models to ensure that it would take a few course occasions before the same model was used twice. The main reason for this was that one of the balancing factors in addition was the distribution of assignments with respect to the levels of required creativity to solve a certain problem. The less creative assignments were in this work categorized as “procedural” (such as matrix multiplication) and are typically based on a few models and the more original as “creative” (such as the higher level combinatorics problems), based typically on multiple models. The overall division is currently considered to be relatively even between procedural and creative elements throughout the whole course. As a note, procedural problems are defined as the ones were the student has to carefully follow the instructions of an assignment and double-check its own calculations to maximize its score. The creative problems test the knowledge of the students on a deeper level by the introduction of problems that are usually not included in precise terms in the textbook or can be found on the Internet, but that easily are solved if the essence of the subject is thoroughly understood. As a rule the generation of procedural problems showed to be the most straightforward to automate, while the creative problems showed to be relatively difficult to automate in the sense that multiple models were required and that it typically took at least five times as much time to develop an engine for a creative assignment.

The addition of uncommon (but plausible) constraints to conventional assignments showed in addition to be a useful tool in the design of original assignments. Not only did it make grading in some occasions significantly easier in procedural assignments by making all solutions to look more or less alike (and almost identical to the generated solution provided by the VMA), but it also excluded the possibility that the student could have used an automatic generator on the Internet to solve the problem without a deeper understanding of the subject.

3. RESULTS

Although automatic item generation could be considered to be relatively difficult to implement within discrete mathematics, it proved to be possible for a single programmer spending one time unit in the development of this system to save potentially 200 time units for a traditional mathematics educator. No decrease was further detected in the quality of the generated assignments and solutions compared to manually developed ones during previous years in the same course. This assumption is partly based on student evaluations, which consisted of 50 replies out of 200 participating students. One positive side-effect of the application of this new system was that since it was developed with a possible future automatic grading system in mind, the manual grading process was significantly simplified as well. This was appreciated by the students since grades could be received typically within 24 hours after examination deadline. The downside was that the procedural elements in the course could only be solved in a very specific fashion to ensure rapid grading, and since all students received identical assignments, this made it difficult to detect plagiarism. The creative assignments did not suffer from this flaw since they could be solved in multiple ways, but made the grading process more challenging.

4. CONCLUSION AND FUTURE WORK

Considering how well this system proved to work in practice (as expected from previous projects similar to this), there is really no reason why such systems should not in the future become a natural integral part of mathematics-based education across the board. Once there are sufficiently many automatic item generators to choose between for a professor so that it takes shorter time for the students to actually learn the subject in question compared with using similar systems to automatically find a solution, this could significantly reduce the required time for the generation of examinations. Since the lifespan of VMA is likely to be considerably shorter than 2048 course occasions, such system could in practice be used to provide each student with an individual assignment, increasing the flexibility by which examinations are issued and at the same time decreasing the risk for plagiarism in both campus and distance courses. While most VMA engines are at this stage considered to be complete, for sustained quality over time, the recommended number of generation models for the combinatorics engines is at a minimum 24 models per engine or preferably the double. In addition, the engine for proof by induction is recommended to be extended by one extra model.

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DIRECTION OF CONTENTS DEVELOPMENT FOR SMART EDUCATION

YoungSun Park, SangJin An and YoungJun Lee
Korea National University of Education
Chungbuk, Korea

ABSTRACT

The aim of this study is to suggest a direction of developing SMART education contents for its effective implementation by analyzing the status of educational informatization policies in Korea. Korean government has built the information and communication infrastructure, and provided teachers and students with various kinds of contents. And, in preparation of the SMART education which will be implemented in all elementary, middle, and high schools in 2015, the government plans to develop digital textbooks and supply contents of cyber home learning system, Edunet, and private companies by linking digital textbooks. In order to realize the merits of the SMART education to the maximum, it is necessary to develop practical and participatory contents per level of student abilities and suggest them to students.

KEYWORDS

SMART Education, Digital Contents

1. INTRODUCTION

Development of information and communications technology and the popularization of smart devices have given rise to huge changes in our life styles across social, economic and cultural areas. Such changes also affected the education area. It is common to see students or office workers listen to mobile lectures using smart phone in bus or subway. In response to such social and educational changes, the Korean government issued the SMART education policy in 2011. The SMART education is not simply learning utilizing the smart infrastructure. It means to provide systematic learning service to learners, based on the close connection of the smart environment and learning principles. And, to make such service effective, it is necessary to provide excellent learning contents with the foundation of the smart infrastructure. Thus, in this study, by analyzing the status of educational informatization policies and characteristics of the SMART education, discusses the direction of contents development for SMART education.

2. EDUCATIONAL INFORMATIZATION POLICIES

Korean government has promoted various policies through the educational informatization project. The educational informatization policies have developed with the evolution of the Internet environment and with various educational purposes. Currently in Korea, there are various educational informatization policies, which provide contents for teaching and learning (Jeong, 2012). Let's examine some typical policies.

2.1 Cyber Home Learning System

Cyber Home Learning System is the learning service the government supports to help students compensate for what they lack using the Internet learning contents which is designed to reduce high private education cost and narrow the educational gap. Cyber Home Learning System began to be executed in 2005. Students who want to study through Cyber Home Learning System can use the program free of charge after registering their names on Cyber Home Learning System homepage. The contents of Cyber Home Learning System are

developed based on national level curriculum. The status of the contents is shown in Table 1(Lim, 2012). Contents are different per level, and each student can choose the level contents of which he or she thinks are proper to his or her ability. However, there has been criticism that the contents simply repeat the textbooks or they are just description of general matters without giving concrete examples (Kim, 2011).

Table 1. The status of Cyber Home Learning System contents (Lim, 2012)

Classification	Contents
Subject	The 4th-9th grades: Korean, Society, Mathematics, Science, English
Type	Self-study type contents produced with the Flash program
Composition	Explanation of learning contents, Questions and explanations

2.2 Edunet

Edunet is the central teaching and learning center established in 2004. It is established to research and support teaching and learning. It provides students with self-study contents, and teachers with various multimedia materials for teaching. As of 2012, Edunet membership is 6.36 million consisting of teachers, students and parents. It keeps acquiring education contents from the department of education, public organizations and private companies (Lim, 2012). It has been found that students use Edunet mainly for self-study (50.8%) or for doing homework (45.7%). And, 61.1% of teachers use it to prepare for teaching. However, some problems of Edunet which need to be remedied have been pointed out, such as too complex make-up of the menu and the difficulty to grasp what kinds of contents are supplied (Kim, 2012). The status of Edunet contents is shown in Table 2.

Table 2. The status of Edunet contents (http://www.edunet.net)

Classification	Teacher	Student
Subject	The 1st-9th grades: all subjects The 10th grade: Korean, Society, Mathematics, Science, English	The 4th-9th grades: all subjects The 10th grade: Korean, Society, Mathematics, Science, English, and Essay writing
Type	Multimedia materials for teaching such as video, animation, and flash, etc.	Materials for self-study such as flash, video, and animation, etc.
Composition	Proposition on teaching and learning process, Teaching materials per level, Materials for evaluation	Different materials per level (basics/supplement/deepening) Explanation of learning contents

2.3 Digital Textbook Project

In 2007, the Ministry of Education, Science and Technology announced the adoption of Digital Textbooks, and developed the prototypes of those textbooks, to support individualized learning activities, and respond to the changed characteristics of learners who are digital natives. Digital Textbooks contain not only contents of book-type textbooks, but various multimedia materials, dictionaries, and evaluation questions, and can be used at home and school without the constraints of time and space(Ministry of Education, Science and Technology, 2007). Digital Textbooks were tested in 20 schools in 2008, 112 in 2009, 132 in 2010, 63 in 2011, and 46 in 2012. The schools which test runs those Digital Textbooks were provided with the infrastructure such as tablet PC, electronic blackboard, wireless Internet, and remote control program (Lim, 2012). Researches on the effects of Digital Textbooks have been done continuously through the operations of schools adopting Digital Textbooks. It has been found that those textbooks contribute to the improvement of various capacities of students such as academic achievement, learning flow, self-directed learning ability, and problem-solving ability (Seo et al., 2009; Noh, 2011; Byun et al., 2011).

Currently, Digital Textbooks use the Window/Linux comprehensive platform, and the platform and contents of it can be downloaded through the web. The status of Digital Textbook contents is shown in Table 3. As shown in the table, typical characteristics of Digital Textbooks are that they provide English contents per level to support individualized learning in classroom. Per-level English contents provide different contents, activities, and exercises for students in different levels for every unit of the textbook, which has not been possible by traditional textbooks. On the contrary, some contents like simulations have linear formats which students simply click or drag them and confirm the results, failing to reflect various situations where students can meet in their learning process and restricting active thinking of students (Kim, 2012).

Table 3. The status of Digital Textbook contents (http://webhard.edunet.net)

Classification	Contents
Subject	The 4th-6th Grades: Korean, Society, Mathematics, Science The 3rd-6th Grades: English per level The 7th grade: English, Science
Type	Learning assistant materials such as flash, video, animation, and photos, etc.
Composition	Complementary explanation on learning contents, game, drawing, mindmap, simulation, virtual museum, and evaluation questions, etc.

2.4 Common Issues of Digital Contents

There is not much difference in the degree of difficulty of per-level contents, and not enough consideration is given to students whose levels are very low, or very high. Furthermore, most of contents are designed as teacher-centered one-way format where learner can only receive learning contents passively. Such characteristics, when combined with cyber learning, can discourage students, lowering their interests and concentrations in learning. Another problem is that, since all the contents provided through Cyber Home Learning System, Edunet, and Digital Textbooks are web-based, they cannot be used in various devices like smart phone or smart pad.

3. SMART EDUCATION

3.1 Definition and Characteristics

In 2011, the Ministry of Education, Science and Technology announced SMART education development strategy as ways to respond to the changing educational environment due to the evolution of Internet environment and popularization of smart devices and to strengthen learner capabilities in the 21st century. SMART education is to embody the individualized learning system by actively applying information and communication technology and network resources, and changing education contents, methods, evaluation, and environment. To realize the goal, the government established a detailed development plan on a wide range of issues such as development and application of Digital Textbooks, activation of online teaching and evaluation, building of sharing environment to utilize of convenient and safe contents, and building of cloud education service. It announced its plan to implement SMART education across the nation in 2015. The characteristics of the SMART education can be classified into five categories which start with the letters, S, M, A, R, and T, as displayed in Table 4(Ministry of Education, Science and Technology, 2011).

Table 4. Characteristics of SMART education (Ministry of Education, Science and Technology, 2011)

Category	Characteristics
Self-directed	Learner-centered education, teacher plays the role of mentor; Provision of the learning management system where the learner can plan, manage, and operate one's own learning
Motivated	Emphasis on experience-oriented, problem solving-oriented educational methods to make the learner learn with interest
Adaptive	Realization of custom-made learning suited to different levels and aptitudes of learners
Resource Free	Letting learners use various contents freely through the open market, the distribution system of contents; Enlargement of sharing of learning domestic and foreign resources, and of cooperative learning through social networking
Technology Embedded	Provision of the environment where the learner can learn at anyplace anytime through information technology like smart phone, tablet PC, cloud computing, and 4G network

3.2 Planned Contents Provision

In SMART education, contents are provided through digital textbooks and open market. Digital Textbooks have been developed and applied in pilot schools from 2007. They are designed to be used through PC, so they cannot be used in various devices like smart phone or smart pad. So, considering smart educational environment, Digital Textbooks which will be developed in the future should be developed to be used in various devices like PC, smart pad, and smart TV.

The learning management system is run for the effective management and use of Digital Textbook contents. It is expected to build the contents sharing environment by linking contents supplied by Edunet, and Cyber Home Learning System, etc. with open market. Such contents will be used not only for teaching in class and individual learning at home, but for online class which is part of regular class. And, to respond rapidly to the changes of educational environment following the textbook publication system to government approved textbooks and revision of curricula, Digital Textbook contents also will change from the system where the government provides all the contents to the one various sources share the responsibility of providing contents. Accordingly, the contents part of Digital Textbooks will be taken charge of by textbook publishing companies, the part of viewer and SMART education platform will be done by the government, and development and provision of contents through the link with the open market will be done by both the government and private companies. Figure 1 shows the concept of digital textbooks (Ministry of Education, Science and Technology, 2011; Lim, 2012).

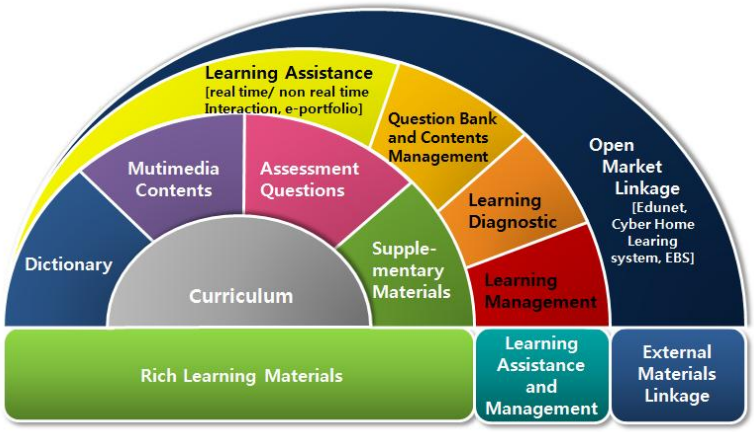

Figure 1. Digital Textbook concept map (Lim, 2012)

3.3 The Direction of Contents Development for SMART Education

The following are directions of contents development for SMART education based on the analysis of the status of educational informatization policies and characteristics of SMART education.

First, contents should be developed per level. To make SMART education an individualized one, it is necessary that Digital Textbooks which will be developed in the future should provide per-level contents in learning units of all subjects where degree of difference is differentiated. In addition, in order not to make contents of Cyber Home Learning System simple repetition of textbook contents, but to help the learner understand the contents, it should be revised to add various examples and reference materials.

Second, in the aspect of contents design, contents should be practical and learner-participating ones. Contents should not be of the one-way format where the learner checks the results by simply clicking and dragging. They should be practical ones reflecting the various restrictive conditions which can take place in real learning. Furthermore, as the SMART education aims at active participation of learners like their experiences and problem-solving processes, it should provide a variety of experiential learning contents like simulation, virtual reality, augmented reality, and educational game. Such contents make it possible for learners to experience various types of learning which they have not been able to acquire in classroom because of the constraints of time and space.

Third, in the aspects of contents production and supply, contents should be produced observing contents development standards, and convenience to access the contents of users should be considered. Since digital textbooks are developed by various publishing companies, it is necessary for the government to suggest contents development standards. Not only Digital Textbooks but existing Cyber Home Learning System and Edunet contents need to be redeveloped observing contents development standards in order to make them be used on various devices. And, since various contents will be provided through open market, it is necessary to build database in order to let users more convenient search for and download materials.

4. CONCLUSION

Currently, in Korea, various educational informatization policies are implemented. Up to now, those policies have achieved quantitative growth in terms of building the information communication infrastructure and supplying various contents to learners. And, now the government wants to upgrade effectiveness of education through the SMART education based on more advanced information technology. For successful implementation of the SMART education, core elements of teaching and learning should be considered, first of all. In this aspect, development of good-quality contents is the most important aspect. When orientations of the SMART education and digital contents meet together, SMART education will be realized for learners.

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http://www.edunet.net

http://webhard.edunet.net

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ONLINE TRAINING IN AUSTRALIA

Joze Kuzic
Monash University
Australia

ABSTRACT

On-line training is becoming an interesting phenomenon in Australia and has attracted a lot of interest across many industries and businesses (Chan and Ngai, 2007). The research reported here looks at the use of online training in corporations in Australia. It focuses on two aspects of online training, the factors that 'warrant' its success as well as on benefits of being involved in online training.

This exploratory study into the issues prevalent to organisations in Australia was accomplished through a survey of top 500 Australian companies.

The findings from this research shows that a lot of success factors of online training identified in the literature have been identified in the Australian environment as well. These include: financial support, cross-functional team, alignment of the software and organisational standards (Driscoll, 1998); top management support, skilled work force (Talib et al, 2010); just in time training (Chan and Ngai, 2007); and usability and transferability (Wang et al, 2004).

Additionally, the findings also confirm the findings from the literature about major benefits of online training. These include: cost effectiveness (Wang et al, 2004); efficiency, competitive advantage, receiving training any time, any place, ability to provide custom tailored solutions (Chan and Ngai, 2007), 24 hours accessibility, flexibility, relearning skills; and improving knowledge and practice of preventive oral health (Talib et al, 2010).

KEYWORDS

Online training, Australia

1. INTRODUCTION

The online training has been "defined" by few authors as activities that uses Internet, intranet, www, for learning purposes (Hall, 1997); a way of communication that uses information technology in order to provide instructions 24/7 and is geographically independent (Chamers and Lee, 2004); (Davis, 2001). Some authors see the advent of the Internet as a vehicle for delivering this important service (Greenberg, 1998).

Online training allows collaborative learning environment, delivering the training in a more cost-effective and efficient way, as well as without the need to attend the classes (Levin et al, 1999), and (Davis, 2001).

Some of the reasons for the companies to get engaged in this activity include its flexibility, adaptability, low cost, and just-in-time training (Chamers and Lee, 2004); (Simmons, 2002).

2. LITERATURE REVIEW

Online training is becoming more and more popular in recent years and because of its ability to provide a variety of benefits has been adopted in many organisations worldwide. In the last few years it has made a profound (Chamers and Lee, 2004). According to Sloman (2001), it is attractive to a large number companies and businesses all over the world.

In addition, according to Talib et al (2010) the use of online training has witnessed the increase in knowledge, efficiency, etc. in many industries. According to the same author, it also supports the practice of preventive oral care, in the health industry. Furthermore, the online training can be of great use in telerehabilitation by providing an alternative to the classical clinic-based approach (Burdea et al, 2000).

To be successful in any field and to be able to achieve benefits the businesses need to identify those few factors that can “make it or break it”. The identification of these success factors is one of the most important tasks for the businesses that want to be involved in online training.

One of the best definitions of success factors is provided by Laudon and Laudon (1988; 1998), and has been cited by Hossain (1999): “success factors are small numbers of easily identifiable operational goals shaped by the industry, the firm, the manager, and the environment that assure the success of an organization”.

In the context of online training, and for that matter in any other context, the achievement of benefits is only possible through the identification of success factors. Some of the major success factor identified by the literature are: top management support, positive attitude towards online training adoption, innovativeness, knowledge about IT, user-friendliness, and championing the online training in an organisation financial support; cross functional team; conformance to the corporate standards; matching the technology and the training topic; right complexity of the content; familiarity with the tools; ability to provide continuous improvement, skilled work force, ability to provide flexible services (Aguinis et al, 2009); (Driscoll, 1998); (Chan and Ngai, 2007); (Chamers and Lee, 2004); (Simmons, 2002); (McGinnis and Ackelsberg, 1983); (Quinn, 1985); (Westmoreland et al, 2010) and (Thong and Yap, 1995).

Among the main reasons for many companies, regardless of their size, to participate in any business endeavor is to be successful and to achieve benefits from it. Online training is not any different in that respect. It has provided organisations with opportunities to achieve benefits by reducing operation costs, improving customer service, and gaining business efficiencies (Chan and Ngai, 2007); (Markham et al, 2009); (Gasparetti et al 2009); (Carpenter et al, 2010); and (Kleinpell et al, 2011).

Additionally, online training can help organisation in providing custom tailored training, achieving time savings, reusing of programs/trainings as many times as they need it, allowing 24/7 delivery, and information sharing (Chan and Ngai, 2007). Online training is about building better relationships between its participants and allowing its consumers to search for products and check for customer service information online, helping in decision making process (Raupach et al, 2009); (Lockhart and Smith, 2009); (Thistlethaaite, et al, 2007); and (Wang et al, 2011).

Achieving benefits in this field, is however, quite difficult, and to make sure they are successful, organizations must really endeavor in identifying factors (CSF) that can bring those benefits around.

3. RESEARCH METHODOLOGY

The research represented in this paper is a part of a larger research into online training accomplished through a survey of top 500 organisations in Australia. It was guided by the following research questions:

a) What are the Critical Successful Factors of online training in top 500 Australian organisations?
b) Is there any difference among identified critical success factors in Recreation and other services, and finance/banking industry?

The survey questionnaire was piloted and subsequently sent to the top 500 organisations in Australia. The participants were asked to list all the critical success factors of online training to their organisations, and rank the importance of each of the factors. The ranking included using 0 to 5 Likert scale, 0 being the success factor not identified, 1 being list important and 5 being most important factor identified.

The responses collected were analysed using the non-parametric statistical test/analyses because of the non-parametric nature of the data from the Likert scale. The data collected for the research reported in this paper included the Rank Analysis, and Kolmogorov-Smirnov test.

The Rank Analysis was conducted to find out what are the most important critical success factors in participating organisations.

The Kolmogorov-Smirnov test was conducted to find out if there were significant differences among the participating organisations from finance/banking, and recreation and other services industry.

4. FINDINGS AND DISCUSSIONS

Out of 500 questionnaires sent out we received 52 useable responses, making the response rate just above 10%. The Communications industry returned the highest number of responses – 11 in total. Insurance, Finance/Banking, and Wholesale/Retail industries returned 10 responses each. It was followed by the Recreation and other services, returning 9, Education/Training industry 1, and Community services 1 response.

In order to find out the importance of each CSF in the whole population and in the Finance/Banking, and the Recreation and other services, we conducted rank analysis. Table 1 shows the ranks of CSF for the whole population and for the two industries.

Table 1. The rank order of CSF identified in the whole population, finance/banking and Recreation and other services industry

Rank	**Whole population**	**Finance/banking industry**	**Recreation**
1	Content	Content	Innovativeness
2	Skilled work force	IT knowledge	Corporate strategy
3	Top management support	Cross-functional team	Content
4	Innovativeness	Flexibility	Top management support
5	Flexibility	User friendliness	Skilled work force
6	Cross-functional team	Corporate strategy	Familiar tools
7	User friendliness	Financial support	User friendliness
8	Financial support	Topic and technology matching	Financial support
9	Familiar tools	Skilled work force	Topic and technology matching
10	Topic and technology matching	Top management support	7 days 24 hours availability
11	7 days 24 hours availability	Online training adoption readiness	Cross-functional team
12	Corporate strategy	Familiar tools	Online training adoption readiness
13	IT knowledge	Innovativeness	IT knowledge
14	Online training champion	7 days 24 hours availability	Online training champion
15	Online training adoption readiness	Online training champion	Flexibility

Table 1 show that 9 critical success factors of online training are represented in the top 5 CSF in the whole population, finance/banking, and recreation and other services industry. It indicates that these factors are evenly spread throughout all 3 populations. It also indicates that the recreation and other services industry has higher degree of “agreement” with the whole population about the importance of these top critical success factors than the finance and banking industry, as it has identified 4 out of 5 factors as very important from their organisations’ point of view. The 9 identified factors represented in top 5 across the whole population and the two industries include: Content, skilled workforce, top management support, innovativeness, flexibility, user-friendliness, IT knowledge, Cross-functional team, and Corporate strategy.

In order to find differences, if any, among identified CSF in finance/banking and recreation and other services industry we conducted Kolmogorov-Smirnov test. The results of Kolmogorov-Smirnov test ($P>.05$) shows that there was no significant difference in the identified success factors between the two industries. It indicates that both industries have perceived the importance of the identified success factors similarly.

5. CONCLUSIONS

This research has confirmed that the critical success factors of online training that have been found in the literature have also been found in the top 500 Australian companies. The two industries, focus of this research, have ranked the identified critical success factors similarly.

The research also indicates that top ranked success factors are evenly spread throughout the whole population, as well as in finance/banking and recreation and other services industry. The most important success factors identified in the whole population as well as in the two industries include: Content, skilled workforce, top management support, innovativeness, flexibility, user-friendliness, IT knowledge, Cross-functional team, and Corporate strategy.

6. LIMITATIONS AND FURTHER RESEARCH

A major limitation of this research, and for that matter all the survey oriented researches, is we couldn't clarify some of the issues that needed some clarification, and clear the doubts raised by some of the answers. A chance to clarify these and some other issues will, hopefully, be presented to us when we conduct few case studies in the future research on this topic.

In the near future we will attempt to conduct few case studies to try to get a better understanding of the issues we have our doubts after this survey. Hopefully we would be able, and that is our aim, to get 5 in depth case studies.

After completing the in depth case studies, we would endeavor to expend our research to large corporations in some of the European Union countries, to get the sense of the state of online training in the Europe, and to make comparisons with the Australia's large corporations.

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USING FACEBOOK AS A VIRTUAL CLASSROOM IN A PUBLIC UNIVERSITY IN MEXICO CITY

Miguel Angel Herrera Batista
Metropolitan Autonomous University

ABSTRACT

Since Information and Communication Technologies have been developed, many changes have taken place in society. Social Networks certainly have changed communication habits, especially among young people. Nowadays, Social Networks are used as a communication system every day. In most countries, university students use this communication and interaction media to share information, images, videos, music, etc. but essentially, they use Social Network to socialize. In Mexico, probably more than 90% of the students between 17 and 25 years old have their own Facebook space. In this way, almost every student in the university knows how to use the social network, especially Facebook, nevertheless, none of them knows how to use virtual classrooms like Moodle, for example. This is a big problem for universities which are interested in using virtual classrooms. That is the case of Metropolitan Autonomous University, in Mexico City that is interested in using Moodle to support academic activities.
That is why we decided to change the paradigm: if we can't take students to virtual classroom, we can take classroom to students. In this way we empowered Facebook as a virtual classroom.
In this paper we describe our experience in using Facebook, no just as a communication media, but as a real virtual classroom, in a public university in Mexico City.

KEYWORDS

Social Networks, e-learning, b-learning, educative Facebook.

1. INTRODUCTION

In July 2012, a survey was conducted at Campus Azcapotzalco of the Metropolitan Autonomous University. A random sample of 470 students was selected. The data collection was carried out during ten days, from July 9 to July 19, 2012. The survey was directly applied in each classroom. The target of the study was to identify the technological tools which are more used by students in their activities such as searching and exchange information, generate agreements, sharing tasks and interact and socialize with other students. Later, we could use those results to design and release didactic strategies for promoting the learning.

The results pointed out among any other things, more than 90% of students usually used the Social Networks every day. Nowadays more than 90% of the Metropolitan Autonomous University students use Facebook for socializing with their classmates. This average corresponds surprisingly with other studies (Chuck Martin (2009), Connie Varnhagen (2011), Nicola Cavalli,(2011), Marisol Gómez, (2011)) . It is interesting that while in 2006, Messenger was the most important media for socialize (with an average of 41 %), now, Facebook is the most important social media (with an average of more than 90 %).

On the other hand, the study, also let us knows that less than 25% of the students had used virtual classroom. Unfortunately, this average is too low if we consider that the Campus Azcapotzalco released a Virtual Education Office in 2006 to promote b-learning. This is disappointing that over the 60 % of our students have never used educational platforms and only less than 20% of them had used Moodle, which is our institutional platform in this Campus.

Considering the facts mentioned previously, we can conclude that we have an especial situation: students do not know how to use virtual classroom but, they are expert in using Facebook. That is why we decided to use Facebook as a virtual classroom. All that inside a b-learning model this is, to use virtual classroom and face-to face- education model.

2. ENABLING FACEBOOK AS AN EDUCATIONAL SPACE

Regarding the use of technology in academic activities and according to the study, there are two facts of particular relevance:

a) The extraordinary development of social networks that has become a phenomenon, especially, for young people.

b) The big potential of the Virtual Classrooms has not been used yet within the community of the UAM-A. In part perhaps because of the lack of a good design of the interface and the low level of usability and simplicity that is required. That is way so few faculty members have adopted Moodle in their courses.

Based on the above, we considered that it is necessary to incorporate strategically Social Networks to education to strengthen the contact and interaction with students and improve the education. In other words, we decided *to take the virtual classroom to the students* instead *to take students to virtual classroom*. With that in mind, we decided to get more information on previous experiences and background about it. We found, at that time (March 2012) that some teachers and professors in the world had already used Facebook to support virtual communication and education (for example Adán Griego, Shirly Arrieta, Luis Armando Miramontes).

Despite shared experiences on the web were scarce, they allowed us to drive our work. We found that Facebook allowed us to create groups (or "circles" in Google Plus) in order to organize our students to perform academic activities.

Since we wanted to take advantage of Facebook, we must to know better this Social Network and all of the tools that we can use, but first we had to answer the following question: Should professors and students be “friends” in the Social Network?

We analyzed the advantages and disadvantages of being friends. At the end we considered that if we were friends of our students, we may have some problems such as loosing authority inside the classroom.

3. CREATING THE GROUP

In order to create the group and given we did not want to be friends of the students; we needed to get two Facebook profiles.

We created an “open” group with my two different profiles.

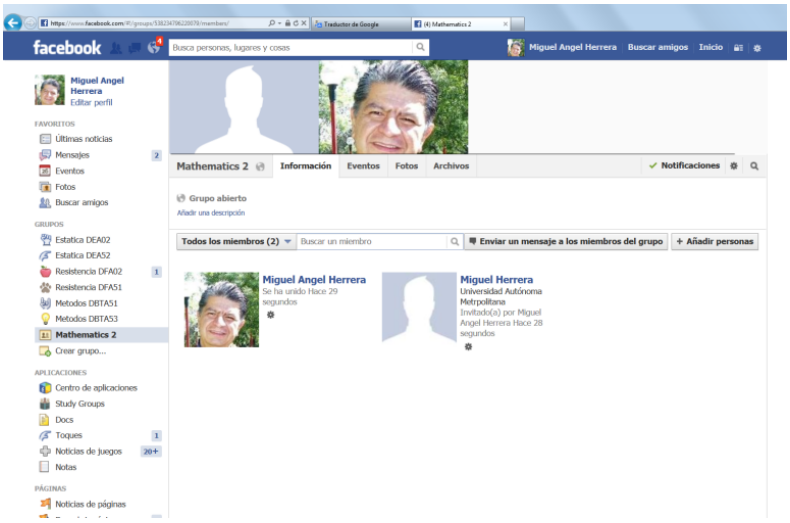

Figure 1. My two different profiles

It is necessary to create a URL (Group Address) for the group and provide it to students. This step is essential.

4. USING FACEBOOK TOOLS

Facebook offers many potential tools for learning like such as the possibility to upload and share, photos, images, videos, files, and recently, documents like word, excel, power point, PDF, etc. And we can also create "Events", "Ask Question" and others. Nowadays there are many educational applications. We used "docs" for Facebook. Below we describe the use we gave to each of these resources.

4.1 Files and Docs

One of the most important document to start a course is delivering the study program to students. We used two ways: "add file" and the application "Docs".

The difference between them is that if we use "Docs", then our documents could be available for future uses. Furthermore, students can also download and edit them.

Figure 2. My documents in "Docs" for Facebook

We use this media to share the study program, exercises and assignments, tutorials in power point, etc.

4.2 Add Photos

It was a very important resource to generate *sense of belonging* among students. We took photos to groups twice or three times during the course. Actually, they enjoy watching themselves on Facebook.

Figure 3. Some photos of the students in the face-to face-class

On the other hand, students have used their cell phones to take pictures of the blackboard, then, we decided to do it as well and share them through Facebook. This was important to remember every topic seen in class.

4.3 Videos

During the course were recorded some videos explaining or repeating any of the exercises in class. This resource was useful for students because they could remember all topics of the course.

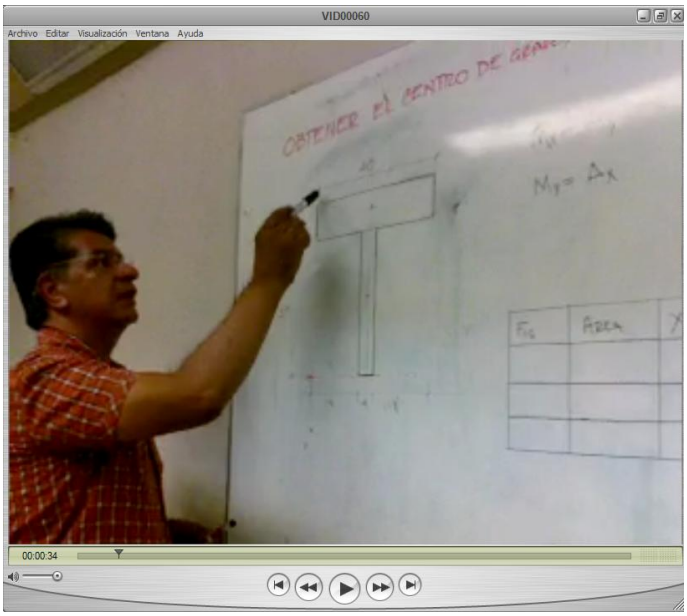

Figure 5. An example of a video taken during a class

It is very important that the students produce and share their own videos.

4.4 Other Tools

Creating events is useful for programming exams and any type of academic activities because in that way they will always be informed.

During course students and I had to generate agreements. We use Asking Questions and it was useful for it. In other occasions, we needed to use Inbox messages to send special task or feedback to some of the students.

5. RESULTS

In general, almost 90% of the students enrolled had an active participation. The platform served as an effective tool for bidirectional communication and distribution of educational materials fundamentally video tutorials and worked examples. Students were interested in using this media. Also it encouraged a sense of belonging in the group and class participation.

6. CONCLUSION

Many changes have taken place in society. Social Networks certainly have changed communication habits, especially among young people

Taking into account the increase of use of Social Networks and the development of mobile devices, it is necessary to take advantages about it and create new way to understand education, as a communicative, interactive and multimedia process that is able to improve the learning experience.

Therefore, teachers must generate instructional materials and digital didactic documents that encourage the ingenious and innovative use of the ICT in education, including the mobile devices as cell phones, i-pods, tablets, PDA, etc. Nevertheless, we must use them not only "as a tool that facilitates the storage, transmission and organization of the courses' content, without a significant difference between face to face courses and others courses supported by ICT " (Montes et al., 2006), but also as a way to improve the quality of learning and to support the development of thought skills (Jonassen and Yueh, 1998).

There are many reasons why the use of social networks, is appropriate for education, especially higher education:

a) The environment of social media is widely known by the students, so the learning curve would be negligible compared with other virtual classrooms as Moodle.

b) Facebook provides the ability for users to create groups sectioned.

c) Facebook has a natural tradition for the use of photos and videos, resources that have great educational potential.

e) The ability to organize and schedule "events".

f) The ease of incorporating other educational applications

g) The growing availability of mobile phones with direct access to social networks, especially Facebook, Twitter and YouTube contributes to the u-learning. That is why we still believe it is better to bring the classroom to students instead of bringing students to the classroom. In addition, Social Networks have always been part of education, even before the technological development of our days.

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EXPLORING COMPETENCY DEVELOPMENT WITH MOBILE DEVICES

Maurice DiGiuseppe, Elita Partosoedarso, Roland Van Oostveen and Francois Desjardins
University of Ontario Institute of Technology
Toronto, Ontario
Canada

ABSTRACT

Computer-based technologies have been used in the field of education for over thirty years. However, more recently, powerful and more affordable mobile technologies are becoming popular in everyday life and the education system. This paper reports on an online survey of student body in a university in Ontario, Canada focused on the use of a wide variety of digital technologies, including mobile devices such as conventional cellphones, smartphones, tablets, and e-readers. Preliminary results indicate that students are using conventional cellphones with less frequency, favouring use of smartphones and tablets ─ using such devices more for technical, social, and informational interactions including texting and sharing data and less for computational functions and talking.

KEYWORDS

Mobile devices, smartphone, higher education, digital technology

1. INTRODUCTION

Although the past thirty years have been witness to a constant influx of technology in the post-secondary education sector (PSE), attention to understanding how students use technology is far more recent. Technology integration in education has usually meant teacher use of technology; however, in the past few years this technology has become far more portable and affordable. Powerful digital technology is now in the hands of learners and they are purchasing and using it for a broader set of purposes (Dahlstrom, 2012).

Mobile devices are essentially small, handheld computers that can be found in a variety of configurations including smartphones, tablets and, most recently, phablets, or intermediaries between smartphones and tablets (Passary, 2013). Most smartphones come equipped with a 8-9cm (3-3.5”) (measured on the diagonal) screen size, while tablets can have screens as large as 25-27cm (9.7-10.6”). Screen resolutions may vary as well from 320x240 to the extreme high end of 2048 x1536 in the 3rd Generation iPad with Retina Display (List of displays by pixel density, 2013). When equipped with powerful but efficient miniature processors that require little electrical power and sufficient memory (16, 32, 64 and 128GB), these devices can be relied upon to clearly display great masses of information.

Most current mobile devices rely on touch input interactivity directly on the screen and through the use of a virtual keyboard that is displayed on the screen. Mobile devices may be equipped with WI-FI or a wireless local area network, Bluetooth, global positioning systems (GPS) and cellular radio capabilities that can allow connections to the Internet and other Bluetooth capable devices such as an automobile or a microphone headset. The feature set is generally rounded out with a camera or two and a media player that is enabled for video, music and static pictures. The operating systems (OS) used in mobile devices provide support and services for the use of small programs known as “apps”. Originally apps were created for a wide variety of purposes, such as email, calendaring, and contact management, and over the past 2 years, more than 100,000 apps have been created for each of the 3 major OS platforms; iOS from Apple, Android from Google and BB10 from Blackberry. The availability of apps for virtual video conferencing, blogging, microblogging and other social networking affordances ensures that mobile devices will be used for educational purposes.

Recently, educational and commercial institutions and systems alike have been affected by a novel phenomenon referred to as Bring Your Own Device (BYOD)(Hesseldahl, 2013). Mobile devices are starting to be used in classrooms at all levels, including Higher Education (HE) and at a higher rate by students than by faculty, resulting in an impetus for a transformation in higher education in the areas of 'recruiting, teaching, learning, delivery, communication, social interactions, and campus operations' (Melton & Kendall, 2012).

Today, most PSE institutions have adopted digital technology into their curricular practices, but to varying degrees, from simply using the World Wide Web as a means of distributing materials to students, to institutions with full laptop programs. At the University of Ontario Institute of Technology (UOIT) in Oshawa, Ontario, Canada, where, for the past 10 years, laptops have been supplied to every incoming student and where the environment has been focused on facilitating access and delivery of learning materials through the Internet, mobile technology used by students is changing the educational landscape. Students use their institutional laptops, but they are also seen using many other digital devices, especially mobile devices. These changes are challenging our assumptions about these learners and causing us to investigate their use of mobile technologies for learning. To help understanding the current use of digital technology by students at UOIT, the study reported here examined five research questions: 1. What technologies do students use? 2. For what purposes? 3. How often do they use them? 4. How confident are they in using these technologies? 5. How long have they been using these technologies?

In order to provide the basic, necessary data, an instrument was adapted from a survey designed to collect similar data from teachers and instructors (Desjardins & Bullock, 2012). Both instruments are based on the premise that all digital technologies are fundamentally computers, and, as such, can only process, store, and transmit computer data. From these three functions, user interactions with digital technology may be categorized into four general classes of interactions (Desjardins, 2005), namely, Technical interactions *(interacting with digital devices)*, Social interactions *(interacting with others through digital devices*), Informational interactions *(interacting with information through digital devices)*, and Computational interactions *(interacting with data processing software through digital devices*).

2. METHODS

Knowing the technologies that students use and what they use them for does not necessarily indicate whether they are able to use them effectively. To determine university students' ability to use mobile devices, we surveyed UOIT students on their use of mobile technologies using two Likert scale indicators, namely Frequency of Use and Confidence of Use (Table 1).

Table 1. Five-point Likert scale used to measure frequency of use and competency of use

Frequency of use	Confidence of use
1 = never	1 = do not know how to use
2 = few times a year	2 = not confident, require assistance to use
3 = few times a month	3 = confident, can solve some problems
4 = few times a week	4 = quite confident, can use with no assistance
5 = daily	5 = very confident, can teach others how to use

Frequency of use was employed as an indicator of effective use on the assumption that the more a specific device or system is used, the more the likelihood of use in different situations and the higher the probability of reinforcing of procedural knowledge. Confidence of use was employed as an indicator of effective use since this measure can be related to the likelihood of a user exploring new uses and applying this technology to new problems or tasks.

A total of 423 students (n = 423) were invited by email to complete the online survey and 157 students (n = 157) voluntarily completed the survey, for a 37% completion rate. Quantitative data gathered from online surveys completed by UOIT students were analyzed in Microsoft Excel using descriptive statistics for frequency of use and confidence in using mobile technologies.

3. FINDINGS

Preliminary data analyzed in this study (Figure 1) indicate that the first device that most students purchased were cell phones without data plans. However, the number of students purchasing their first cellphones without data plans has decreased since 2010. This decrease coincides with the increase in the number of students purchasing Internet-enabled smartphones and tablets over the same period.

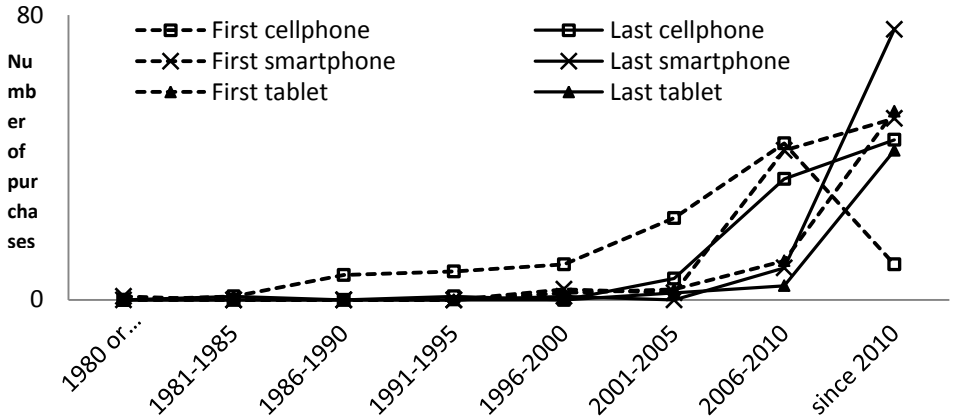

Figure 1. Year of first and last purchase of cellphones (no data), smartphones (with data), and tablets

Of the four general categories of devices (cellphones with data plans, cellphones without data plans, smartphones with data plans, and tablets), students had the most access to Internet-enabled smartphones, with the majority of these students owning at least one smartphone. The number of students with access to a tablet or e-reader was higher than the number with access to cell phones with no data plan.

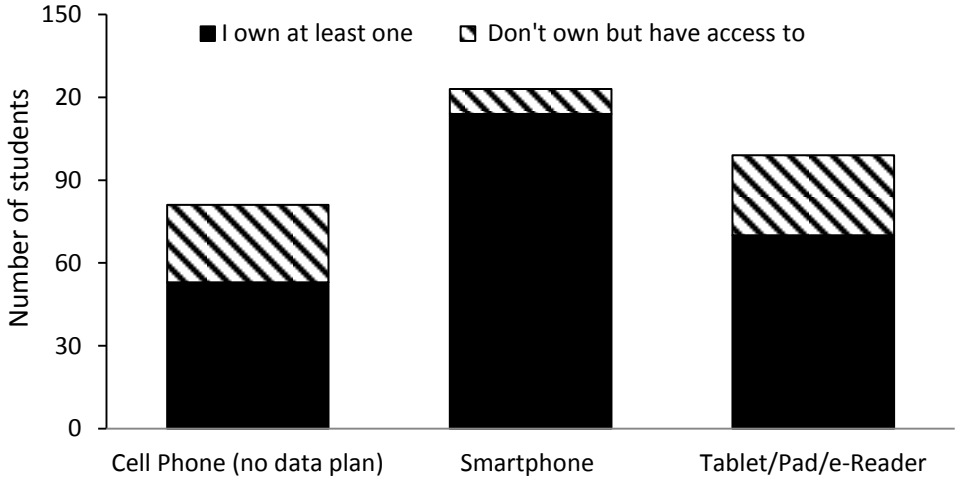

Figure 2. Student access to cellphones (no data), smartphones (with data), and tablets

Data in Table 2 indicate that students used their smartphones most frequently (daily) to communicate via texting, with other modes of communication, namely audio, email, and social media occurring reasonably frequently (a few times a week). These students were quite confident in their abilities to use their smartphones for these purposes. Students also used their smartphones to create and edit documents and multimedia objects reasonably frequently. Students used their smartphones less frequently to search for information, although they were confident in being able to obtain this information with these devices. Most students did not use their smartphones for computational purposes; this was reflected in their lower confidence levels for these tasks. With the exception of sharing documents, students primarily used their smartphones for technical, social, and informational interactions and mainly for personal purposes.

Table 2. Frequency, confidence, and main purpose of smartphone use for the four classes of interactions.

		Frequency of use (5-point scale)	Confidence of use (5-point scale)	Main purpose of use		
				Personal	Studies	Work
Technical	Create/edit documents	3.66	4.33	78.4%	14.8%	6.8%
	Create/edit voice recordings	2.19	4.02	69.2%	23.1%	7.7%
	Create/edit multimedia	3.14	4.33	85.5%	8.1%	6.5%
Social	Email	3.92	4.69	65.1%	12.7%	22.2%
	Video	2.21	4.33	92.5%	0.0%	7.5%
	Texting	4.76	4.74	95.7%	1.1%	3.2%
	Audio	3.86	4.62	93.2%	1.4%	5.4%
	Social media	3.80	4.62	98.5%	0.0%	1.5%
	Share document	1.97	4.02	18.2%	69.7%	12.1%
	Share works and ideas	1.55	3.68	66.7%	20.0%	13.3%
Informational	Search for articles	2.68	4.57	63.9%	27.8%	8.3%
	Search for short videos	2.99	4.73	86.5%	9.6%	3.8%
	Search for movies	1.25	3.60	100.0%	0.0%	0.0%
	Search for music	1.59	3.84	100.0%	0.0%	0.0%
	Search for ebooks	1.34	3.53	85.7%	14.3%	0.0%
Computational	Share calendar	2.95	4.18	59.5%	29.7%	10.8%
	Use concept maps	1.05	2.94	33.3%	66.7%	0.0%
	Use diagrams	1.17	2.74	42.9%	28.6%	28.6%
	Sort data	1.25	3.26	80.0%	10.0%	10.0%
	Produce graphs	1.14	3.00	14.3%	57.1%	28.6%
	Complex calculations	1.71	3.88	55.0%	40.0%	5.0%

4. CONCLUSIONS

Preliminary analyses of the data in this study indicate that the majority of post-secondary students who participated in this study changed the types of mobile devices they have been using since 2010, reducing ownership of cellphones without data plans in favour of smartphones and tablets — primarily employing these devices for technical, social, and informational interactions. Furthermore, initial findings indicate that a majority of these students own at least one smartphone and more have access to a tablet or e-reader than a

cell phone with no Internet accessibility. These analyses also indicate that students are using their mobile devices more for texting and sharing data than for talking only. These results point to a marked transformation in student frequency of use and confidence in using Internet-accessible mobile devices such as smartphones and tablets (Melton & Kendall, 2012), and suggests further studies focused on student and professor use of mobile devices in the learning and teaching process.

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A STUDY OF THE METACOGNITION PERFORMANCE IN ONLINE INQUIRY LEARNING

Ya-Ping Huang and Chiung-Sui Chang
Department of Educational Technology, Tamkang University, Taipei, Taiwan

ABSTRACT

The purpose of this study is to probe into the effect of metacognitive thinking strategies with different teaching strategies in an online inquiry-based junior high course. Two types of teaching strategies were applied in classes with totally 69 students of 9th graders in New Taipei City. Among participants, 34 students were in the experimental group accepting the strategy of "Collaborative Online Inquiry" while the control group of 35 students with "Personal-based Online Inquiry". Data were collected for a six-week lesson on this topic "Campus Folk Song". ANCOVA and class observations, instructors' diary, and interviews with students are measured to understand the different effects of two teaching strategies on students' metacognitive thinking strategies. The result shows that students by 'collaborative online inquiry' in experimental group perform their metacognitive strategies better than those by "Personal-based Online Inquiry" in the control group.

KEYWORDS

Online Inquiry, Collaborative Learning, Metacognition

1. INTRODUCTION

"Campus Folk Song" is popular during the 1970s to 1990s in Taiwan. The music style is similar to country song but with more local consciousness. They were originated from the student singers in colleges and those song revealed the inner voices of the man in the street and some aroused many deep thoughts about the Taiwan positioning in world politics and it was resonatory in that times.

Though "Campus Folk Song" represents a period of historical moment of Taiwan democracy progress and was with great impact on ordinary people in many respects, it is hard to catch the attention of junior high students, not to mention to investigate in further the historical background, famous composers, famous songs, etc. In order to motivate the net generation to research this topic, online inquiry learning strategy were used in the class. Wallace and Kupperman(2000) indicate that online information seeking is a complex and difficult process. The intension to develop students' understanding of content through use of the Internet is a challenging task for both students and teachers though this learning strategy may more attractive to the digital natives. Because Internet-based learning environment is with high degrees of freedom, it may favors students who possess mature computer skills and metacognitive skills(Park et al. 2009). Tsai(2009) reported that students' metacognitive strategies play important roles in their online inquiry learning, and Huang, Shen and Chang(2011) also pointed out that promote metacognitive thinking is very important when using online inquiry learning.

The metacognitive activities involved in online inquiry include metacognitive knowledge and metacognitive regulation. Metacognitive knowledge is knowledge about one's self as a learner, task knowledge and strategic to learn(Flavel,1979; McCormick,2003). While metacognitive regulation of online inquiry includes (1)planning the online inquiry; (2)monitoring and controlling the progress through the online inquiry process; and (3)reflecting on what was learned after reading certain information(Schraw,1998; Howard et al. 2011).

In order to help teachers facilitate students' learning and to ensure learners are really involved in higher levels of cognitive activities rather than just copy and paste aggregately, this study used collaboration as a teaching strategy to stimulate learners metacognitive thinking, and the effect on metacognition performance of online inquiring learning is examined.

2. RESEARCH METHOD

2.1 Participant

A pretest-posttest quasi-experimental design was executed in a New Taipei City's junior high school. Participants were sixty-nine students among two classes. One class with thirty-four students was assigned to the experimental group, and another class with thirty-five students was assigned to the control group. They are ninth graders and their families are with ordinary social status.

2.2 Instructional Design of Online Inquiry Learning

A six-week online inquiry learning on "Campus Folk Song" was held in two classes. Basically the online inquiry journey had 4 steps: planning the web inquiry strategy, searching web resources, analyzing & synthesizing, evaluating. Researchers designed four questions to guide students' investigating activities and the online inquiring steps were scaffold through learning sheets which were distributed in the beginning of each class. Two classes of students should finfish their own learning sheets and submit in the end of each class. Besides, students in experimental group needed to finish one extra group activity learning sheet.

Table 1. Instructional Design Outline

<table>
<tr><td>Cycle</td><td colspan="8">Questions to answer and Online Inquiry Process</td></tr>
<tr><td rowspan="3">Cycle 1</td><td colspan="8">Questions to investigate in cycle 1:
What is the definition of "Campus Folk Song"?</td></tr>
<tr><td>Personal-based Online Inquiry (control group)</td><td colspan="2">Planning the web inquiry strategy</td><td>Searching web resources</td><td colspan="2">Analyzing & synthesizing</td><td colspan="2">Evaluating</td></tr>
<tr><td>Collaborative Online Inquiry (experimental group)</td><td>Collaborative Discussing</td><td>Planning the web inquiry strategy</td><td>Searching web resources</td><td>Analyzing & synthesizing</td><td>Collaborative Discussing</td><td>Evaluating</td><td>Collaborative Discussing</td></tr>
<tr><td rowspan="3">Cycle 2

Cycle 4</td><td colspan="8">Questions to investigate in cycle 2:
Why "Campus Folk Song" is so popular during 1970~1990 in Taiwan?
Questions to investigate in cycle 3:
What are the style and lyric characteristics of "Campus Folk Song"?
Questions to investigate in cycle 4:
Are there some typical composer or singer of "Campus Folk Song" ?</td></tr>
<tr><td>Personal-based Online Inquiry (control group)</td><td colspan="2">Planning the web inquiry strategy</td><td>Searching web resources</td><td colspan="2">Analyzing & synthesizing</td><td colspan="2">Evaluating</td></tr>
<tr><td>Collaborative Online Inquiry (experimental group)</td><td>Collaborative Discussing</td><td>Planning the web inquiry strategy</td><td>Searching web resources</td><td>Analyzing & synthesizing</td><td>Collaborative Discussing</td><td>Evaluating</td><td>Collaborative Discussing</td></tr>
<tr><td rowspan="3">Cycle5</td><td colspan="8">Task to complete:
Prepare an oral presentation in front of the class with ppt.</td></tr>
<tr><td>Personal-based Online Inquiry (control group)</td><td colspan="2">Evaluating</td><td colspan="2">Planning the web inquiry strategy</td><td colspan="2">Searching web resources</td><td colspan="2">Analyzing & synthesizing</td></tr>
<tr><td>Collaborative Online Inquiry (experimental group)</td><td>Evaluating</td><td>Collaborative Discussing</td><td>Planning the web inquiry strategy</td><td>Searching web resources</td><td>Analyzing & synthesizing</td><td>Collaborative Discussing</td><td>Work on group presentation ppt</td></tr>
<tr><td rowspan="3">Cycle6</td><td colspan="8">Task to complete:
Deliver the presentation and finish the peer evaluation sheet.</td></tr>
<tr><td colspan="4">Personal-based Online Inquiry (control group)</td><td colspan="4">Oral presentation, evaluating , discussing and reflecting</td></tr>
<tr><td colspan="4">Collaborative Online Inquiry (experimental group)</td><td colspan="4">Oral presentation, evaluating , discussing and reflecting</td></tr>
</table>

2.3 Instruments

2.3.1 Metacognitive Strategy Scale for Online Inquiry Learning

The Metacognitive Strategy Scale for Online Inquiry Learning (MSSOIL) used in this study was developed by Huang(2011) which was developed based on Metacognition Rating Scale for General Biology (MRSGB) and Metacognive Self-regulation sub-scale of Motivated Strategies for Learning Questionnaire(MSLQ). The MSSOIL is a 6-point Likert scale reflecting students' metacognitive behavior when working on their online inquiry learning. The overall Cronbach's coefficient alpha of MSSOIL was .91 while the subscales' are from .75 to .87. The dimension description of MSSOIL is presented in the following table.

Table 2. Description of MSSOIL'S Dimensions

Dimension	Item	alpha	
Self-plan (SP) (4 items)	● In terms of doing the online inquiring assignment, students have some thoughts about the purposes, searching strategies, reading skills before browsing the web	.82	.91
Learning-monitor (LM) (4 items)	● Students usually think about the relationship between the course content and the information on the web, and also the connections between the assignment project and the information on the web.	.87.	
Comprehension monitor(CM) (3 items)	● Students usually know whether there is anything not understood yet when browsing the web, and try to make sense to information which is usable but unfamiliar.	.77	
Self-modify (SM) (7 items)	● Students can usually find a better way to search for appropriate information and adjust personal views toward project topic if there is problem to complete the job.	.85	
Self-evaluate (SE) (4 items)	● Students usually try to examine the proficiency of knowledge acquired after navigating the web, and they also have interests to review peers' comments if possible.	.75	

3. FINDINGS

The results of covariance in metacognition performance are showed Table 3 and table 4 which summarize the regression homogeneity test and ANCOVA respectively for "Collaborative Online Inquiry" group and "Personal-based Online Inquiry" group in the metacognition performance of online inquiry learning.

Table 3. Summary of Regression Homogeneity Test For Both Teaching Strategies In Metacognition Performance

Dimension	Sources of variance	SS	df	MS	F	Significance
Total	Between(regression-coefficient)	66.914	1	66.914	.538	.466
	Within (error)	8079.467	65	124.299		
SP	Between(regression-coefficient)	4.264	1	4.264	.651	.423
	Within (error)	425.664	65	6.549		
LM	Between(regression-coefficient)	4.798	1	4.798	.630	.430
	Within (error)	495.113	65	7.617		
CM	Between(regression-coefficient)	1.186	1	1.186	.224	.637
	Within (error)	343.762	65	5.289		
SM	Between(regression-coefficient)	41.511	1	41.511	2.354	.130
	Within (error)	1146.121	65	17.633		
SE	Between(regression-coefficient)	1.788	1	1.788	.230	.633
	Within (error)	504.689	65	7.764		

P<.05

According to Table 3, the regression-coefficient homogeneity test did not show statistical significance in the total scores (F=0.538, p>.05) and each dimension. This means that these two teaching strategies have the same slope and conform to the fundamental assumption within regression-coefficient homogeneity.

Table 4. Summary of ANCOVA For Both Teaching Strategies In Metacognition Performance

Dimension	Sources of variance	SS	df	MS	F	Significance
Total	Between(group)	1469.813	1	1469.813	11.908	.001**
	Within (error)	8146.381	66	123.430		
SP	Between(group)	11.319	1	11.319	1.738	.192
	Within (error)	429.928	66	6.514		
LM	Between(group)	85.483	1	85.483	11.286	.001***
	Within (error)	499.911	66	7.574		
CM	Between(group)	29.655	1	29.655	5.674	.020**
	Within (error)	344.948	66	5.226		
SM	Between(group)	200.401	1	200.401	11.137	.001***
	Within (error)	1187.632	66	17.994		
SE	Between(group)	34.702	1	34.702	4.522	.037**
	Within (error)	506.477	66	7.674		

*P<.05, **P<.01

The ANCOVA results in Table 4 exclude the influence of original ability (pre-test), and the two teaching strategies in the metacognition performance assessment indicated that experimental group made significantly greater gains compared with control group in comprehension-monitor ($F(1, 66) = 11.286$, $p < 0.01$), self-modify ($F(1, 66) = 5.674$, $p < 0.05$), self-evaluation ($F(1, 66) = 11.137$, $p < 0.01$), cross-evaluation ($F(1, 66) = 4.522$, $p < 0.05$) and total scores ($F(1, 66)=11.908$, $p<0.01$). The dimension of self-plan ($F(1, 66) = 1.738$, $p > 0.05$) is not significantly different in the post test excluding the pre-test effect.

4. DISCUSSION AND CONCLUSION

In the "Learning-monitor" dimension, students in the experimental group were more aware of their learning process because they had more chances to interact with others to discuss the relationship between the questions teacher proposed and the information they inquired on the web. For the "Comprehension-monitor" dimension, groups with collaborative discussion performed better for they need to clarify the usefulness of information, and by went through this process they explained what they learned from the web messages reciprocally which can help them to be more reflective on their comprehension level of this learning topic. As the "Self-modify" and "Self-evaluate" dimensions, students in the experimental group faced more compulsion to listen to others and group activity also provided more chances to communicate different opinions which can both encourage and force learners to evaluate and modify their learning.

Whipp et al.(2004) suggested that proper self-monitor and tracking are important characteristics of computer-based learning, because students always confront with metacognitive challenges about task understanding, planning, monitoring, regulation, and reflection throughout the whole online inquiry process (Quintana et al. 2004). In this study, collaborative online inquiry learning presented better metacognition performance than personal based online inquiry significantly. This result provides a confirmation of positive effect of collaboration on metacognitive thinking, and further studies about the interaction during the collaboration are suggested.

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EDUCATIONAL COMPANY AND E-LEARNING

František Manlig[1], Eva Šlaichová[2], Věra Pelantová[3], Michala Šimúnová[4],
František Koblasa[1] and Jan Vavruška[1]
[1]*Technical University of Liberec, Faculty of Mechanical Engineering, Department of Manufacturing systems Studentská 2, 461 17 Liberec, Czech Republic*
[2]*Technical University of Liberec, The Faculty of Economics, Department of Business Administration Studentská 2, 461 17 Liberec, Czech Republic*
[3]*Technical University of Liberec, Faculty of Mechatronics, Informatics and Interdisciplinary Studies, The Institute of New Technologies and Applied Informatics, Studentská 2, 461 17 Liberec, Czech Republic*
[4]*Slovak University of Technology in Bratislava, Faculty of Materials Science and technology in Trnava, Institute of Production Systems and Applied Mechanics, Department of Production Systems, Rázusova 2, 917 24 Trnava, Slovak Republic*

ABSTRACT

This article deals with nowadays urgent issue. It tries to find a way how to achieve as highest probability of current students employment as possible, especially in the age of business crises. It comes from actual industry practice requirements on hiring employees. There is briefly, considering limited range of article, described innovative education concept "Educational company", which implies elements of problem based learning with focus on e-learning application and acquirement of soft skills by students. This article shows structure of mentioned concept. There are mentioned differences between traditional and developed education concept. A contribution describes current experiences of all participants, concept benefits and also problems, which this concept faces. There are presented further steps connected with concept development.
The experience of concept versatility are very good and show it´s high potential. A concept is motivating not only for students but also for the teachers, which are acquiring the new abilities and are getting new knowledge. Mostly it is going about more effective form of education with clear results not only in the form of created products but mainly in good student versatility in practice.

KEYWORDS

E-learning, „Educational Company", silky abilities, student, teacher, product.

1. INTRODUCTION

1.1 The Theoretical Outlets

Education at all types of schools should go through regular innovations. The reason is achieving it's quality results. Schools are operating in a very competitive environment like all other organizations. In this, it is necessary to help graduated students in the future versatility in the globalized labor-market. The process of an education includes important factors such as: teacher, student, subject or specialization, etc. Each student has his way of learning. It includes perception and processing of knowledge (Kohoutek, 2008). During an education the method of student learning affects the teacher´s teaching (Průcha, 2009).

The requirements for specialization by students are rising according to (Smith, 2005). On the other hand, companies require from the schools greater connection with practice and mastery of soft skills as well. Also these requirements decide about student versatility of labor market (Meyers, 2007). Therefore, also in the Czech Republic promote educational systems of various types. Except from traditional teaching "in front of blackboard" are discussed other learning systems, above all e-learning and Process Based Learning.

E-learning is a form of education that uses informational technologies to inform the students, to provide a communication between student and teacher or more students together and for the distribution of learning materials and presentation of the theory and also the management of education (Dostál, 2008). The e-learning materials are often created in multimedia forms (see, e.g. Šimon and Edl, 2011; Edl, 2012). Implementation of e-learning takes place through the Learning Management System. Therefore, the smart learning systems have a three program modules – teachers (it includes a specifics of a teaching materials and theory), student (it includes a specifics of a concrete student), and tutor (it includes teaching strategies) according (Brdička, 2004). Process Based Learning is the education concept of larger and longer-term issues that requires the active exploration by students. Compared to the traditional education this concept is less structured. However, students must work together, organize their work and lead to the desired result (Brownell et al., 2004).

To the development of these mentioned methods in terms of empirical research would like to contribute the authors of this article as well.

1.2 The Practical Outlets

Unrelenting market requirements and tough competition are reflected in the personnel area of manufacturing organizations. Companies choose their employees with not only their professional knowledge in the given field (such as: the construction machinery or preparations, the technologies of plastics processing and mold manufacturing, etc.) and language training. Leading organizations are beginning to realize the importance of soft skills.

Industry according the author (Manlig, 2010) with particular emphasis on:

- the comprehensive interdisciplinary knowledge,
- the processing thinking,
- the systematic approach,
- the ability to work in the team,
- the practical experience in the branch.

In addition in the present, organizations are required from the workers, according to available job offers: interdisciplinary collaboration, time management, communication skills, independence, creativity, accuracy, reliability, ability to work with legislation and internal business documents. Workers must be able to control a variety of information technologies (software for various fields/branches). They are accessing the capabilities to introduce a modern technologies and orientation in various tools of management.

Most companies already aren´t looking for only the specialists (exclusive experts in the given area), but also interdisciplinary professionals who ***are able to solve business ties and problematic tasks much more complexly*** - they have the procedural and holistic thinking. Therefore technically oriented engineers with the comprehensive knowledge (i.e. technically oriented multi-professional worker who knows the business processes and the ties between them) find out the versatility in the present time.

2. IDEA OF EDUCATIONAL CONCEPT „EDUCATIONAL COMPANY“

The idea of educational concept of "Educational Company" based on the mentioned requirements of industrial practice. It introduces the elements of problem-oriented education and e-learning to the education, as are presented in detail in the text above. To date, there is a significant gap between business requirements for recruitments and knowledge taught in schools of all types in the country. The presented concept is trying to close this gap.

The concept of "Educational Company" connects the selected objects into an unified education system by complex project. In this project, the students solve the problems related to the design of batch production. It proceeds from the initial idea and a introductory marketing study, over the development of the product, to the design of a production in the concrete shop floor conditions of the home department, as is illustrated in Figure 1.

Figure 1. Schematic concept of „Educational Company“

In addition to getting the expertly knowledge the students learn to work in a team. They acquire the current and newly developed company ties. They learn to work considerately of others' work. Quality permeates of the all performed activities. Above solved problematic, the people discuss in personal contact and through information technology as well, and not only in limited time of teaching. On the other hand, must acquire soft skills. This is connected with the deliberate application of information technologies and the involvement of "common sense" and humanity, which is in the some areas currently being lost. The concept is trying to balance the aspects of the technology world and emphasis on grasping of the human factor in modern business.

The concept of "Educational Company" with its structure also builds on the idea of the process, as is currently enforced in quality control. The output of one object is the input to another object (e.g. design of the technology for specific departmental conditions in the study subject CAD / CAM (Computer Aided Design / Computer Aided Manufacturing) is the output at the same time it is the input for the design of production process in the study subject Design of the production systems). Here is the aspiration to make students working on the project very similar to real production conditions. In this context, regular consultations with industrial companies in the area are utilized. Even there is an aspiration to introduce partial cooperation in the "sharp" business problems of related organizations. This places big demands on all involved partners.

For a closer approximation in the following table (Table 1) are shown the main differences between the innovative concept of "Educational Company" and the traditional education of "In front of blackboard", which is very common not only in this country.

Table 1. The comparing of "Educational Company" with "In front of blackboard"

Activity	**Traditional education „In front of blackboard“**	**„Educational Company“**
Course interdependence	Low	Aspiration for the biggest connect object
Task solving	Tasks are solved separately in each course	Complex project – solving task from the perspective of different profession
Types of projects	Given by nature of the project – from individual to team projects	Team project with emphasis on project management principles
Type of task	Mostly model situations	Solution design for specific workshop conditions
Pedagogues' role during project solving	Superior behaviour and task control	Usually project head manager (sponsor), can behave also as a coach
Student motivation	Depends on the type of task/project low till high	High
Demand placed on teacher to prepare course	Low till medium	High
Use of information technologies	Low till medium	Medium till high
Use of teaching aid materials	Small	High, rich production
Requirements of course	Low	High, continually
Soft skills learning	Unnoticeable	Rich

3. CONCLUSION

Past experience with the introduction of the concept of "Educational Company", both from the teachers and the positive response of graduates and other professionals from the industry, demonstrate the considerable potential of this approach to education. An unique connection of normal professional knowledge versatility, information technologies and soft skills, as well as the creation of additional knowledge, are preparing students for the real situation not only in domestic organizations.

In addition to professional knowledge is highlighting in particular following:

- scope and knowledge of corporate ties,
- easier integration of graduates into business processes.

Finally, there is outlined next development of described concepts:

- creating of e-learning support for particulars modules of "Educational Company" concept,
- the expansion of an existing example of the design production process as well as learning example for complex design of a new production machine concept with regard to both technical and technological capabilities, as well as organizational requirements,
- currently we are discussing about the possibilities of linking education between some subjects and faculties.

The aim of the cooperation of the Faculty of Mechanical Engineering with the Faculty of Economics is bigger interconnection of technical aspects of the project with economic aspects.

Significant involvement of the other faculties still alludes to well-established ways of education, which would be "very difficult to change". Inter-faculty cooperation is therefore solved directly with personal contact (staff) across the university.

Application of the "Educational Company" concept requires a good teachers and also experts in given fields. Not only knowledge is needed but also technical support and finances. In this way, the education is related especially with necessary willingness and the enthusiasm of the teachers. This is the motor of this difficult but interesting project.

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STRUCTURAL CONTRUCTIVISM AS AN EPISTEMOLOGY FOR PROFESSIONAL e-LEARNING: IMPLICATIONS & RECOMMENDATIONS FOR THE DESIGN OF eCPD PEDAGOGICAL MODELS

Gurmit Singh & Maggie McPherson
School of Education, University of Leeds, Hillary Place, Leeds, LS2 9JT, UK

ABSTRACT

This position paper deploys a dialectical worldview and a critical sociological perspective on practice to conceptualize professional e-learning as a reflexive bundle of knowing, doing, thinking and reflecting that produces practical knowledge as the power to change when immersed in the dynamism of practice across social structures. It is therefore a structural constructivist process. Two implications for the design of electronic continuing professional development (eCPD) pedagogical models to address this learning challenge so as to improve the impact of eCPD programmes on professional practice are explored. Firstly, acknowledging the diversity of social actors in any process of eCPD for changing practice highlights that implementing technologies and implementing new evidence to improve practice brings up issues of conflict and confrontation because of the agency of all practitioners. Secondly, in such a context, educators could tackle the challenge of managing the reflexivity of professional networks by creating new informal social structures for social interaction and collaborative learning networked with technologies that disrupt existing structures. Finally, it concludes with recommendations for designing eCPD as a strategy to improve impact on practice.

KEYWORDS

Agency, CPD, epistemology, professional e-learning, online pedagogical models, reflexivity

1. INTRODUCTION

Today, electronic continuing professional development (CPD) is routinely delivered to various professionals across the world through Internet-connected devices such as computers, laptops, smartphones and tablets. Whether for doctors, nurses, teachers, engineers, accountants or filmmakers, eCPD courses largely take the form of self-study modules with videos and podcasts, as well as interactive blogs and discussion forums. eCPD aims to support professionals update knowledge and skills, as well as share and collaborate, so as to improve practice, including the products and services offered to end users such as patients in healthcare. Yet, despite critical reviews showing the low impact of current eCPD pedagogical models from current research in healthcare (author et al., forthcoming), there are few attempts to rethink the underlying epistemological assumptions of designing eCPD pedagogical models. Current research into designing and evaluating innovative eCPD approaches in healthcare to improve impact on practice (author et al, 2012) tackles this problem by reframing the epistemology for professional e-learning. This position paper elucidates a new epistemology of professional e-learning – structural constructivism, critically discusses two key implications, and makes recommendations for designing eCPD to manage and optimize the 'e-learning-practice change' relationship and improve impact.

2. REFLEXIVITY: PROBLEMATISING EXISTING eCPD DESIGN

From a critical perspective on education, existing pedagogical models for eCPD based on a set of 'objectivist' and 'socially constructed' assumptions about professional e-learning that are neither 'objectivist' nor 'socially constructed' are a problem. They cast professionals who learn reflexively – that is they learn automatically

from experience – to improve their practice through informal social relationships (Gabbay & LeMay, 2004; Nardi et al, 2002) as a problem to be fixed with inputs of knowledge and skills, and assume a static linear causal relationship between e-learning inputs and practice improvement outputs. While social constructivism promises much in theory, its enactment in online environments to deliver short courses to busy professionals is challenging (Nunes & McPherson, 2007; Sandars et al., 2007). Social constructivist pedagogical models do not change or modify the wider structures that produce unanticipated barriers to professionals' capacity for agency to change practice as a result of learning on an eCPD programme. While acquisition and participation are both important in learning (Sfard, 1999), as are critical reflection and practitioner research (Brookfield 1987; Carr & Kemmis, 1986; Schön, 1983) the impact on improving practice ultimately rests on the ability of pedagogical models to improve the access of professionals to a multiplicity of perspectives and resources in in safe spaces such as informal networks to work on and try out new practices that empower them. The danger of current binary debates about 'what works' in curriculum development and implementation for eCPD is that positive and productive strategies necessary to improve practice may be overlooked or discounted in efforts to use technologies to stimulate naïve and unproven ideals of online communities of practice and reflective practice (author et al., forthcoming). Seen from a dialectical worldview therefore, the reflexivity of humans across social structures suggests that professional e-learning that produces changes is better termed *structural constructivism* – a reflexive bundle of knowing, doing, thinking and reflecting that produces practical knowledge as the power to change when immersed in the dynamism of practice across social structures – enabling critical design implications for eCPD pedagogical models.

3. PROFESSIONAL LEARNING AS A STRUCTURAL CONSTRUCTIVIST PROCESS: IMPLICATIONS

3.1 Increase the Capacity for Agency

Approaches for the design of pedagogical models for professional learning to improve impact on practice, drawing on different learning theories, compete actively in e-learning research and practices today (McPherson et al., 2008). To move beyond the socially-thin assumptions of the traditional input-output perspectives on eCPD design toward an understanding of eCPD as a change process, a critical sociological practice perspective allows educators to articulate a post-structural logic for learning and practice change with technologies, where professionals have the energy to reflect on their behavior and modify their actions as they seek to maintain and improve their social position, thus making their reaction to any 'learning' delivered through programmes less mechanical and more emergent.

In essence, acknowledging the diversity of social actors in any process of eCPD for changing practice highlights that implementing technologies and implementing evidence to improve practice brings up issues of conflict and confrontation because of the agency of all practitioners.

Agency is an important factor in the construction of an 'authentic' online teaching-learning context to make eCPD more effective. It means educators can take less for granted in terms of how their programmes affect the empowerment of professional e-learners. It also means managers and leaders need to work with educators urgently and take productive strategies to design for changing practice that focus on new forms of controlling teams and new incentives for digitally mediated e-learning that is not distinct or separate from their self-directed learning in the dynamism of practice.

In today's digitally mediated and technology-saturated organizations, the dynamism of practice is also driven by the impact of learning and other Web 2.0 technologies being implemented into the 'learning-practice change' process during eCPD. Research into the use of blogs, wikis, podcasts, and asynchronous discussion forums shows that the different levels of agency afforded by particular social networking technologies will affect the usefulness and usability of these technologies for professional learning networks to adopt for interaction and collaborative learning (Boulous et al., 2006; Sandars e al., 2007).

3.2 Restructure the Structures of Practice

If the capacity for agency to change practice where professionals work is curtailed by the existing social structures, these realities make a difference to what can be achieved educationally with eCPD programmes.

eCPD designers have often used metaphors of 'learning communities', 'networks of practice' or 'small groups' to describe social structures through which programmes and technologies are embedded to support professionals to learn and improve their practices. However, an absent question is: Do these structures increase the capacity for agency to make changes? From a practice perspective, professional e-learners are not passive subjects into which learning can be inputted, they are active social agents who reproduce and are produced by social structures as they go about their daily working lives (Bourdieu 1977). Since their capacity for agency is structurally and digitally mediated, a second implication is that eCPD pedagogical models need to deliver programmes and design processes to support healthcare professionals learn about and modify the structures of their practice so as to increase their capacity for agency. This requires that eCPD pedagogical models construct new informal social structures that are safe and enabling, with the intention to channel the agency of practitioners that already exist, and to allow their 'social energy' (Bourdieu, 1980) to connect and flow, with technologies and artefacts that are designed with the involvement and input of the networks of professionals they are intended for.

4. CONCLUSION, RECOMMENDATIONS & FUTURE WORK

To take one major professional group, the medical and healthcare sector, the evidence on the low impact of eCPD in a recent critical literature review on improving impact on practice (author et al., forthcoming) showed that existing studies consists largely of self-reported behaviour change from healthcare professionals who access stand-alone one-off modules, and based on experimental study designs. Similar stories of low impact are heard in other professions such as teacher eCPD. Self-reported claims of change are characteristic of the positivist epistemology and the technical-rational industrial logic of 'evidence-based' professional education and research that dominates today, based on linear causal assumptions of change that treat e-learning as a treatment to be injected into professionals to magically make them improve. These assumptions, based on a teleological worldview, have resulted in the dominance of behaviouralist approaches in the current eCPD field.

The intention of rethinking e-learning philosophically here is not to disprove the need for evidence of change, but rather to note the way in which the rhetoric of the current normative evidence-base practice approach positions linear causality as the way to produce impact and solve the problems of improving practice. In this account, pedagogies are causal solutions to the problems of changing behaviour. Because evaluators' criteria are behaviouralist alone such as reaction and satisfaction, they make no critical analysis and produce no evidence of the complexity of the process of changing practice or the social relationships involved. Nor do they require or support professionals to make sense of complexity and become smarter about knowing what they are getting out of eCPD with effective self-evaluation tools customized for measuring e-learning process impact. Neither have they rethought their epistemological and ontological assumptions to advance theory building and practice in e-learning.

Reacting to this lack of prior research and the reification of eCPD, this paper offers a socially critical practice-based perspective for knowing and handling professional e-learning to change practice. This epistemology reflects the situated, emergent, and recurrent aspects that make learning reflexive, and enables it to be understood and generalized as a structural constructivist longitudinal process.

A structural constructivist epistemology of professional e-learning improves upon existing dominant cognitive psychological and social constructivist perspectives. By positioning eCPD and change at the structural level of society, it raises to the fore the two important implications discussed above for the construction of dynamic teaching-learning contexts that designers need to be mindful of. Moving forward, these features are necessary to design e-learning that can achieve a critical grasp on understanding change processes at multiple levels and with the various components of eCPD programmes, in particular the affordance of particular technologies and pedagogies. Overall, this epistemology bring eCPD closer to the reality of the dynamism and contingency of contemporary professional practice, which is characterized less by traditional tightly knit communities than by weak and loose ties, competing objectives and intensional networks, in a 21st century world of global digitally-mediated work (author et al., 2012).

Given the issues of conflict and confrontation during curriculum development and programme delivery, as well as technology implementation in organizations, can educators working online to deliver eCPD programmes continue to take for granted the resources available to them and their students to produce change? Even if they may have the intention to change, professionals' ability to change practice can be

curtailed by the existing social structures. These realities make a difference to what can be achieved educationally with eCPD programmes that a structural constructivist lens grasps conceptually to transcend socially thin dualistic thinking that separates learning, change and practice.

By turning away from social constructivist perspectives, this position paper recommends from a structural construvist lens on professional e-learning that an eCPD strategy should be viewed as an emergent process of formal and informal practices designed to achieve an understanding among management, educators and users regarding the effectiveness of a particular programme and approach with learning technologies on improving impact. Because the use of technologies modifies the level and importance of agency, it also recommends that explanations for the impact of eCPD on how and why practice changes now develop tools for measuring the agency of professionals in relation to what resources eCPD programmes offer. Making professionals conscious of their agency to change by not only having a recourse to subjective reflection on their behaviours individually or collectively, such tools will need to capture objectively how their social interactions and collaboration with their teams/networks shapes their agency. This becomes vital to manage team reflexivity and improve performance in a financially challenging environment, where e-learning is often touted as a cost-effective alternative for CPD. Yet little research exists on evaluating the value of time spent in and on online process, and is necessary for making e-learning productive and empowering.

Drawing on a structural constructivist epistemology, future work will sketch out a theoretical scaffolding and conceptual model for designing eCPD as a strategy to improve impact. This position paper is offered to stimulate debate among funders, policymakers, researchers, designers and practitioners of professional e-learning, whichever industry we might work in.

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E-LEARNING SYSTEM FOR EXPERIMENTS INVOLVING CONSTRUCTION OF PRACTICAL ELECTRONIC CIRCUITS

Atsushi Takemura
Tokyo University of Agriculture and Technology
2-24-16, Naka-cho, Koganei-shi, Tokyo 184-8588, Japan

ABSTRACT

This paper proposes a novel e-learning system for technical experiments involving the construction of practical electronic circuits; this system would meet the various demands of individual experimenters. This mixed mode is beneficial for practical use in that an experimenter who does not have sufficient circuit components for circuit making can still learn to construct practical, large-scale circuits and evaluate their behavior using virtual measurements and a simulation technique involving circuit translation into SPICE. The proposed system is expected to be applicable to various educational media (e.g., e-Learning, mobile learning, virtual laboratories). The proposed system is constructed by combining real and virtual circuit making systems, and performs the improved circuit recognition of images including both real and virtual circuit regions. The usefulness and effectiveness of the proposed system were evaluated by analyzing circuits made by ten university students in an actual class.

KEYWORDS

e-Learning system for experiments, electronic circuit making, circuit translation into SPICE

1. INTRODUCTION

Teaching and learning the design and construction of electronic circuits is important in the field of technology education. Recently, several education support systems have been developed to improve students' understanding of electronic circuits and circuit-making ability. The stand-alone simulation systems (Abramovitz, 2011; Fitch, 2011) and virtual laboratories (Gurkan, 2008; Oliver, 2009) are useful for students lacking experimental facilities. However, these conventional systems cannot cope with the wide variety of circuits constructed by individual experimenters because they are based on all-purpose or ready-made learning tools and apply only to specific circuits within a subject area.

To overcome these disadvantages, a distance learning system has been developed in the present study for experiments involving both real circuit making (RCM) and virtual circuit making (VCM) (Takemura, 2012). An experimenter who has the required circuit components but lacks measurement equipment can learn circuit making and analyze circuit behaviors using the virtual measurement technique of the RCM system. Distance learning using the VCM system is useful and effective for users lacking both circuit components and measurement equipment for making and analyzing real circuits. Both RCM and VCM systems are applicable to various educational media (e.g., virtual laboratories and e-Learning). However, there is a need for systems utilizing which users can learn to construct larger-scale circuits and various practical circuits. To deal with the shortcomings of the stand-alone systems mentioned previously, this study proposes a novel learning mode that combines RCM and VCM. This proposed mixed mode performs the improved circuit recognition of images including both real and virtual circuit regions. The mixed mode enables an experimenter who lacks the necessary circuit components and measurement equipment to learn the construction of practical and large-scale circuits and evaluate circuit behavior.

2. METHODOLOGY

Figure 1 illustrates the proposed e-Learning system for experiments involving the design and construction of practical, large-scale circuits. This system consists of individual users' computers and a remote analysis system. Individual users can choose a preferred mode from three learning modes (VCM, RCM, and the mixed mode) depending on the required purpose or environment (subsections 2.1–2.3). To support circuit design and construction, each student uses a computer to transmit the circuit image to an analysis system that runs on the internet. The analysis system recognizes the circuit construction using image processing techniques and translates the structure of the circuit into a general circuit description language (SPICE) (Rabaey, 2012). This SPICE translation technique indicates the working of the circuit and enables virtual measurement without real measurement equipment, and it can identify the incorrect components present in the circuit (Takemura, 2011). This is an important step that aims to improve the efficiency and prevent the occurrence of serious accidents such as electric shocks or fire.

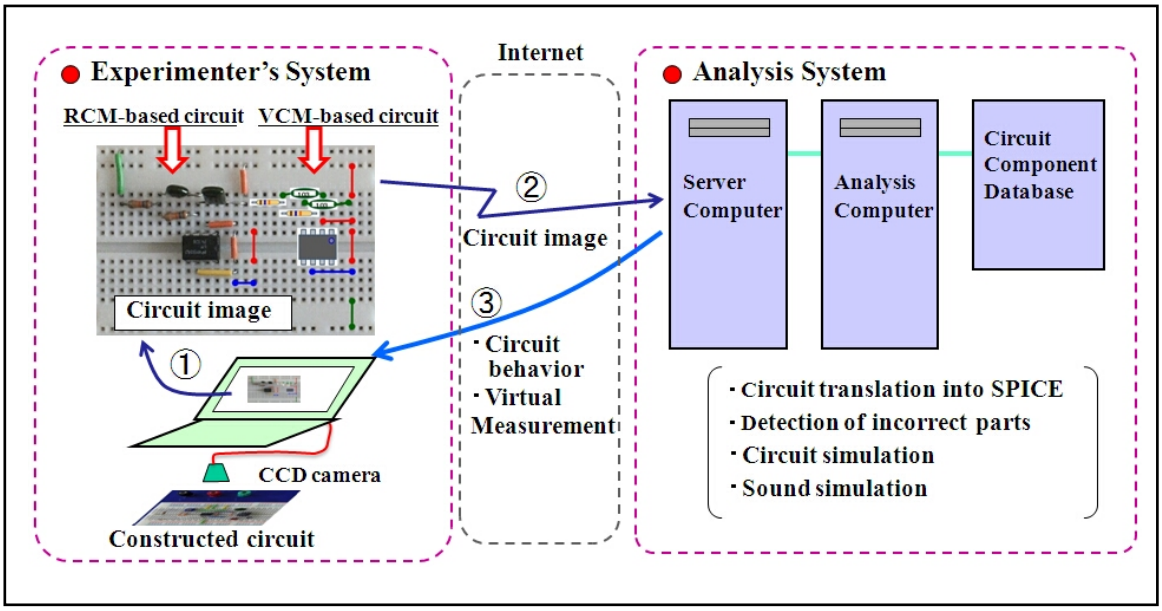

Figure 1. Schematic of the proposed e-Learning system for experiments involving circuit making.

2.1 VCM Mode

The VCM mode of the system is useful for students lacking circuit components, measurement instruments, or facilities (e.g., laboratories). The VCM mode (Takemura, 2012) enables individual experimenters to use graphics editors, which are installed on a user's computer. Therefore, this system does not require the use of proprietary graphics software. Each experimenter can download virtual circuit components and a template circuit-board image from the analysis system. The connections of circuit components on a virtual circuit can be indicated by placing the virtual circuit components and the characters representing their parameters (e.g., IC resistance and capacitance) on the template circuit-board (breadboard) image using the experimenter's preferred graphics editor. The experimenter indicates the virtual-circuit connections by drawing colored lines on the template image using a graphical user interface (GUI) and saves the image of the virtual circuit in a commonly used file format (e.g., JPEG and BMP). The virtual circuit image is transmitted to the analysis system, and the analysis system performs circuit recognition using image processing techniques (pattern matching) by comparing the components in the virtual-circuit image with each circuit component available in the server database of the analysis system. The analysis system translates the virtual circuit into SPICE without errors because circuit recognition is based on the input data of the virtually constructed circuit.

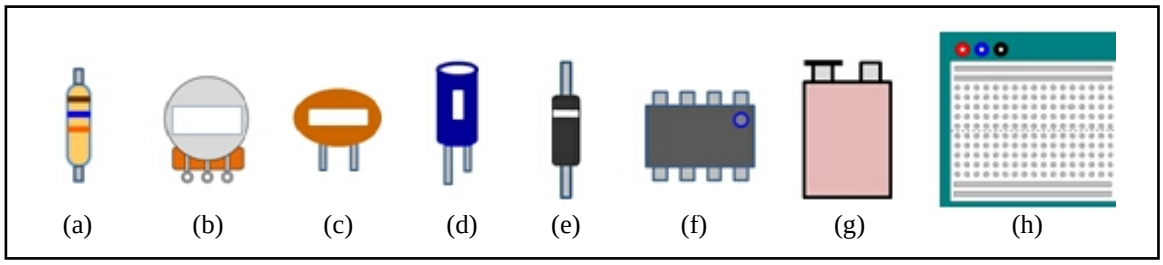

Figure 2. Circuit components for the VCM mode: (a)–(f) virtual circuit components prepared for connection on the circuit board image (resistor, potentiometer, capacitor, electrolytic capacitor, diode, and IC, respectively), (g) 9V battery, and (h) circuit board image used to construct a virtual circuit.

2.2 RCM Mode

An experimenter having the circuit components necessary for circuit making can learn to construct a circuit and analyze its behavior using the RCM virtual measurement mode (Takemura, 2012). The experimenter transmits the image of the constructed circuit to the analysis system. The analysis system performs pattern matching between the virtually constructed circuit (drawn using the VCM system) and the circuit constructed using the RCM mode. This enables the analysis system to automatically differentiate the layout of each device and determine the circuit wiring. In addition, the analysis system performs circuit recognition on the basis of the training data obtained from this approximate differentiation and the circuit device database. The pattern matching process between the virtual circuit and the real circuit improves the accuracy of circuit recognition and SPICE translation and decreases the computational cost.

2.3 Mixed Mode

The mixed mode of the proposed e-Learning system for practical circuit making can translate a circuit image consisting of both real and virtual circuit components. This mode is useful for experimenters who do not have sufficient real circuit components needed to make a complete circuit because it enables them to study the construction of practical and large-scale circuits through the following steps (A)–(E):

(A) An experimenter designs and constructs a virtual circuit using virtual circuit components downloaded from the analysis system and saves an image of the VCM circuit.
(B) The experimenter constructs a partially real circuit using real circuit components and saves an image of the incomplete RCM circuit.
(C) Using a graphics editor, the circuit image is completed by placing the VCM components on the incomplete RCM image.
(D) The analysis system automatically indicates the incorrect components on the circuit image on the basis of the difference between the translated SPICE information obtained from the images saved in (A) and (C).
(E) The experimenter can study the behavior of the circuit on the basis of SPICE information. Measurement instruments are not needed to check circuit behavior.

In this study, the image analysis technique for circuit recognition was improved to make it usable for circuit images including both real and virtual circuit regions. Concretely, the database of the circuit components for pattern matching techniques was increased to cover both RCM and VCM modes, and a morphological operation (Haralick, 1987) is used to detect the connected position of each component on the breadboard and adjust the size of the discriminated virtual components on the basis of the size of real components.

2.4 Experimental Methodology

The proposed system was evaluated by analyzing the circuits designed and constructed by ten experimenters in an actual class at Tokyo University of Agriculture and Technology. Figure 3(a) shows the diagram of a practical sound processing circuit for electric guitars to be constructed using the mixed-mode of the proposed system. The physical circuit components to be used to construct a simple circuit (an active filter) (Fig. 3(b)) were provided to each student on the assumption that experimenters who learn circuit construction using an e-Learning system do not have sufficient circuit components. Therefore, the circuit components provided to the students were not sufficient to construct the circuit shown in Fig. 3(a), and thus, the mixed mode of the proposed system is indispensable to the construction of the complete circuit.

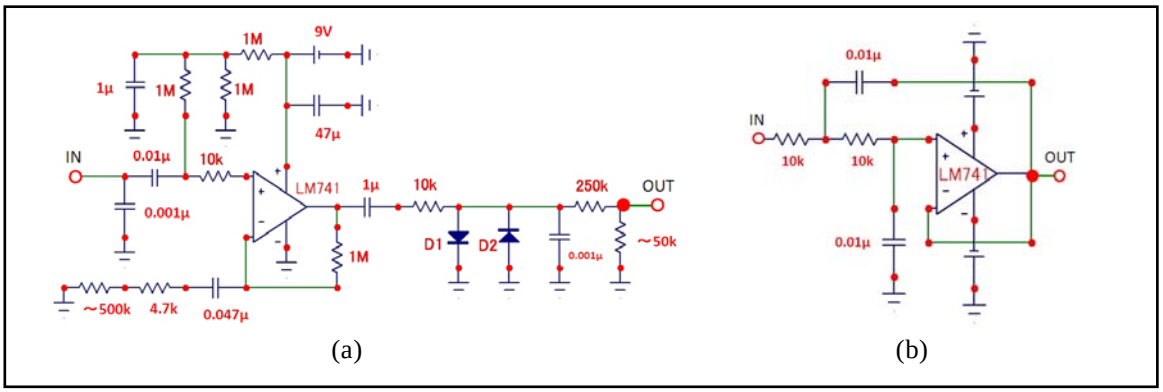

Figure 3. Circuit diagrams to evaluate the proposed system: (a) circuit to be constructed using the mixed mode of the proposed system and (b) circuit to be constructed by individual users using the available circuit components.

3. RESULTS AND DISCUSSION

Figure 4(a) and (b) show examples of the circuit designed using the VMC mode and the circuit constructed using the proposed mixed mode by an experimenter, respectively. Figure 4(c) shows an example of the simulation results (sound waves of the input and output signals) obtained from the SPICE translation of the circuit constructed using the mixed mode. The analysis system provided simulated the sounds and provided the simulation results, enabling the experimenter to examine the behavior of the circuit and the effect of sound processing (synthesized sound) on the basis of the virtual circuit.

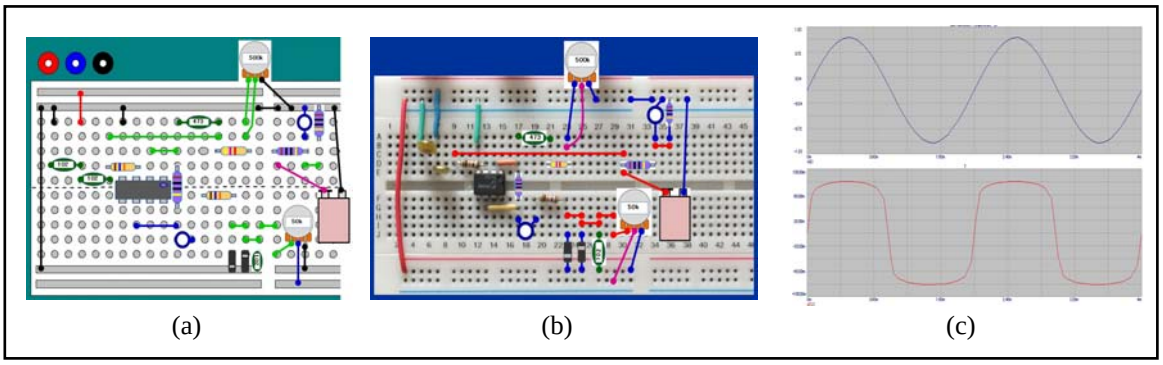

Figure 4. Results of circuit construction using the mixed mode: (a) circuit designed using the VCM mode, (b) image of the circuit constructed using the proposed mixed mode; (c) SPICE simulation based on circuit translation(sound waves of the input and output signals).

The proposed system was evaluated by analyzing the circuits constructed by ten students at Tokyo University of Agriculture and Technology. The following positive responses, which pertain to the usefulness and efficiency of the proposed system, were obtained from all students:

- The mixed mode of the systems is useful because it enables e-Learning of topics such as circuit design and experiments involving practical circuit making.
- The proposed system is instructive, and individual students can study practical circuits. The system enables enlargement and optimization of a physically constructed circuit using the mixed mode of the e-Learning system.

However, there were also a few technical disadvantages and suggestions for improvement:

- A remote educational system to study digital circuits is expected.
- The size of the experimenter's system should be reduced.

4. CONCLUSION

This paper deals with a novel e-learning system for technical experiments involving the construction of large-scale, practical electronic circuits. The proposed mixed-mode system is developed by combining RCM and VCM systems. The usefulness and effectiveness of the system were verified by analyzing electronic circuits constructed by ten students in an actual university class. Positive responses, which pertain to the usefulness and efficiency of the proposed system, were obtained from all the students. The following steps are necessary to practically realize the proposed system:

- A mobile communication tool instead of an experimenter's computer is expected to reduce the size of the system.
- Computational costs for circuit recognition procedure should be decreased.

ACKNOWLEDGMENT

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COMPONENT-BASED APPROACH IN LEARNING MANAGEMENT SYSTEM DEVELOPMENT

Larisa Zaitseva, Jekaterina Bule and Sergey Makarov
Department of Software Engineering, Riga Technical University, Latvia

ABSTRACT

The paper describes component-based approach (CBA) for learning management system development. Learning object as components of e-learning courses and their metadata is considered. The architecture of learning management system based on CBA being developed in Riga Technical University, namely its architecture, elements and possibilities are described. Modern technologies used for implementation of the systems are outlined.

KEYWORDS

Component-based approach, learning management system, technologies

1. INTRODUCTION

The problem of providing a high quality learning and teaching process is becoming more actual since distance education, open education and life-long learning are very popular and useful forms of enhancing education. The availability of the new software technologies possibilities opens the doors to everyone who wants to be involved in the process of developing e-courses. Many scientists work on the technologies and methods of adaptive learning [Oppermann R. et al, 1997; Wey Chen J., 2010; Zaitseva L., Bule C., 2011], models [Bule J., Zaitseva L., 2007; Tsinakos A., 2010; Heineman G.T., Councill W.T., 2001; Scorm, 2013] and standards [LOM, 2002.; LTSA, 2003]. Different learning management systems and portals [eCollege, 2013; Edmodo, 2013; Moodle, 2013; WeBWork, 2013], specialized and universal learning systems [Coursera, 2013; eFront, 2013; Edutools, 2013] are being created and broadly used. Considering such a variety of developed and a huge open-sourcing it is convenient and appropriate to utilize a reusability feature, i.e., apply component-based approach of software engineering to an e-course development.

The aim of the paper is to describe a learning management system development process taking into account component-based approach principles. The following section shows learning objects as the main components of an e-course. The third chapter reviews learning management system architecture. The last chapter outlines the technologies used to implement the described system.

2. COMPONENT-BASED APPROACH TO SOFTWARE DEVELOPMENT

Component-based engineering [Heineman G.T., Councill W.T., 2001] is one of the trends of the software engineering. This approach supposes that software systems are assembled from reusable components (RC). These components are developed earlier and saved in a repository of RC. Then they are used for new system's development. Component-based approach (CBA) also can be successfully applied for learning management system (LMS) and e-learning courses as basic elements of LMS development.

E-learning course is a set of learning objects (LO) implemented using modern computer technologies and consolidated into a scenario that is created to organize a learning process of a definite topic of a subject by student or students' group (Collaborative learning).

Thus, LOs are reusable components of an e-learning course. Learning objects can be of two types: learning object information (LOI) and learning object task (LOT). LOI describes theoretical information of a course – different concepts, examples, etc. LOT is used for knowledge control and/or training during

acquisition of a course. LO has a complex structure and can be not just of various types (LOI and LOT), but also of different kinds and parts within a type. Both for LOI and LOT the kinds are the same since a LOT is supposed to be used to evaluate knowledge and/or skill level on a definite LOI. So, the kinds are as follows: structure, definition, example and rule [Zaitseva L.V. et al, 1989], – depending on what exactly is being described in a LOI. As well there can be various parts for each LO:

- LOI – main, example, explanation. Example and explanation are optional LOIs of different detailing level;
- LOT – two parts: general task and individual task. The general task is the same for all students and individual task is generated for each student separately to specify a general task. Every LOT according to a type has one or several answers, which are also referred as separate LO – LOA. As well there can be included comments for LOTs in general and every LOA particularly – LOC as well of different detailing level.

In addition to LO's complexity there is a list of metadata that should be considered while developing an e-course. The full list of LOs metadata is available in IEEE standard [LOM, 2002]. It is evident that all the data is required to implement an e-course of high quality, but there is always more critical data that should be taken into account for different purposes (Table 1).

Table 1. LOs metadata

LO metadata	Purpose	Description
LO title, description, language, platform, keyword, coverage/topic, type (LOI – main, example, explanation), specialty, program (study level – bachelor, master, college, etc.), purpose, copyright, restrictions	The initial list of reusable LOs to be included into an e-course	The main criteria to choose from the list of LOs available in repository
LO significance, mode of using (control, training), number of tries (LOT), time (acquisition – LOI or performing – LOT), type (LOI – main, example, explanation), difficulty	Possible minor modifications to adapt for an e-course	Means just adaptation of the parameters, not exactly modifications of LO itself
LO representation (media), LOT's type (multiple choice, word, number, etc. [Zaitseva L. et al, 2005]), language	Possible major modifications to adapt for an e-course	It is consider as a major modifications, if changing of media or translation is involved
LOI kind (definition, example, rule, structure), purpose, topic, LOT's type	Decision on developing new LOs	In the case when there are no LOs of specific kind or on definite topic of a course, or there are just one-type LOTs

As it was mentioned earlier, LOs are components of an e-course side by side with different processing programs/modules. Thus, to apply component-based approach for LMS and e-learning course (ELC) development repositories of learning objects and program components are necessary.

3. LEARNING MANAGEMENT SYSTEM ARCHTECTURE

Different classes of users can use LMS. They are: student, tutor, e-learning courses author (ELCA), administrator, operator, but basic classes of users are first three. That's why to present the architecture of LMS (Fig. 1) we selected only three agents. LMS also has a main program module (kernel of a system) that provides users identification and connection to specified agent, a unified interface for all agents, organization and maintaining of connection session, repository and databases maintaining, etc.

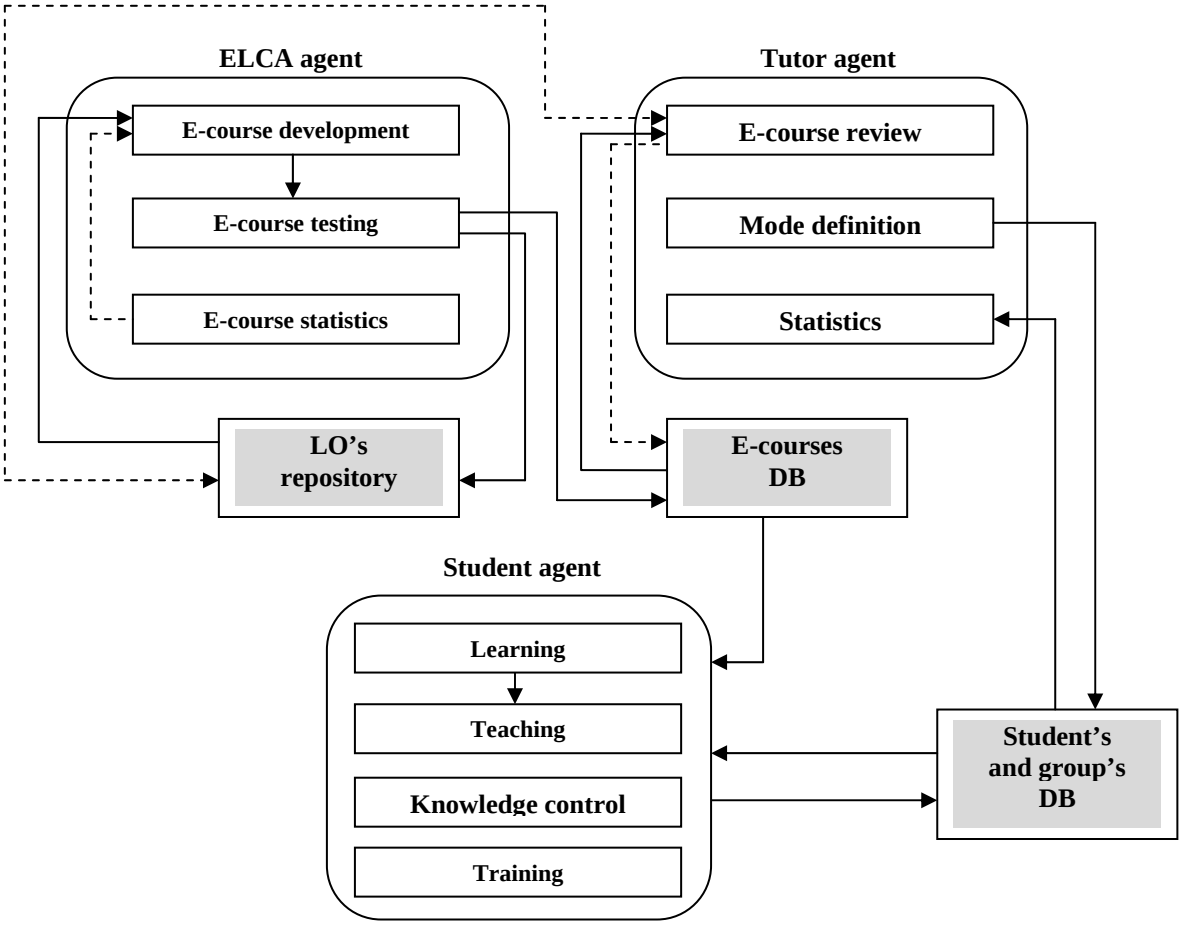

Figure 1. Learning management system architecture

Learning objects and their metadata are saved in LO's repository and can be used by ELC author to develop e-learning course. Developed and tested ELC is saved in e-course's database. A tutor after reviewing offers it to students and/or groups of students. Students can use e-learning course for learning, teaching, knowledge control or training. Student's and group's database includes information about students and groups of students, as well as a protocol describing a work with e-course.

The main functions provided by **ELCA agent** are e-learning course development and testing. A process of an e-course development based on CBA consists of the five stages: 1) define a goal and objectives of the e-course; 2) develop the e-course scenario using information about LOs and their metadata saved in a repository. Usually a scenario of an e-course is represented as a graph with LOs as vertexes and edges show the connections types between them [Zaitseva L., Bule C., 2011]; 3) select necessary learning objects from a repository and check them. An analysis and reviewing of the selected learning objects is performed during this stage to find out whether they fully correspond to the goal and objectives of the e-course, as well as to make a decision on each LO: to use it with no modifications; edit it adapting to the e-course requirements; develop fully new LO(-s); 4) modify the selected LOs, develop new LOs and test them. Modifications can be as follows: add new information to LO, remove unnecessary information according to the e-course author and/or represent existing information by means of other media; 5) integrate LOs into the e-course according to the scenario developed in the stage 2. The next step is testing of the e-course in general. Afterwards it is placed into e-course's DB. If during and ELC development the new LOs were created or modified the existing ones, author can save them in a repository.

The function „E-course statistics" allows author to get information about students work with ELC. After analyzing it author can improve a quality of an e-course by making some modifications, for example, adding more detailed representation of learning information with new examples or specifying a text of a task.

The **Tutor agent** provides the following functions:

- E-course review. Before making an ELC available for students tutor has to test it and evlauate it's correspondance to goals and tasks of a subject taught as well to make a decision on expoliting it without any modifications or make some amendments, for example, add more examples, questions and/or tasks. In the last case a copy of an e-course with tutor made changes is saved in e-course's DB.
- Mode definition. Depending on a chosen strategy of an ELC using [Zaitseva L., Bule C., 2011] tutor can set paramateres of a course exploiting that are usually specified for a group of students. For example, an ELC is supposed to be used for totally unassisted learning, training or knowledge control. For knowledge control (KC) it is possible to determine KC method, a number and difficulty levels of tasks, etc. [Zaitseva L.V. et al, 1989].
- Statistics. This function allows a tutor the possibility to get the detailed information about student work results.

The **Student agent** ensures a work in four modes for students:

- Learning. This mode gives student a possibility to learn independently any course that is available in e-courses' DB, using Teaching, Knowledge control and/or Training.
- Teaching. The mode provides an e-course teaching that was assigned by a tutor according to developed scenario.
- Knowledge control (KC) is used to test and evaluate students' knowledge and skills level. If the mode is assigned by tutor, a student answers questions and performs tasks according to set control parameters. If the KC is chosen by student to test own knowledge and skilss level (self-control) then he/she can choose as well a number of tasks, difficulty level and detailing of comments.
- Training is supposed for mastering skills on tasks solving on chosen or assigned by tutor topic. In this case it is the best practice to provide detailed comments on every student action.

Learning management system includes also various supplementary program components (modules) to ensure learning and teaching functions, namely: module for choosing tasks from similar ones to ensure that students get different questions during learning process; module for generating input data and calculating results while tasks performing and solving calculation assignments and others.

4. TECHNOLOGIES FOR LEARNING MANAGEMENT SYSTEM IMPLEMENTATION

Considering complexity of e-learning system architecture, it is implemented based on a multi-layer structure, which is standard for modern business software. System itself is based on web technologies since it is the most efficient way to deliver content. As well they have developed dramatically recently and allow simple processing of all kinds of information used in e-learning process. Client side is a browser-based user interface with all functionality needed to show all e-learning components for user, while server side contains all processing logic and databases/repositories.

Client side realized by using current web technology standard: Ajax, which allows dynamically changing content depending on input and reducing processing requirements on server, and considering increased requirements for security, Secure Socket Layer (HTTPS protocol) is a "must have" technology. To design user-friendly interface (UI) cross-browser integration framework should be used – jQuery [jQuery, 2013], Prototype/Scriptaculous [Prototype, 2013; Scriptaculous, 2013], MooTools [MooTools, 2013], Dojo [Dojo, 2013]. One of the most optimal frameworks for client side is MooTools, which ensures such an UI rendering that it looks the same on every popular browser currently on market.

Server side implements business logic and DBMS system. Considering a length of a life-cycle of software, five to seven years, technologies used in business logic implementation must be solid, i.e., have long history of support and without major changes in syntax through version history and with a big enough community of developers, like Java, .Net, PHP. Therefore server side logic is performed on Java, which has efficient integrated environments also there are a lot of frameworks available. As well one of the advantages is that almost everything is for free, so development costs are highly reduced. Taking into account that OSGi container [OSGi, 2013] is used for different modules, the GlassFish Java server [GlassFish, 2013] was chosen for providing a performance of LMS. OSGI allows separating some logic and functionality, and also dynamically adding new content to server.

To ensure data storage in repositories DBMS PostgreSQL is employed since it it's free, open-source, highly customizable and has powerful tools for data managing and processing inside database [PostgreSQL, 2013].

5. CONCLUSION

The component-based approach to develop learning management system allows reducing time and other resources consumption. Since this approach is based on the reusable components using to create a new product it also facilitates the whole process. In case of LMS implementation the benefits of CBA are for both the system itself and e-courses that are developed in it. Thanks to it and used technologies (OSGi) existing modules can be easily modified and the new ones added, and the same situation is with learning objects from available repositories that are treated as components for an e-course.

As further work we plan to enhance the existing LMS by using modern technologies as well to transfer already developed e-learning courses into the improved learning management system.

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LEARNING PORTFOLIO AS A SERVICE – A RESTFUL STYLE

Shueh-Cheng Hu[1], I-Ching Chen[2] and Yaw-Ling Lin[3]
[1]*Department of Computer Science and Communication Engineering, Providence University*
Taichung 43301, Taiwan, ROC
[2]*Department of Information Management, ChungChou University of Science and Technology*
ChangHua 51003, Taiwan, ROC
[3]*Department of Computer Science and Information Engineering, Providence University*
Taichung 43301, Taiwan, ROC

ABSTRACT

Learning portfolios play a critical role in fostering learning and assessing learning achievement. For easy access and more efficient processing, various electronic portfolio systems have being developed and receiving widespread adoption. Contemporary electronic portfolio systems are designed and developed proprietarily, such that the limited functionalities of each system are available to particular users only, and it is difficult to integrate them due to diverse access interfaces. However, just like other pedagogy support systems, e-portfolio systems must be renovated continuously to make them adapt to the ever-changing learning contexts and meet diverse requirements from teachers, educators, and administrators. Besides, to facilitate sharing and consolidating resources from different e-portfolio systems, it is of great importance to build easy-accessible as well as open e-portfolio systems. In consideration of the necessary agility, versatility, and accessibility, the present work proposed the concept of learning portfolio as a service and realized it with a restful styled approach. This article describes the design rationales and implementation of the learning portfolio as a service system, and analyze its impact on educational facets.

KEYWORDS

E-learning, electronic learning portfolio, cloud computing, SaaS, Restful Web services.

1. INTRODUCTION

Learning portfolios have being widely used to record all kinds of relevant data during the course of teaching and learning activities, and insightful information that can improve learning performance could be further distilled from these records. For the sake of efficiency and easy access in the age of Internet, many Web-based learning platforms take in e-portfolio systems to fulfill the task of tracking learning activities and documenting the corresponding artifacts. However, to adapt to ever-changing learning environments and meet diverse requirements from students, teachers, administrators, e-portfolio systems need to be agile and versatile. Furthermore, because cross-institute integration of portfolio resources enables cooperative analysis, planning, and management among different education institutes, administrative and accreditation agencies, functionalities of ideal e-portfolio systems need to be accessible.

Just like other Web-based learning management and contents systems, most currently-deployed e-portfolio systems have two major drawbacks, which include (1) proprietary design and implementation make each e-portfolio system be available to limited users who teach or learn in particular environment; (2) non-common application programming interface leading to difficulty in integration of distributed but complementary resources. Fortunately, the service-based approach, to certain extent, is able to resolve these shortages (Hu and Chen, 2008).

Among many advantages of service-based pedagogical resources, the most attractive one to both content consumers and providers is the open access method that are based on existing standardized techniques including HTTP, XML, etc. Not only being able to couple distributed and heterogeneous resources easily, the standardization, the derived openness and interoperability also facilitate the access to service-based resources and ease the composition of them.

In view of the importance of an agile, versatile, and accessible learning portfolio system, the present research work aimed to develop a system that realizes the concept of "learning portfolio as a service" (LEPORAAS) according to the restful style. Besides the fundamental functionality of a typical e-portfolio system, the LEPORAAS will enable prompt assessment of learning, pervasive assessment in diverse instructional and learning situations, efficient cross-institute cooperation, and macro administrative works and decision making.

2. PRIOR RESEARCH WORKS AND RELATED TECHNIQUES

2.1 Requirements of an Ideal E-Portfolio System

In general, education institutes use portfolios to document students' learning activities, progress, and concrete artifacts. The original and main purpose of learning portfolios is providing educators and administrators an alternative tool to assess students' learning (Ryan, 2011, Cavaller, 2011) from not only result-oriented, but process-oriented viewpoints. Portfolios support summative and formative assessment (Gans, 2009), which usually need reflection of artifacts that were developed during the course of learning and thus is more difficult to conduct than conducting quantitative and summative assessments, such as standardized tests. The electronic version of learning portfolios offer extra merits including storage of multimedia contents, easy access, fast index and search, efficient and precise analysis in depth.

Beyond its typical application to assessment, functionality of e-portfolios has been proved to be multi-facet. Many prior research works indicated that, main effects of portfolio also include improving students' knowledge and understanding, creating greater self-awareness and encouragement to reflection (Inácio and Salema, 2011), and nourishing the ability to learn independently (Buckley et al., 2009, Hays, 2004, Zembal-Saul et al., 2002). Additionally, along with Websites and Facebook, e-portfolios have been applied to aid pre-service teachers in understanding how to integrate technology into their instruction (Shaltry et al., 2013). The study conducted by Lambe et al. shows that e-portfolio can assess aspects of pre-service teacher education program within the specific context of special needs education, and can demonstrate a range of teaching competencies (2013). E-portfolio also can serve as an effective tool to facilitate the communications among students, teachers, and parents who can keep track of children's classroom learning through the corresponding e-portfolios (McLeod and Vasinda, 2009). Not surprisingly, career placement could be more suitable and precise by referencing long-term portfolios (Brennan and Lennie, 2010) of job seekers, rather than relying on the result of a single placement test. The reason is that contents in e-portfolio reflects a student's strength, weakness, interests, and particular the progress in specific domains.

In recent years, ICTs facilitate new learning approaches such as collaborative learning and edutainment. In addition, situations for learning have been broadened by wireless and broadband communication networks, which realized the concept of mobile or pervasive learning. In summary, all new aspects of teaching and learning activities correspondingly induce new requirements for e-portfolio systems. That means e-portfolio systems need to be adaptive and versatile, in order to meet emergence of ceaseless new requirements. Besides, they need to be accessible for easy consolidation of portfolio resources from multiple institutes (Ritzhaupt et al., 2008).

In addition to the aforementioned aspects, the widespread necessity for e-portfolio systems by institutes leads to two more requirements of an ideal e-portfolio system: a cost-efficient delivery mode and an elastic usage/payment scheme. The cost-efficient delivery mode reduces burden on preparing and maintaining software, while the elastic payment scheme makes cost be proportional to actual usage. Both of these two aspects are valuable to educational institutes due to their great deal of variety in demand for e-portfolios functionality and financial strength. Taking all of these advantageous aspects into account simultaneously, provisioning learning portfolios as a service is a reasonable and promising option.

2.2 Software as a Service and Restful Styled Web Service

As one of the service model in cloud computing, software as a service (SaaS) (Liu et al., 2010, Goth, 2008) should be the one which most end users of software can benefit from. SaaS reshaped the paradigm through which software deliver its functions to users. Unlike traditional software that need to pre-acquired and installed on particular host(s), SaaS deliver user functions that were wrapped in Web-based interfaces through the Internet, or more specifically, the Web service techniques (Petrie, 2009, Yi and Blake, 2010). Because the corresponding program and configuration files are controlled and maintained by service providers on remote sites, users of SaaS are able to access the latest updated functions of software without installation and maintenance by themselves.

The most valuable advantage of SaaS is that SaaS enables a fairer consumption/payment scheme: pay-per-use in software industry. The advantages of SaaS already attracted volume of users who want to use software functionality and pay for it fairly, but are reluctant to manage and maintain software.

When Web service techniques were applied in the provision of e-learning functionalities and materials, its platform-neutrality characteristic means no matter which implementation techniques and operating platforms were chose, once an instructional resource was developed or just wrapped as a service, all clients on the Internet can send compliant request to access it. Obviously, that will leverage the reusability and sharing of educational resources beyond the current level.

To resolve the overhead issue by the SOAP based Web service, the representational state transfer (REST) architectural style (Fielding, 2000) offers a promising approach. The restful Web applications (Vinoski, 2008) emerged as an lightweight alternative for realizing the concept of SaaS, which is one of the major service models in cloud computing (Dillon et al., 2010) environment. In a restful Web application, everything that could be accessed or operated are treated as resources, and resources must be identifiable via an uniform naming scheme, or practically, the uniform resource identifier (URI). In contrast with its heavyweight counterpart: the SOAP-based Web service, the restful Web service associates standard HTTP methods with operations that intended to be performed on resources.

Due to the uniform identifying scheme and access (operation) interface, the restful approach significantly reduces the complexity that are caused by processing of SOAP-encoded messages, such reduction offers users and bystanders a lightweight option for adopting Web services. Moreover, the plain HTTP-based access interface eases the integration of popular and lightweight techniques such as asynchronous JavaScript and XML (AJAX) into client side of restful Web applications, which further makes more service consumers using devices with various form factors to access online resources pervasively.

In general, the restful style have being applied to develop Web applications with diverse purposes (Belimpasakis and Moloney, 2009, Rissanen et al., 2010, Gao et al., 2010, Qian and Xianglong, 2010). Considering the advantages of restful Web applications, this research work proposed the learning portfolio as a service and realized it with the restful style and the supported techniques. The implementation work embodies merits including lightweight, pervasive access, scalability, and flexibility.

3. REALIZATION OF A RESTFUL LEARNING PORTFOLIO SERVICE

This section explains the design rationales of the restful learning portfolio service system, as well as describes how the design concepts were realized accordingly.

3.1 Design Rationales

To embody the concept of learning portfolio as a service, a corresponding system was designed and implemented. The system consisting of major components is illustrated in figure 1. The design of the interface for accessing this e-portfolios service system complied with the following constraints: first, all types of resources will be organized in hierarchical style. For example, a user's portfolio consists several of sub-portfolios that in turn comprising different types of records and artifacts associated with a specific user. Second, identifiers of all resources follow a common URI pattern, and thus could be represented hierarchically. For example, to identify a particular (say, with ID =10) certificate in a sub-portfolio recording a user's all certificates, we can use *http://www.eportfolio.org/username/certificate/10*.

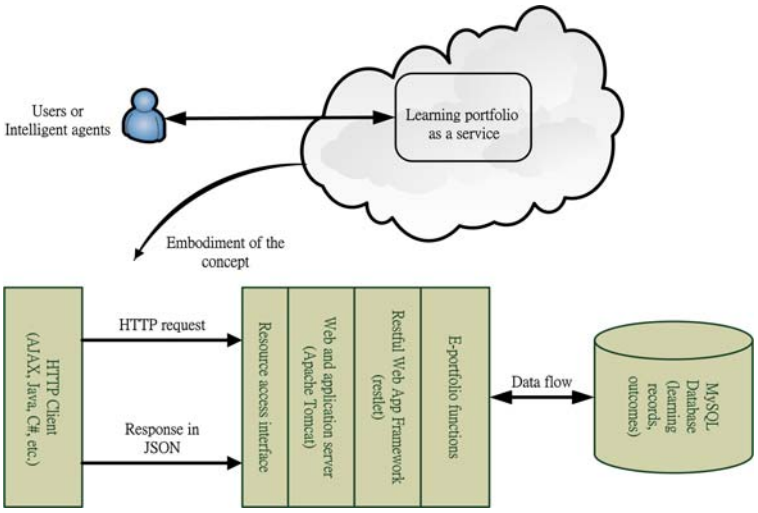

Figure 1. Architecture of The Restful Learning Portfolio Service System

Third, the four basic HTTP methods: POST, GET, PUT, and DELETE are uniformly used to map the CRUD (Create, Read, Update, Delete) operations on a resource, respectively. Accordingly, to create a new instance of the certificate record for a particular user, a POST request including the HTTP verb along with the request contents (input data) would be sent to *http://www.eportfolio.org/username/certificate/new/***.**

3.2 Implementation

To realize the design concept, the Apache Tomcat was used to serve as the Web and application server, the restlet was used for frameworking the restful Web application with Java servlet and JSP techniques. To persist all data records regarding contents in users' portfolios, mySQL was the choice. On the client side of the proof-of-concept system, the AJAX was applied to send the four basic HTTP requests, as well as to receive and handle the response messages from the service provider. Typical restful applications allows that resources have different formats, e.g. plain text, XML, and JSON (JavaScript Object Notation), etc.

4. ADVANTAGES AND IMPACTS

The advantages of the learning portfolio as a service and the corresponding impact on multiple facets are discussed in this section.

4.1 Agility and Versatility

With adoption of the SaaS concept, consumers of e-portfolio services can always use the latest functionality but do not need to install and maintain various software any more, instead, they pay for what they actually used. Doubtless, this flexibility of payment scheme will reduce waste that are caused by pre-licensed but under-utilized software. Moreover, the pay-per-use scheme enables a finer-grained budget allocation.

By inheriting the most valuable merit of the service-oriented architecture (SOA) (Yau et al., 2009, Joseph, 2006) for building up software systems, innovative functionalities of e-portfolio service system could be developed in shorter time frame by mashing up available services, rather than developing everything from scratch. An most importantly, the useful services could be within or outside of the present system. This versatility keeps moving the e-portfolio service system forward to meet new requirements of emerging educational methodologies and circumstances.

4.2 Pervasiveness

Fundamentally, the restful e-portfolio services need to be accessed through basic HTTP methods. Consequently, the widely support of HTTP client makes it feasible to perform e-portfolio functions diversely and pervasively. This is a critical feature making the e-portfolio service system be adaptive to the ever-changing learning approaches and contexts.

Besides the pervasiveness, the simple application interface utilizing URI and HTTP methods also reduces work load of service provider significantly because of the lower time complexity of algorithms that are responsible for composing and decomposing large volume of messages between service clients and providers. Obviously, the simplicity of the restful e-portfolio service benefit users of mobile devices in particular due to the inferior computing power and communication bandwidth embedded within constrained space.

4.3 Accessibility

Many kinds of teaching, learning, and administrative works need seamless collaboration among multiple participants using e-portfolio services. For example, both assessment of a collaborative learning activity and nation-wide evaluation or comparison of students' achievements need to consolidate contents of e-portfolios that are owned by multiple institutes and located on different sites. Fortunately, the common and standardized interface of restful Web services make it easier to consolidate resources from multiple e-portfolio and/or other pedagogical services. Actually, it is straightforward to access resources from multiple service providers and integrate them directly within any type of HTTP client, including the application of AJAX technique in most Web browsers.

5. CONCLUSIONS

Electronic learning portfolio systems play a significant role in tracking learning activities and assessing learners' achievement, and have been widely adopted by many institutes to fulfill other purposes. To meet diverse pedagogic and administrative requirements, as well as adapt to ever-changing learning contexts, ideal electronic learning portfolio systems must be agile, versatile, and accessible. However, most currently-deployed e-portfolio systems that originally aimed to serve specific clients only, thus were built with monolithic and proprietary approach, which make these e-portfolio systems cannot meet the requirement of being agile, versatile, and accessible.

The present work proposed the concept of learning portfolio as a service, which actually is an extension of the generic software as a service (SaaS) concept. The most significant advantages brought to users by SaaS include the lower preparation and maintenance cost, and the fairer payment (pay-per-use) scheme. The restful styled embodiment of a SaaS is relatively favorable in terms of performance, comparing with its SOAP-based counterpart. The present work designed and implemented the proof-of-concept with restful style.

Looking into the future, the design patterns and experiences learned in this work could be applied to develop other online pedagogical services. Although the feasibility of a restful learning portfolio service has been confirmed, the widely acceptance of it needs further works on session management and security. For the sake of scalability, restful services supposed to be completely stateless. In other words, using widely accepted server-side session mechanism violates the constraints of the restful design. However, it is obvious that access control and session management mechanisms are vital to practical pedagogical services.

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CONTEXT AWARE RECOMMENDATIONS IN THE COURSE ENROLMENT PROCESS BASED ON CURRICULUM GUIDELINES

Vangel V. Ajanovski
Faculty of Computer Science and Engineering, Ss. Cyril and Methodius University, Skopje, Macedonia
http://www.finki.ukim.mk/en/staff/vangel-ajanovski

ABSTRACT

This research is a part of an ongoing project for development of an integrated student information system, aiming to incorporate self-adaptivity, personalization and social navigation, both in the overall management of university processes, and throughout the course work. In this paper the focus is on the advancement of the existing course recommendation framework to a more context-aware level. The model presented in this paper aims to increase the personalization in processes happening at the beginning of the academic term and the start of the teaching. The first part of the paper presents recent development on the modernization of the process of term enrolment and the virtual academic adviser component. The evolution of the virtual adviser is discussed that allows the student to change and experiment with different study paths and specializations without affecting the overall length of the studies. In the second part of the paper, a new framework is described that is based on the model of knowledge given in referent curriculum guidelines from professional organizations. This model is than used to offer course recommendations that are more inclined to the context

KEYWORDS

E-learning, LMS, learning management, recommender system, information systems.

1. INTRODUCTION

Throughout the years, higher education in EU was extensively revised and new curricula and managed study processes were introduced. The most significant revision was the alignment towards the Bologna process and ECTS. In each revision, more and more options within the study programs were given to students. Nowadays, mandatory courses are only 50 percent of the programs, while the rest is left on the student to choose. Elective courses are offered by other study programs at the same department, inter-disciplinary courses from other departments, and corporate courses that can also be recognized as credits. Finally, student mobility has evolved and through EU programs such as Erasmus, the student can spend a short period at another university and enrol courses there. This creates administration considerations regarding the overall quality of the study process, and in addition to that raises a significant burden on the student – which path to choose?

We addressed some of these issues with *profiles* – groups of related courses that are not enforced, but only used to recommend paths towards a certain specialization. Unfortunately, the students are rarely in position to strictly align to the recommendations. As unemployment rises, they might be forced to work during studies and support themselves and their families, resulting in a decrease in the pace of studying – lowering the number of enrolled credits. If this is not possible, they are usually in danger to fail a course. This, creates even more problems – the student can inadvertently make wrong decisions. Together with the complexities in the process due to course inter-dependencies and prerequisites, it could later turn out that the student has no other choice but to prolong the total length of the studies. In fact, this case is not a rarity, since many students take 5 or 6 years to finish a 4-year long study program. This problem can be mitigated, with better communication with the academic advisers. But, as the number of students is constantly increasing, the quality of the communication with the assigned academic advisers decreases. This is where the need for systemic tools becomes obvious. Tools that will help the students to assess their situation on their own and act upon it.

2. VIRTUAL ADVISER AND COURSE RECOMMENDATIONS

During earlier efforts, a generic model of the study process was built and it was used as a base to create a new system for management of the study processes. This system, presented in Ajanovski (2010), introduced the following functionalities: static structure of the studies – study programs, subjects and curricula; dynamic processes – course offering in each term, online courses and timetables; and students status – admissions, enrolments, mobility and recognition. In Ajanovski (2011) the implementation of a virtual academic adviser component was discussed. This component was intended to help alleviate the problem of course selection and the influence of the selection over the future semesters. The virtual adviser generates a forecast map of possible future enrolments of the student, based on his history and enables the student to experiment with the most important new scenarios: change study program and change order of courses in order to optimize and balance the load during the studies, and if desired, graduate as early as possible.

This development gave the student better overview over the context of his situation and enabled wiser choices. This also opened-up possibility to include social navigation elements and include automated course recommendations based on the history of enrolments at the institution. The current implementation of the latest virtual academic adviser, that uses a course recommender engine is displayed in Fig. 1. The focus is on the upper part where the map of the possible future enrolments is shown, term by term. The projection extends until the semester in which the student would be able to graduate. Each future semester has a label with the form +*n*, which means *n*-th semester in the future. This effort was presented in Ajanovski (2013).

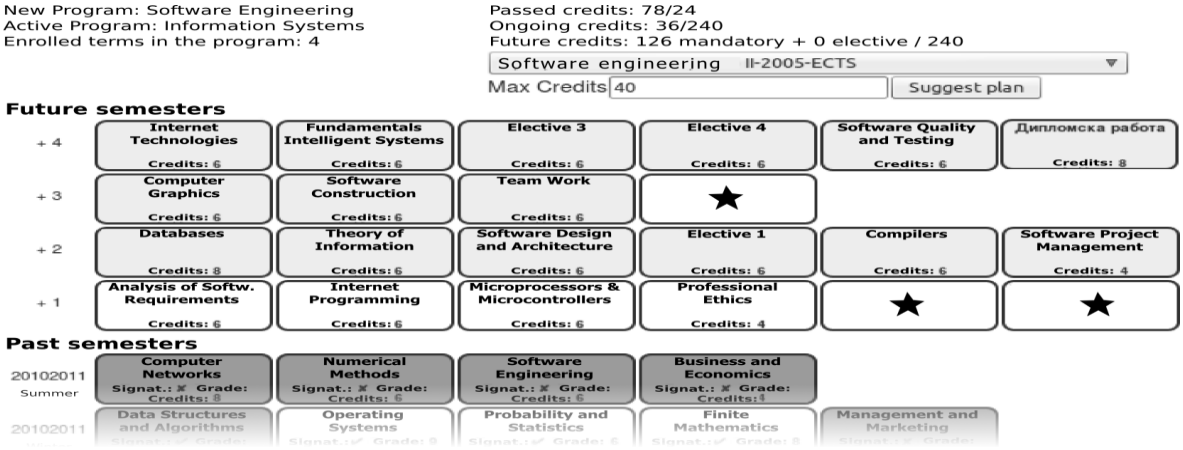

Figure 1. Current state of the virtual adviser.

The plan that the adviser generates is based on the study programs definition and the chosen profile by the student. First the mandatory courses are taken into account and each of them is placed in the earliest possible future term. After this all electives from the current chosen specialization are placed. In each step courses are arranged according to the maximum number of credits per semester, and in which semester they are on offer and prerequisites are taken into account to decide on priority. In the end, slots are created for all free-choice slots that will fill the future plan up to a total number of credits required to finish the study program.

In order to increase flexibility the recommender system Easyrec was chosen, an open-source software, where recommender engines can be developed, plugged-in and experimented with. The system allows easy integration with any application due to the REST API. The historical data on course enrolments was imported in the system to prevent the cold-start problem and later, student course grades were imported as course ratings. This gave the possibilities to:

- indicate popular course selections among similar students;
- recommended courses based on what similar students passed with a good grade;
- indicate recommended programs to switch to.

Since the mandatory courses are already laid out on the map and only elective courses are later filled-in by the students, there is no real danger of misguided automated recommendations. The only question is satisfaction of the students with the relevance. All course offers are listed and top recommended courses are annotated with an icon, so if the student is not satisfied – the possibility to choose any other course remains.

3. CONTEXT AWARE RECOMMENDATIONS AND GUIDELINES

Initial experiments confirmed that the recommendations are in line with the expectations, but the approach with a generic recommender based on history of course enrolments and grades does not help with offering something new and in the general academic area (unless it was popular in the past with related students). So, the software would implicitly incline the students towards local popular courses from the same department and related study programs. Since using recommender engines to issue course recommendations is not a new topic an investigation of some other efforts was done.

There are many publications that show that students will use good recommendations and that they can lead to better success. Some of them were influential for this research. For example, in O'Mahony and Smyth (2007), a system for offering course recommendations is discussed in an environment where only 20% of the study program is elective and the number of places per course is limited. In this research, the analysis is not made on specific instances of course enrolments, but on the pairs (code, student) where the code is a token from the course code, usually signifying the academic discipline. With this the domain was reduced to about 80 disciplines from about 2000 courses, in order to have better recommendations. This gave the idea to try to use knowledge areas and topics instead of courses. The authors Itmazi and Megías (2008) analyse and discuss various systems for recommendations and filtering in a massive and open course management system, where students are free to choose among many courses. They propose an integrated framework that filters the list of courses according to different criteria in several steps using different types of recommender and filtering systems. This gave the idea to implement an external recommendation system such as Easyrec, which could be plugged-into and used from several applications, and for several different measures. Vialardi et al. (2011) define the notions of a measure of student potential and course complexity and later this measure is used to forecast the success of the student in a certain course. Based on this forecast, the course is recommended to the student or not. This gave the idea to use student grades as rating for how relevant a course is to the success-fullness of a student.

To disperse the interests to a wider area of specializations and inter-disciplinary courses, we decided to try an alternative approach with a more general model of the knowledge, that can be mapped to an existing model of studies, so that students could seek courses that are from the general academic area, or which push for similar learning goals. This is similar approach to the one investigated by O'Mahoney and Smyth, the difference is that a more generic model is used that is codified universally, so it can be used in an inter-university environment. The model we start with, as the initial building block, is the concept-model of the curriculum architecture used in the documents on ACM and AIS curriculum guidelines by Topi et al. (2010). This model is used to define the structure of curricula proposed by ACM and AIS for undergraduate and graduate studies in information systems, but since it is a generic model it can be used in any academic discipline. The simplified concept model of the curriculum architecture presented in the referenced documents is shown in Fig. 2.

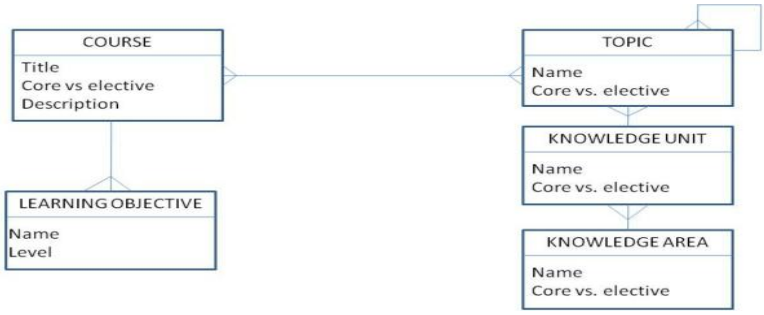

Figure 2. Simplified Concept Model of the Curriculum Architecture

This model is interesting for our problem since it defines the relationships between knowledge areas, knowledge units and topics per unit on one hand, and the proposed courses together with all learning objectives in each course, on the other hand. For each discipline, all knowledge areas are listed, with knowledge units and topics. Finally, for each course comprising the guidelines a mapping is given to covered knowledge topics. Since many universities offer similar or sometimes even the same courses as in the guidelines, it is possible to define a map from actual university courses on offer to the codified knowledge

areas, units and topics from the guidelines. Depending on the detail that the university has for each course and their own study programs, this map can be used to build relations between students and codified knowledge areas, and even a map of interests per unit. Relations are formed for the pairs: **(student, area)** and if given enough detail from the student information system database even ratings/grades per area could be calculated with the triplets **(student, area, average/aggregate grade)**.

This enables the usage of a recommender engine to reach indirectly to courses that have covered a similar set of topics, but from another perspective. Such courses would not be directly found as relevant with the usual approach based on history of course enrolments. The difference between our original and this approach, is that the first one gives recommendations blindly (course content is disregarded and only historical data is taken into account), while the second approach is more tailored towards the generic pieces of content that truly build a course (as defined by the curricula guidelines). In addition to that, not only are similarities found indirectly from the content, this is done in a structured way – via comparison to a reference structured model of curricula, which gives the possibility to perform structured navigation through the recommendations and enable the student to choose an elective course with broader sense of its context.

4. CONCLUSION AND FUTURE WORK

The observations during the experimental tests with a generic recommender engine conclude that it is mainly useful for offering courses that are within the same department, or courses that are unrelated but are strongly popular. The system could skip entire sets of courses that have similarities, but were enrolled by entirely different populations of students from two different departments. This proposal takes into account a more structured approach directly related to reference categorization of course content and uses it to analyse historical data and offer recommendations within context. Since the system is only used in positions where the student has a free choice and in such situation bad recommendations could not hinder the pace of studying of the student, there are no negative side-effects. The measure of success of the recommendation system has yet to be discussed, as at the time being it can only be evaluated by the subjective satisfaction of the students from the issued recommendations. The success of the overall solution with the virtual adviser is also a topic of discussion and further research, since it can be measured in several ways – decreasing total number of empty term slots, decreasing average length of prolonged studying, etc.

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A MODEL OF E-LEARNING UPTAKE AND CONTINUED USE IN HIGHER EDUCATION INSTITUTIONS

Nakarin Pinpathomrat, Lester Gilbert and Dr Gary B Wills
School of Electronics and Computer Science, University of Southampton
Southampton SO17 1BJ, UK

ABSTRACT

This research investigates the factors that affect a students' take-up and continued use of E-learning. A mathematical model was constructed by applying three grounded theories; Unified Theory of Acceptance and Use of Technology, Keller's ARCS model, and Expectancy Disconfirm Theory. The learning preference factor was included in the model. National culture influences the learning preference, hence national culture will also be considered in this research.

KEYWORDS

E-learning uptake, Continued use of E-learning, Higher Education, National Culture-Influenced Learning Preference

1. INTRODUCTION

Despite the high level of investment on E-learning system in many universities around the world, researchers have found a low uptake of this technology amongst students and those who do start to use the system opted out later (Liao & Lu, 2008). In order to understand how to increase the number of new E-learning users and how to sustain them to continue using the system, this research has constructed a model for the effective uptake and continued use of E-learning in Higher Education Institutions.

2. FACTORS INFLUENCING THE UPTAKE OF E-LEARNING

In E-learning uptake research area, most researchers ground their research in the Technology Acceptance Model (TAM) or the Unified Theory of Acceptance and Use of Technology (UTAUT). TAM highlights the importance of a user's attitude towards the system, but does not address adequately the social and resource factors. Therefore, we have adopted UTAUT as the grounded theory for this investigation.

2.1 Unified Theory of Acceptance and Use of Technology (UTAUT) and the Application in this Investigation

The UTAUT model asserts that an individual's uptake of new technology is driven by their intention (motivation) to take up that technology (Venkatesh, Morris, Davis, & Davis, 2003). By applying the UTAUT model, behaviour intention factor will be adopted in our proposed model, called as 'Motivation to use E-learning' factor, to capture a student's motivational level for predicting E-learning uptake. Additionally, the proposed model will have the four UTAUT factors that influence student's motivation to take up E-learning: [1] Performance expectancy (PE) is defined as the degree to which an individual student believes in the ability of an E-learning system to support them in learning activities to achieve their intended learning outcome; [2] Effort expectancy (EE) is the degree to which an individual believes that the use of that system does not require an increase in effort; [3] Social influence (SI) is the degree to which an individual expects that the use of E-learning should be encouraged by their important persons; [4] Facilitating conditions (FC) is the degree to which an individual student believes that an IT resource exists to support use of E-learning.

The factors from UTAUT model focus on technical point of view. "E-learning" has two aspects to its definition, 'learning' (referring to learning environment) and 'E' (referred to technology); the former is overlooked by researchers in the field, thus any existing model could not fully explain the uptake of E-learning (Chen, 2011). This research adds "learning motivation" to the proposed model. To identify learning motivation factors, the ARCS model has been applied.

2.2 Keller's ARCS Model and the Application in this Investigation

The ARCS model asserts that four major factors influence a student's learning motivation, it includes 'attention' (A), 'relevance' (R), 'confidence' (C) and 'satisfaction' (S) (Keller, 1987). Two ARCS factors will be not included in the model as E-learning uptake factor. According to Keller, attention can be promoted by arousing the learner's curiosity in what is being taught. However, this research aims to increase E-learning uptake in general; thus their attention and curiosity about a particular course is not relevant. Therefore, attention will not be integrated in our uptake model. Similarly, learning satisfaction is not included as an uptake factor. Learning satisfaction occurs when a learner takes a part in learning environment (t_1) and achieves their desired outcome from a course (Keller, 1987). At the initial stage (t_0), before a student takes up E-learning, their satisfaction with the provided course in E-learning has not manifested. The use of the remaining two ARCS factors (learning relevance and confidence) in this investigation is called 'learning preference' factor, and be defined as the degree to which an individual believes that an instructional environment in E-learning (which includes content and learning activities) is relevant to their goals, learning styles and has confidence in their past experiences about what is being learned.

3. FACTORS INFLUENCING THE CONTINUED USE OF E-LEARNING

A problem of high opt-out rate with E-learning was also found in much of the literature on the subject (Lee, 2010). In order to tackle this problem, Expectancy Disconfirms Theory (EDT) was utilised as a grounded theory. EDT asserts that repurchase motivation is primary influenced by a customer's satisfaction with prior use of the product (Oliver, 1980). The principle seems to be consistent with many researches in the field, which found that satisfaction with the E-learning system is a key influential factor that leads the E-learner to continue using the system (Roca, Chiu & Martínez, 2006). So satisfaction will be used as a key factor that influences a student's motivation to continue using E-learning in this investigation. In addition, Oliver claims customer satisfaction with the product is directly influenced by confirmation of their level of expectancy; discrepancy between perceived product performance and the initial expectation. This principle is supported by many researchers in this field; they assert that E-Learners will be satisfied with the E-learning system if the actual outcome is better than their initial expectation (Lee, 2010).

4. A PROPOSED MODEL

By applying the theories introduced earlier, a model for E-learning uptake and continued use is proposed (see Figure 1). Before a student takes up E-learning (at the time represented by t_0), an initial expectation is created (Oliver, 1980). From UTAUT and ARCS model, a learner has five potential expectations (belief) toward E-learning; performance expectancy (b_1), effort expectancy (b_2), social influence (b_3), facilitating condition (b_4) and learning preference (b_5). Thus, the 'expectation of E-learning' construct ($\sum b_i$) is added into the model to aggregate levels of belief for each expectation (uptake) factor and can be expressed as:

$$\text{Expectation of E-learning} = \sum b_i = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \\ b_4 \\ b_5 \end{bmatrix} = \begin{bmatrix} \text{performance expectancy} \\ \text{effort expectancy} \\ \text{social influence} \\ \text{facilitating condition} \\ \text{learning preference} \end{bmatrix} \quad (1)$$

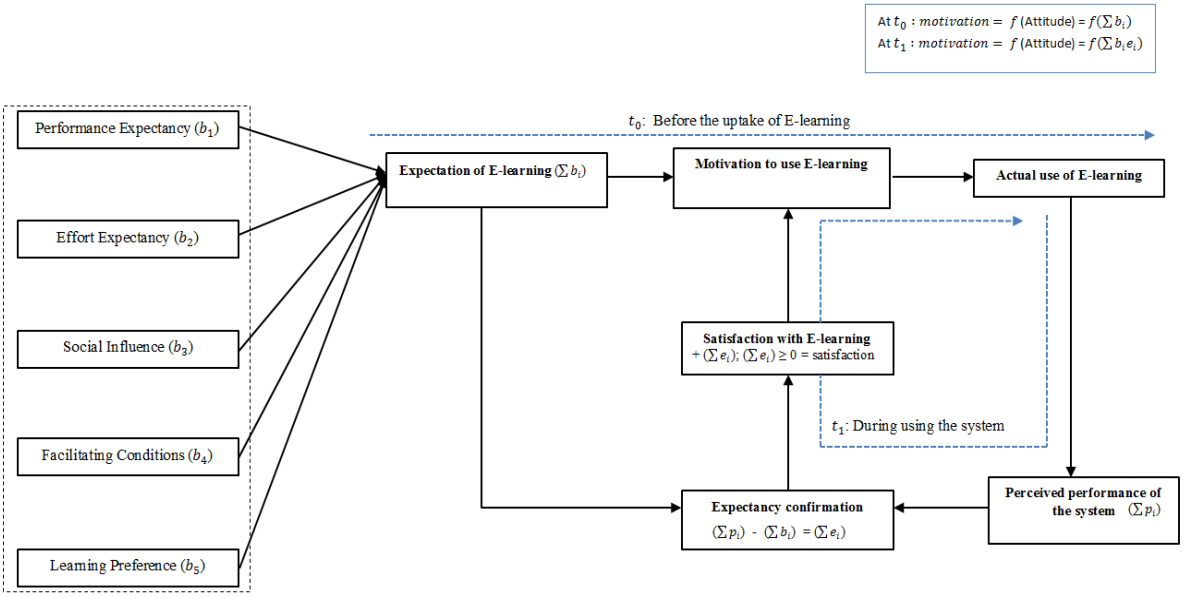

Figure 1. A model of E-learning uptake and continued use in Higher Education Institution

The learner's motivation to take up E-learning is directly influenced by their expectation towards the system and the E-learner will decide to take it up if their expectation is high; sum of beliefs is positive ($+ \sum b_i$) (Oliver, 1980).

During the consumption period (t_1), perceptions of the system performance will be formed, measured by the 'perceived performance of system' factor (the expression $\sum p_i$). Oliver (1981) asserted that initial expectation is formed for creating a reference level that the customer uses to make a comparison with perceived product performance to determine their level of confirmation. Thus, in perceived performance of system factor, there are five factors based on each expectation, expressed as:

$$\text{Expectation of E-learning} = \sum p_i = \begin{bmatrix} p_1 \\ p_2 \\ p_3 \\ p_4 \\ p_5 \end{bmatrix} = \begin{bmatrix} \text{Perceived performance of } b_1 \\ \text{Perceived performance of } b_2 \\ \text{Perceived performance of } b_3 \\ \text{Perceived performance of } b_4 \\ \text{Perceived performance of } b_5 \end{bmatrix} \quad (2)$$

Then, the learner compares their perceived performance with their initial expectation to determine their level of expectancy confirmation. Therefore, the 'expectancy confirmation' factor ($\sum e_i$) was added in the model, and expressed as follows:

$$\text{Expectancy confirmation} = \sum e_i = \begin{bmatrix} e_1 \\ e_2 \\ e_3 \\ e_4 \\ e_5 \end{bmatrix} = \begin{bmatrix} p_1 \\ p_2 \\ p_3 \\ p_4 \\ p_5 \end{bmatrix} - \begin{bmatrix} b_1 \\ b_2 \\ b_3 \\ b_4 \\ b_5 \end{bmatrix} \quad (3)$$

A learner's satisfaction with E-learning is a function of their expectancy confirmation; learners are satisfied with the system if each actual performance is better than each anticipated performance. This is expressed as:

$$\text{Satisfaction with E-learning} \equiv \text{positive expectancy confirmation} \equiv + \sum e_i \quad (4)$$

Fishbein and Ajzen (1975) assert that the most immediate precursor of motivation towards specific behaviour is attitude, which is the function of personal belief (represented by expectation of E-learning factor in our model) and evaluation of outcome (represented by expectancy confirmation factor in our model). Therefore, the general equation is expressed:

$$\text{Motivation to use} = f\ (\text{Attitude}) = f(\sum b_i e_i) \quad (5)$$

By putting equations (4) into (5) and assuming that a student who takes up E-learning will have a positive belief toward E-learning, thus the motivation towards continued use can be expressed as

$$\text{Intention to use } t_1 = f\ (\text{+Attitude}) = f(\sum(+\sum b_i)(+\sum e_i)) = e_1b_1 + e_2b_2 + e_3b_3 + e_4b_4 + e_5b_5 \quad (6)$$

As can be seen from equation (6), satisfaction $(+\sum e_i)$ is a key factor for supporting E-learner to continue using the system; if E-learner does not satisfy with the system $(-\sum e_i)$ they will have nagative attitude towards system which lead them to dropt out from the system.

5. AN APPLICATION OF THE PROPOSED MODEL INTO HIGHER EDUCATION INSTITUTIONS IN EACH COUNTRY

The factors discussed so far have been widely validated in both eastern and western countries, and have been accepted by many researchers as influencing towards uptake and continued use of E-learning; it is likely that these factors would also be applicable to solve problems of E-learning uptake and continued use in each different country (Chen, 2011; Maldonado, Khan, Moon, & Rho, 2011). However, one factor that may differ between each other country is learning preference, which includes learner's goal and style (Tetiwat & Huff, 2003). Additionally, literature suggests that the main cause for difference in learner's learning goal and style between each country is culture (Oxford & Anderson, 1995). Therefore, in order to truly understand students' learning goal and style in each country, the National Culture-Influenced Learning Preference (NCILP) dimension was constructed in this research by reviewing the literature (see Figure 2).

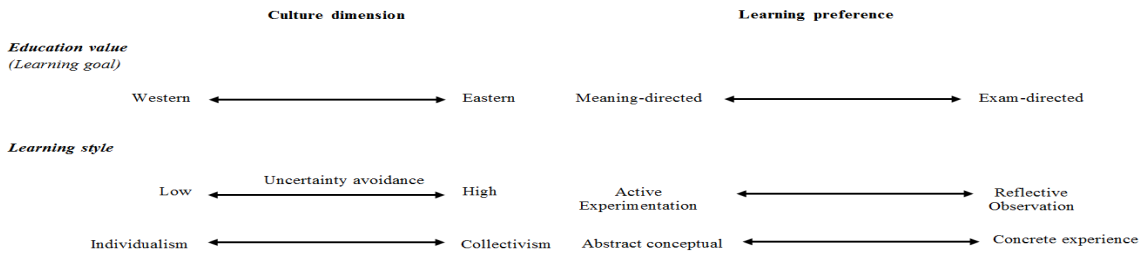

Figure 2. National culture influenced learning preference dimension

The first dimension is relationship between culture and educational value. In cross-culture educational value field, the researchers agrees that eastern and western students have different educational values; the former view education as a way to climb the social ladder (social approval) and to get a higher salary job, the latter is driven to learn by their personal interest in that subject (Biggs, 1991). In order to be approved by the people society (e.g. parent, peers) and obtain a good job, Eastern students are highly motivated to obtain high grades and a university degree. Therefore, students in these countries are exam-directed learners. In contrast, as can be seen from the figure, in Western countries, students are meaning-directed learners, and study is more a result of personal interest (Eaves, 2009).

The second and third dimensions explain the relationship between culture and learning styles. It was constructed by using Hofstede's four cultural dimensions and Kolb Learning Style. Upon the review of literature on differences between the cross-culture of learning styles, the results of all research in this area confirm that if an individual has a reflective observation style, this strongly indicates that they are from a culture that has high uncertainty avoidance, while people who scored high in active experimentation have low uncertainty avoidance (Joy & Kolb, 2009; Yamazaki, 2005). In a culture that has high uncertainty avoidance, people fear failure and prefer tasks with a definite outcome and clear guidelines, thus students in this society are more comfortable in a lecture that is a structured learning situation, more than a scientific method with trial and error process (active experimentation) (Joy & Kolb, 2009). The 'concrete experience' style of learning has also been confirmed by Yamazaki (2005) and Joy & Kolb (2009) to be higher in a collectivist culture. People in collectivist cultures are interdependent, and students will rely on others to help them learn (social learning) rather than by a self-contained 'abstract conceptualisation' style of learning.

NCILP dimension help universities in each country to understand their student's learning motivation, which can be used for constructing learning environment in E-learning to be responsive to their student's learning motivation need. However, only focusing on learning motivation is not enough. As E-learning is a piece of technology; students will not take up this technology if they do not accept it. Thus, the technology motivation is also needs to be considered by the university. The literature review found four factors; 1) PE: E-learning in the university has to support students to learn better (fast and higher performance) than other possible way of learning; 2) EE: the system design suits the student's level of IT skills; 3) SI: the student will take up the system if their significant others (e.g. parents, teachers and peers) encourage them to use; and 4) FC: necessary IT resources (ex. computer and internet) need to be provided. As can be seen from the proposed model, by achieving these mentioned conditions, not only will university students take up E-learning, they will continue to use the system. This is because the Expectancy Disconfirm Theory (EDT) asserts that people will continue using the service if their expectations are met (Oliver, 1980).

6. CONCLUSION

The main purpose of this research was to construct a model of effective uptake and continued use of E-learning in Higher Education. The model from this research will fill in the gap left by other researchers by adding "learning motivation" to the model. Moreover, the emphasis on cross-national application of the model; differences between cultural aspects will be addressed to ascertain their influence on particular students' learning styles and goals. In order to complete the answer to these research questions, future work will focus on validation using triangulation; including investigator and methodological triangulation.

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Reflection Papers

THE DEVELOPMENT OF LOGICAL STRUCTURES FOR E-LEARNING EVALUATION

Uranchimeg Tudevdagva[1], Wolfram Hardt[2] and Jargalmaa Dolgor[3]
[1]*Power Engineering School, Mongolian University of Science and Technology, P.O.B. 46/520 Ulaanbaatar, Mongolia*
[2]*Computer Science Department, Chemnitz University of Technology, D-09107 Chemnitz, Germany*
[3]*Computer Management School, Ikh Zasag University, Ulaanbaatar, Mongolia*

ABSTRACT

This paper deals with development of logical structures for e-learning evaluation. Evaluation is a complex task into which many different groups of people are involved. As a rule these groups have different understanding and varying expectations on e-learning evaluation. Using logical structures for e-learning evaluation we can join the different expectations of groups and can evaluate quality of e-learning with multidimensional targets.
Key targets form the base for a logical evaluation structure. The evaluation is successful or positive only if all key targets were achieved. If only one key target was not achieved the whole process has missed its target.
As a rule key targets can be achieved on different ways. This can be mapped by corresponding sub targets which form the inner logical structure of key targets. By this method very flexible target structures can be modeled. If consensus has been reached on the logical target structure of an e-learning project further evaluation can be performed based on adapted checklists and the use of measure theoretical methods as that has been presented in previous papers of authors.

KEYWORDS

Evaluation, e-learning, e-learning evaluation, evaluation target, logical target structures.

1. INTRODUCTION

Evaluation is playing a very important role during development, implementation and realization of an e-learning framework. Educational evaluation models and approaches were developed by several authors: D.L.Kirkpatrick and J.L.Kirkpatrick (2006), and especially for e-learning evaluation to Stufflebeam (1972), Khan (2004), Ehlers et al. (2006), Colace et al. (2006), Lam and McNaught (2008) and Ruhe and Zumbo (2009).

However, the groups which are involved into an e-learning framework: pedagogues, administrators, educators, multimedia designers, managers, stakeholders, decision makers, tutors, and learners have distinguished ideas and expectations on evaluation.

Moreover, e-learning is as a rule a work, time and cost intensive project which needs development and qualification from one implementation to the next. It is a team work result of different groups, experts or partners. If we try to measure the quality of e-learning we have to take into consideration the interests and expectations of all involved groups. Besides the groups mentioned above this can be moreover educational institutions and financial backers, for instance.

Figure 1 emphasizes that the interested groups in e-learning evaluation can have different expectations and distinguished targets. But all these groups have one common main target. They want to measure anyhow the quality of e-learning or want to know how successfully an e-learning course is running.

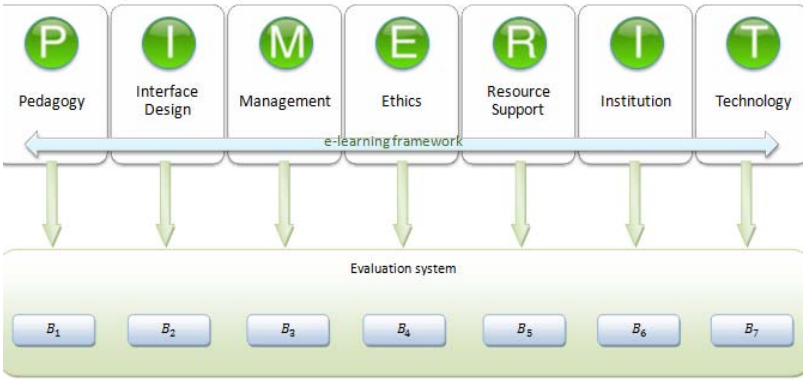

Figure 1. E-learning and evaluation

To create and develop e-learning courses different environments have to work together (Khan, 2004):

- Pedagogical environment
- Interface Design environment
- Management environment
- Ethical environment
- Resource support environment
- Institutional environment
- Technological environment

By means of logical structures we can evaluate the quality of an e-learning course not only in sense of expectations of involved different groups we can measure the quality of an e-learning course for each environment, too.

2. LOGICAL STRUCTURES OF KEY AND SUB TARGETS

By our model it becomes possible to evaluate for all involved groups how the corresponding group has achieved its target. Based on an adapted logical structure we can see how successful the components of an e-learning process are running, where we have to spend more attention and what should be improved for the next round. A further advantage of our model is we can consider very flexible logical structures, if necessary. Simultaneously it becomes possible to evaluate in a consistent manner how special single targets were achieved.

The formal details of this approach are presented by Uranchimeg, Hardt (2011). Key targets are involved into a logical structure via serial schemes. A corresponding main target can be achieved only if each key target of logical structure is achieved. If only one of key targets is missed the corresponding main target is missed, too.

Sub targets of key target are visualized by a parallel schemes (see Figure 2). That means if at least one of the sub targets is achieved we will consider the corresponding key target as achieved. A key target can consists of several sub targets. But to extensive parallel structures should be avoided. In this case we can get high evaluation values for a key target even in cases when the evaluation values for the sub targets are uniformly small. This should be noted during the design of a logical structure.

After definition of logical structure of an evaluation target the evaluation scores can be computed by means of the calculation rules presented in Uranchimeg, Hardt (2012) based on the observation data obtained by adapted checklists.

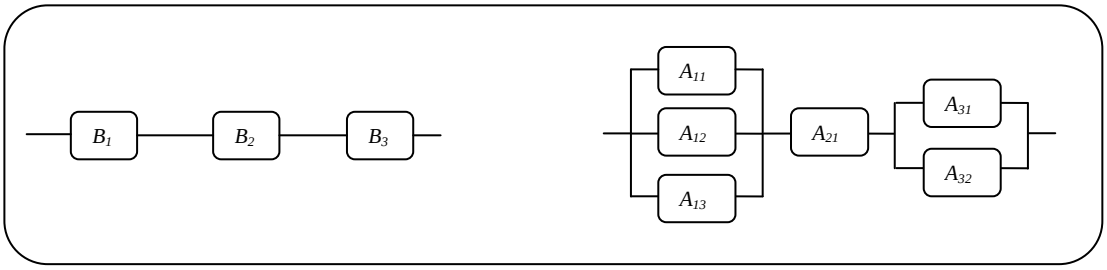

Figure 2. Visualization of logical structure

For instance, the score that an e-learning course whose logical target structure is defined as it is demonstrated in Figure 2 is calculated by

$$Q^*(C) = Q^*\left(\bigcap_{i=1}^{r} B_i\right) = Q^*\left(\bigcap_{i=1}^{r}\bigcup_{j=1}^{s_i} A_{ij}\right) = \prod_{i=1}^{r}\left(1 - \prod_{j=1}^{s_i}(1 - q_{ij}^*)\right).$$

Here denotes $q_{ij}^* = Q^*(A_{ij})$ for $i = 1, \dots, r, j = 1, \dots, s_i$, the estimation value for the score that the single target A_{ij} has reached its target. These estimation values are determined from the checklist data. It holds $0 \leq Q^*(C) \leq 1$ as well as $0 \leq q_{ij}^* \leq 1$. A value $Q^*(C) = 1$ means the main targets of a target structure C have been reached completely, $Q^*(C) = 0$ means the targets were missed. For the details we refer again to Uranchimeg, Hardt (2011).

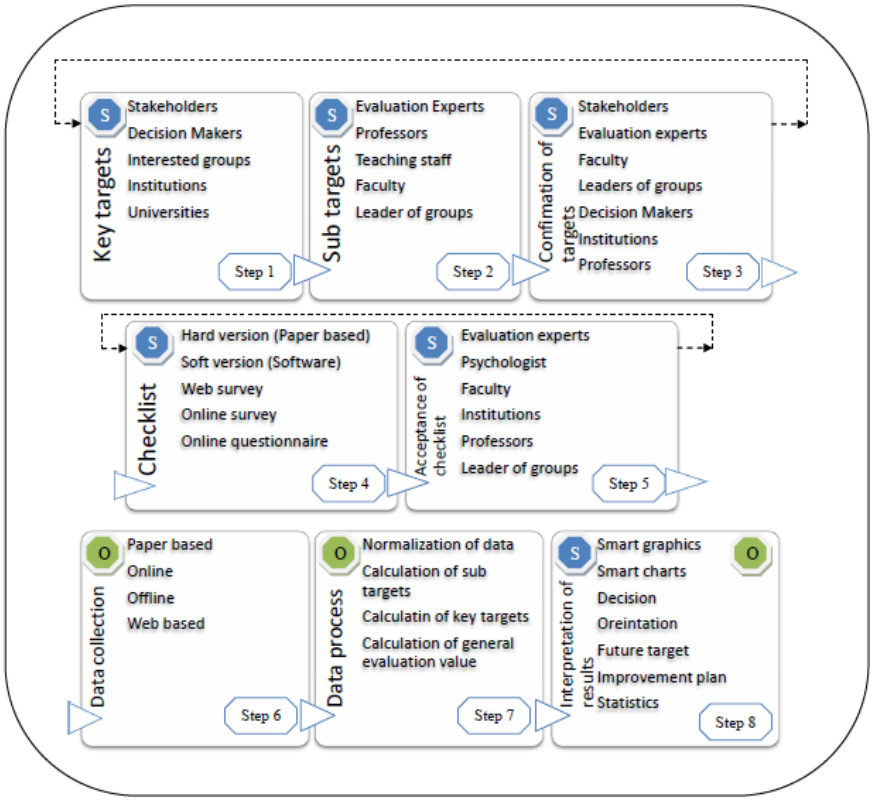

Figure 3. Logical structure of different groups

The e-learning evaluation process consists of eight steps (see Figure 3): 1) definition of key targets, 2) definition of sub targets, 3) confirmation of evaluation targets, 4) creation of checklist, 5) acceptance of checklist, 6) data collection according checklist, 7) data processing, 8) interpretation of evaluation results and outcomes. Some steps are subjective oriented (characterized in Figure 3 by 'S'), some are more objective oriented (characterized in Figure 3 by 'O'). Subjective steps should be repeated until agreement is reached between stakeholders or group leaders which are involved into e-learning process.

3. CONCLUSION

The structure oriented scoring model is an alternative to the frequently used linear evaluation models. By concentration to the logical structure of target of an e-learning process and calculation of the score by application of the corresponding rules of general measure theory we don't need the more or less subjective weight factors which are used for linear models.

The presented model offers the possibility to consider parallel and consistent the expectations of the different groups which are involved into development and implementation of an e-learning process. Hence, the model can be applied for global evaluation of an e-learning process as well as an evaluation of embedded processes. Via the consideration of group relevant logical sub structures it becomes possible to involve and to integrate all interested groups into an evaluation process. The corresponding data can obtained based one a general checklist where the data are processed according to considered logical structures of evaluation targets. This can avoid frequently observed conflicts at determination of priorities for evaluation. Using one checklist we can collect data from learners about all environments.

The use of model in context of formative evaluation can help the institutions to recognize weaknesses of an e-learning process or to monitor running processes.

Moreover, the structure oriented scoring model can be used in more general sense for structural evaluation and monitoring of functionality of general processes with a logically describable function target.

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ETHICS IN E-LEARNING

Alena Bušíková and Zuzana Melicheríková
Vysoká škola manažmentu v Trenčíne, Panónska cesta 17, 851 04 Bratislava

ABSTRACT

The use of information and communication technology has grown at an unprecedented rate and provides a revolutionary way of learning because specific information is easy to find on the Internet. One of the technology approaches in learning is e-learning or electronic learning. Whereas in the U.S., e-learning has become very popular in the recent years as, in Slovakia e-learning is far from being widely used as most of the universities in Slovakia offer only in-class courses and use information technologies only to support those. One of the disadvantages of elearning is that it provides more possibilities for the academic fraud (Nagi, 2006). The purpose of this article is to point at issues of ethical misconduct in higher education and to analyze the current threats of ethical misconduct of e-learning on an example of Slovakia. As part of our analysis, the answers to questions such as whether the online students committed more academic fraud compared to the daily students will be answered and conclusions will be drawn.

KEYWORDS

E-learning, ethics, academic fraud, scholastic honesty, ethical misconduct, online environment.

1. INTRODUCTION

The e-learning is learning eased by electronic technology and its aim is to increase the knowledge, skills and productive capabilities of the learners (Ismail, R. et al., 2011, p. 49-52). It serves as a substitute for the traditional classroom setting and offers education with fewer space or time limitations, education in which discrimination against age and race is almost non-existent, the record keeping much easier and discipline problems kept to a minimum (Njenga, J., Fourie, L. 2010, p. 199-212). Despite of its undisputable benefits many people view e-learning as inferior in quality in comparison with the traditional classroom setting. The critics often argue that the lack of personal contact causes low motivation of students. They also claim that the lack of control causes that students do not do their tasks properly (Khoury A. H. et al., 2011, p. 53-56). Another disadvantage is that e-learning provides more possibilities for the academic fraud as Nagi (2006) states that it is easier to cheat online than face to face.

2. ETHICS IN E-LEARNING

Of the problems confronting contemporary universities, academic dishonesty may be one of the most serious especially since the online environment provides a more tempting environment for students to cheat (Pavela, 1993). The survey conducted within U.S indicates that as high as 59% of U.S. students involved in e-learning programs admit to some sort of academic fraud either “very often (27%) or “often” (32%). Most of the studies on e-learning indicate “psychological distance” as a main problem of studying online. When using information technology we tend to break the ethical rules because the act feels less personal as we cannot see or hear the other person. Today we cannot rely on the fact that traditional moral rules were learnt at home. Students tend to find „easy ways“ of getting their degree and do not feel guilty breaking the ethical rules (Brown, T., 2008). Fass (1990), in a study for the American Council on Education, described early patterns of inappropriate behavior in e-learning. He identified the following categories of academic fraud in the e-learning environment: inappropriate assistance on examinations, misuse of sources on papers and projects, writing assistance and other inappropriate tutoring, misrepresentation in the collection and reporting of data, improper use of academic resources, disrespecting the work of others, lack of protection for human subjects in research, breaches of computer ethics, lack of adherence to copyright and copy-protection, providing inappropriate assistance to others and lack of adherence to academic regulations.“

Whereas in the U.S., e-learning has become very popular in the recent years as indicated (Allen, Seaman, 2010), in Slovakia e-learning is far from being widely used as most of the universities offer only in-class courses and use information technologies only to support those. Our survey revealed that the Slovak teachers and students do not seem to have much experience in e-learning as above 13% of teachers and 17% of students answered "I don't know" when asked to rate the e-learning at their particular university. Above 30% of teachers and 25% of students evaluated e-learning at their universities as bad or very bad.[1]

Similar to other countries, e-learning in Slovakia is especially tailored for students that work during the day and want to enhance their qualifications by acquiring their degree in the comfort of their homes. The online students are mostly adults that are employed at various positions (even the top management) and may have families which in many cases, puts their education on a second or third place of priorities in their lives (Dutton et al., 2002). Due to the lack of time, online students may be more prone to ethical misconduct when compared to daily students. On the top of that, the online students may be less scared of the consequences (if caught) since a dismissal from their study or a forced break in their registration may not affect their lives as traditional students' lives would (Kročitý, 2013). Based on the statistics provided by Slovak university that is a leader in fighting the plagiarism in Slovakia (School of Management), we tried to find out whether online students committed more academic fraud compared to the daily students (expressed as a percentage on total number of students). The following table presents the violations of scholastic honesty by daily and online students for the period of 2002-2011.

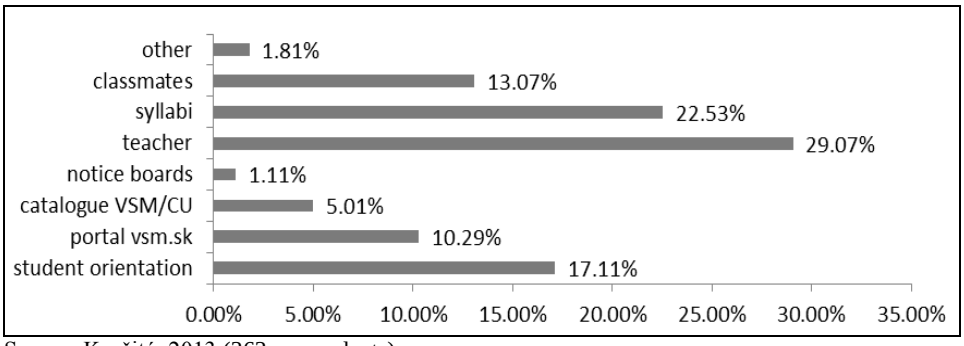
Table 1. Violations of scholastic honesty by daily and online students (2002-2011)

Academic year	Number of students violating scholastic honesty rules		Total number of enrolled students		Percentage of students violating the scholastic honesty rules on total number of enrolled students	
	daily	online	daily	online	daily	online
2002/2003	65	2	548	52	11,86	3,85
2003/2004	120	10	671	141	17,88	7,09
2004/2005	59	13	640	264	9,22	4,92
2005/2006	68	37	713	411	9,54	9,00
2006/2007	81	41	792	412	10,23	9,95
2007/2008	78	46	836	465	9,33	9,89
2008/2009	78	69	850	496	9,18	13,91
2010/2011	44	52	1030	458	4,27	11,35
2011/2012	35	54	1047	340	3,34	15,88

Source: own survey based on statistics of Scholastic Honesty Committee, School of Management, 2013

The table above provides significant results as the percentage of academic fraud cases in daily programs has fallen down over the years whereas it has significantly increased in online programs in the same time period. We have conducted an interview with the Head of Scholastic honesty Committee Mr. Kročitý who mentioned that the drop in the number of cases of academic fraud in the daily programs may have fallen down due to the more intensive means of communication at school (especially teachers, classmates, admission officers). On the other hand, he admits that communication with online students has severe limits and is – in many cases – limited to the in person orientation at the beginning of studies and several warning emails and short paragraphs in the school's academic catalogue and in the course syllabus. In his study, he has examined the sources of information about the scholastic honesty cases (students were asked a question "how did you find out about the scholastic honesty rules and procedures?") that are presented in the following figure.

[1] The questionnaire was distributed by email to more than 7,818 teachers employed at the Slovak universities and more than 9,020 students studying at the Slovak universities with the response rate of 20.23% in case of teacher respondents and 15.61%.



Source: Kročitý, 2013 (363 respondents)

Figure 1. The source of information on scholastic honesty rules and procedureS

Figure 1 reveals that the most common sources of information are teachers, course syllabi, student orientation and classmates. Less common sources are the VSM portal and school catalogue. The focus of information dissemination should be aimed at teachers who are also responsible for creating syllabi for every course.

As aresult of this study, we believe that the limitations in communication in online programs (especially on the part of teachers) accompanied with the increased number of online students have caused the percentage of students violating the scholastic honesty rules to grow. Our recommendation is to focus on student-teacher communication in the forums, especially using a multimedia communication means (e.g. video, video-conference, webinar) which would be a better substitute of the traditional in class setting.

According to Kročitý (2003) the most common way of breaching the scholastic honesty is the improper citing or paraphrasing which was the main interest of our analysis. However, other ways of conducting the ethical misconduct have been revealed. Due to the limitations of this paper, we provide a brief summary of the most common cases as well as our recommendation to limit the possibilities of the students committing the fraud in table 2.

Table 2. Recommendations to fight the academic fraud in online programs

Most common ways of ethical misconduct in online studies in Slovakia	**Our recommendation to fight the academic fraud in online programs**
Improper citing or paraphrasing on the research papers, case studies, homework and on discussion boards.	Focus on prevention by intensifying **student-teacher communication** in the forums, especially using multimedia communication means. Establish Scholastic Honesty Committee at your university. Arrange for a solid academic plagiarism checker technology.
Writing assistance of another person on behalf of a student (often a paid service either through a personal acquaintance or even by a professional company specializing in writing papers on behalf of students).	Support the government action to abolish the businesses that write papers on the behalf of students . Examine the student work carefully and pay attention to the student's writing style. Check the date of creation of document as a listed by MS Office. Ask student to present the paper in a webinar.
Providing username and password to a third person who contributes in the discussion forums on their behalf.	Pose similar questions from discussion forums on the test. Pay attention to the student's writing style.
In case of an online test, a student may browse the Internet to find the correct answers or someone else may take the test on the student's behalf logging under student's name.	We generally do not recommend the online tests and suggest imposing the requirement of taking 1-2 on-campus proctored exams or using the professional proctor if a student is at a distant location. However, if online test is the only way, block the possibilities of opening another window on student's computer. Have a large test bank of questions so that the students' questions are unique. Ask open ended questions. Ask student to arrange a 360 web camera.
Asking someone else to sit for the exams.	Check the student's ID at each exam. Pose similar questions from discussion boards on the test.
In case the exam is being proctored through a proctor abroad, the proctor may not be reliable (a personal acquaintance which is very difficult to verify).	Ask the proctor to provide the verifiable credentials (e.g. the school's email address, confirmation from the school manager on a letterhead, business card, etc.). Verify the proctor by calling the university or check the name and the position on the Internet (e.g. on LinkedIn, Facebook, etc.).

Source: own work; conclusions based on the analysis of literature and own experience

3. CONCLUSIONS

In our paper, we examined whether online students generally commit more academic fraud compared to the daily students in Slovakia. We found out that at School of Management, the university that has the most experience with fighting academic fraud, percentage of academic fraud cases in daily programs has fallen down over the years (especially due to the more intensive means of communication at school in daily programs) whereas it has significantly increased in online programs in the same time period. During the last year, the percentage of students violating the scholastic honesty rules in daily programs on total number of enrolled students was approximately five times higher than in daily programs so we can accept the hypothesis that the online students committed more academic fraud compared to the daily students. The most common way of breaching the scholastic honesty is the improper citing or paraphrasing. One of the main recommendations to fight the academic fraud is to improve the teacher-student communication in online programs. The focus should concentrate on the methods of credible deterrence, which do not necessarily have to focus on punitive actions. Raising the level of awareness of scholastic honesty through more effective information and knowledge dissemination will create a climate of mutual trust that encourages unrestricted exchange of ideas and thus motivates people to reach their highest potential (Kročitý, 2013).

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A COMPARATIVE STUDY OF E-LEARNING SYSTEM FOR SMART EDUCATION

SangJin An[1], Eunkyoung Lee[2] and YoungJun Lee[1]
[1]*Korea National University of Education, Chungbuk, Korea*
[2]*Korea Institute for Curriculum and Evaluation*, Seoul, Korea

ABSTRACT

Korean government aims to implement SMART education nationwide, so it is planning many ways to provide digital learning contents. There are some ways of distributing digital contents, and each way has its own characteristics. Edunet is nationwide system for providing educational resource. Cyber Home Learning System is a regional service which offers supplemental learning materials. E-textbook provides electronic textbooks which are actually used at learner's real class. Digital Textbook uses the latest smart device and technology. Each approach has advantages and disadvantages so it need to choose a different spreading method depending on the e-learning environment. And through the modularization of contents, it needs to recycle digital contents.

KEYWORDS

E-learning Contents Distribution, Smart Education

1. INTRODUCTION

Traditionally, the textbook has been regarded as the most important learning material for teachers and students. Because textbook was able to contain letters and pictures, a major representation of knowledge, most of information was spread in the form of a book for a long time. However, there are many ways of knowledge representation and tools for those representations are rapidly updated in this digital era. In recent years, computer technology has been improved rapidly and it affects the learning environment. Because most of the educational materials are becoming computerized, there is a growing need of new distribution system which takes full advantage of these materials in the learning environment.

Republic of Korea is one of the countries which are most interested in the e-learning environment. To implement SMART education nationwide, Korean government is concerned about digital contents distribution. So it steadily tests several methods with various policies and some main distributing services are running nowadays. The purpose of this study is to find common features of e-learning system for SMART education by analyzing characteristics of running services. To achieve the purpose, four services of digital contents distribution are compared and analyzed.

2. BACKGROUND

2.1 SMART Education Development Strategy

Korea is one of the most fast-changing countries, especially in this technical area. This social trend provokes rapid changes in the educational media, learning environments, and teaching-learning methods. To respond to these fast-pace shifts and to nurture the talent needed for the future society, Korean government is attempting to transition to a new educational system, named 'SMART Education'. SMART education aims to get learners participate in their learning process, build their own knowledge, and develop lots of competences for the future society. With the latest technology and pedagogical theories, it is the primary goal to create an ideal environment where learners can learn by themselves.

In SMART education environment, media that learners actually interact affect learning process and result of them; in other words, the way of contacting educational materials can be very important factor, as well as learning contents. From this perspective, Korean government has been interested in contents distribution. The following services show the ways of providing educational contents in the non-face-to-face education.

2.2 Edunet

Edunet is a comprehensive online service system for exchanging educational materials. It was established in 1996, served as a nationwide repository of teaching and learning materials for K-12. Teachers can easily search teaching resources; students can acquire necessary learning materials. Parents and educational administrators can make use of most of data. It also offers basic cyber lectures for K-12 students so those who want additional study can find useful lessons in Edunet. Most of the lectures are interactive lectures produced by the Adobe Flash programs and video lectures.

2.3 Cyber Home Learning System

Whereas Edunet is a nationwide service, cyber home learning system is a supplementary e-learning system for regional primary and secondary students. All metropolitan cities and provinces offer their own cyber home learning system since 2005. Each system focuses on local public education so it offers contents which are closely related to the real school classes. Similar to Edunet, most of the lectures are flash-based interactive lectures and video lectures. It also has personal learning management system (LMS), learning contents management system (LCMS), and many community services for students.

2.4 Digital Textbook

Digital textbook is the generic term that includes recent endeavors to apply a variety of materials in the field of education, especially in public education. Around the world, many countries committed to replace the traditional textbook to learner-centered media, and Korea is one of them. Digital textbook project started in 2007. The concept of digital textbook is an educational material with a combination of textbooks, reference books, workbooks, dictionaries, and multimedia contents such as video clips, animations, and virtual reality. And it offers personal learning management system and variety of external learning materials. The aim of digital textbook is to integrate all possible educational services into it and make it portal of SMART education. Until 2012, digital textbook contents were provided in the form of Windows and Linux program which is optimized for the tablet PC with touch screen. From 2013, digital textbook contents are being reorganized to be accessed by any devices and any operating system.

2.5 E-textbook

E-textbook is a transitional media between textbook and digital textbook. Digital Textbook demands devices equipped with the latest technology and ideal network environment. Although IT infrastructure of South Korea is quite excellent, it is hard to supply every equipment required for digital textbook environment to every student. So e-textbook aims to run on common PC and mobile environment and provide digitalized books which contain same contents as textbook actually used in school. While using e-textbook, teachers and students can get the time to adapt to the digitized textbook environment. Textbook providers produce additional e-textbook with lots of multimedia contents to help students' learning, and they provide e-textbook since autumn of 2012.

3. COMPARISON

3.1 Contents

Table 1 shows the status of contents providing of four services. There are a few things to think in terms of contents.

Textbook is more relevant to students' school work. But e-textbook does not support interactive contents, so it can decrease their interest and motivation. Contemporary educational system needs more participation of learners.

Learners can produce their own contents only in digital textbook environment. In digital textbook platform, students can type answers, draw pictures, capture screen, and save those products at their own cloud storage.

Table 1. Contents comparison

	Contents provider	Interactive contents	Relevance with school work
Edunet	Central government	Flash-based contents	Low
Cyber home learning system	Local education office	Flash-based contents	Average
Digital textbook	Central government	Multi(using touchscreen and sensors)	High
e-textbook	Textbook provider (Local education office)	Not support	High

3.2 Usability

Table 2 shows usability of four services.

All services are run on PC environment, but digital textbook needs tablet PC with touchscreen to use all the features. E-textbook is the only one which can be run on mobile devices (in app style). All service need multimedia and interactive contents, so basic media player and Flash player is required.

Lectures of Edunet and cyber home learning system always need connection to network. Digital textbook is basically download-and-run service, but to take advantage of all the features it has to be connected to network. 'e-textbook' is purely download-and-run service so it does not need network.

Cyber home learning system and digital textbook offer LMS and personalized environment.

Table 2. Usability

	Device	Network Connection	LMS	User contents production
Edunet	PC	Always connected	X	X
Cyber home learning system	PC	Always connected	O	X
Digital textbook	Tablet PC	Frequently connect	O	O
e-textbook	PC, Mobile	X	X	X

4. CONCLUSION AND DISCUSSION

In conclusion, e-leaning system of Korean public education can be divided into two parts. First, there is a system which provides various learning materials to general students. This system offers universal lectures which were produced by the central government and it does not support any personalized service and LMS.

Edunet and e-textbook are included is this system. The second one is for personalized learning, offering LMS and user-created contents management. It provides interactive contents which are based on the real school textbooks and curriculums. This system includes digital textbook and cyber home learning system

Technology is enhancing more and more, but not the entire e-learning environment is perfect. In Korea, a variety of e-learning environment has been built so learners can study in any learning environment. In order to prepare smart learning environment, we would like to make a few suggestions. First, it is necessary to construct the environment in which learners can produce and manage learning outcomes rather than one-side contents providing. Learners are exposed to a variety of learning materials, so it needs to present meaningful and relevant contents to increase the effectiveness of learning. Next, it should be designed to be used in general-purpose devices. Digital textbook has lots of merits and functions, but it needs special devices for using. Nearly all students have at least one smart devices and uses them well, all educational materials are furnished for all smart devices.

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ALTERNATIVE ASSESSMENT TECHNIQUES FOR BLENDED AND ONLINE COURSES

Brenda C. Litchfield and John V. Dempsey
University of South Alabama, UCOM 3800
Mobile, AL 36688 USA

ABSTRACT

Alternative assessment techniques are essential for increasing student learning in blended and online courses. Rather than simply answer multiple-choice questions, students can choose activities in an academic contract. By using a contract, students will be active participants in their own learning. Contracts add a dimension of authenticity to blended and online course and students can learn, retain, and transfer more of course content. Guidelines and an example of a contract are given.

KEYWORDS

Alternative assessment, authentic assessment, e-assessment

1. INTRODUCTION

Developing effective assessment for online courses can present unique challenges for both graduate and undergraduate level courses. Because many graduate course assignments are project-based rather than objective-based, authentic assessment is becoming a motivating method of evaluation in many situations. In undergraduate courses where there is often a lot of information that needs to be transmitted, the use of authentic assessment combined with objective-based testing can provide a more meaningful and satisfying experience for students (Hamilton & Carlson, 2010).

There are many names for online assessment that use real situations and involve students in active ways. Authentic, alternative, and performance-based are regularly are used interchangeably. The term alternative assessment seems to be most appropriate because it is an alternative to the usual objective-based testing that is so prevalent in online and blended education today. This paper will use the term, alternative assessment.

2. ALTERNATIVE ASSESSMENT

2.1 What is Alternative Assessment?

Alternative assessment is a type of assessment where students perform as task rather than select answers from a test (Maclellan, 2004). Students are involved in completing the assignments that relate directly to course content. These can take the form of group or individual projects, presentations, studying the community, interviews on specific topics, and a wide range or other activities.

The quality of student work is judged on pre-set criteria given to the students ahead of time. These criteria can take the form of rubrics or specific guidelines to follow. These detailed criteria provide guidance for students and increase their confidence because they know what is expected of them.

Research on alternative assessment has shown that learning for students is moved into the active category rather them than passively absorbing information. Because students are part of their learning experience, they tend to spend more time-on-task and, therefore, learn, retain, and transfer more course content.

Students have a greater interest in the material because they are involved in creating their own products. Rather than simply reading online text as lectures and watching PowerPoint slides, they are constructing their

own knowledge and exhibiting their learning in creative and unique ways. Because online and blended students are more involved, more learning occurs.

There is a great depth of understanding and cognitive processing when students are creating artifacts that demonstrate what they have learned. With alternative assessment they are not just reading material online, but instead, creating and choosing from a variety of activities that can be judged by the professor as an indication of their mastery of the subject (Reeves, 2009).

To be effective, alternative assessment needs to address the major concepts and objectives of a curriculum. In all subjects there is a great deal of information. It is imperative that professors determine the critical objectives and then design alternative assessment measures to match those objectives.

As with all good instruction, alternative assessment requires more planning time at the beginning. It is essential to start with sound instructional objectives in a variety of cognitive levels. From those objectives, the activities and assessment can be constructed. Each activity must be created so as to allow students to demonstrate mastery of the content and/or skills of the course.

2.2 Benefits of Using Alternative Assessment

Alternative assessment is a more valid indicator of students' knowledge and skills. It encourages students to be active participants in their own learning and moves them from a passive to an active mode. Rather than being on the other end of the computer receiving information, they are interacting with course content and developing meaningful modes of inquiry.

When students are actively involved with their learning, they are more likely to develop critical thinking and effective problem solving skills. They are not passively waiting for the weekly online multiple-choice test but are thinking of ways to complete the alternative assessment assignments that provide them with practice and active learning opportunities.

Another benefit of alternative assessment for blended and online courses is that it provides variety for professors and students. Students can choose among many interesting, course-relevant activities to complete. This ability to be able to choose from among activities they are interested in builds confidence and satisfaction with the subject (Keller, 2010).

This type of assessment requires practice in self-monitoring and self-evaluation. Students are responsible for their own learning and this is a very different type of learning for many students. They often feel empowered to be part of their own learning and being able to make a selection from among alternative assignments.

The ultimate benefit is that students learn and retain more. Because they are active participants in their own learning they feel a connection to what they are doing. Taking multiple-choice tests and getting back a number grade can be somewhat satisfying but when students know they have accomplished a project or activity, they tend to remember that much longer and are able to transfer the new learning to future situations.

2.3 Practical Application of Alternative Assessment

One alternative assessment technique that works well and in online and blended university graduate and undergraduate classes is Academic Contracts. Academic contracts, an alternative assessment technique, are applicable for all ages and grade levels. They allow variability in teaching and learning. They build students' confidence by providing them with varied activities at which they can excel. They also address learning styles by letting students chose areas they prefer and can do while enjoying the learning experience. So they give everyone a change from the usual multiple choice or essay/term paper assignments.

For many online and blended classes, testing is not a good option because there is no security. Who knows who is taking the test? Or if they are looking things up in the book? Academic contracts are a viable alternative to objective-based testing. Some people have asked, "If you use academic contracts, how do you know the student is actually the one who is doing the project?" With on campus courses professors do not know that, either. But it is more difficult to get someone to do a huge project for you than it is to take a test.

Students learn a lot more about a subject doing projects, papers, and production-type work. Quizzes can be used as a self-check, though. You can also use quizzes as self-checks that are not graded. This can help build confidence because students find out how they are doing as they go along. They can gauge their progress and see how much they have learned.

A major objective with academic contracts is to provide students with real-world applications of skills and knowledge gained in a course. When they can apply what they have learned to a meaningful assignment they tend to feel much more satisfied with their learning experience. By applying what is learned to relevant, meaningful activities, students do learn and retain more and are able to successfully transfer this to other situations (Lee, 2006).

The main components of a good academic contract are listed below.

1. Cover a wide range of areas and processes – music, reading, writing, drama, interviews, observations, video, analysis, etc. Many professors make the mistake of having, for example, seven assignments and four or five of them are writing assignments. There needs to be MORE variety than that. Not all students learn the same way or like to exhibit what they have learned in the same way. They should be provided with different ways to show what they have learned.
2. Provide explicit criteria for each option. This is essential. If specific criteria are not included, students will not know exactly what to do. Very specific criteria for each of your assignment in your contract must be included.
3. Make sure you have enough optional assignments for them to be optional. For an A, if you require the required activities plus four optional activities and only have five or six from which to choose, that is not much option. A good guide is to have twice as many activities to choose from as you require. If they have to do four assignments/activities then there should be at least eight to choose from.
4. Include a space for other activities. Students may think of some excellent projects they can do and sometimes ones that professors will never think of. Always have Other as an option but specify they need to get it approved by the professor first.
5. Stagger the due dates throughout the semester by indicating due dates on the course schedule. Do not make the mistake of having everything due at the end. There will be too much to grade at the end of the semester.

3. CONCLUSION

Academic contracts are an effective method for applying alternative assessments methods in online and blended courses. Contracts allow students to be actively involved in their own learning and address their learning styles. Although creating academic contracts does take additional time and planning, the results are worth it in terms of student learning and satisfaction. The main consideration is to be creative and provide students with a variety of learning activities. Below is an example of a contract used in a graduate educational psychology course along with criteria examples.

EPY 502 - Principles of Human Learning Contract
Signed contract due second week of class

Name _____ Completion date See syllabus for dates

Required Activities – 500 points
• Create a one-page vita with a photo and upload to course site (10 points)
• Five concept maps and associated anecdotes (50 points)
• Webliography - four annotated sites on relevant course topics (40 points)
• Complete an ARCS motivational chart for a unit of study (50 points)
• Design, implement, and evaluate a behavior modification plan (100 points)
• Design, implement, and evaluate a self-regulation plan (100 points)
• Online discussion participation (150, 10 points per week)

Optional Activities - Group I - 100 points each
• Design a board game that teaches concepts and principles of a course you teach (may work w/partner)
• Analyze articles using specified format (six articles)
• Produce an instructional video on a topic covered in the text – must be approved
• Create an academic contract and criteria to use with your students

Group II - 50 points each
• Interview a K-12 teacher about instructional strategies used in the classroom
• Observe a K-12 teacher and evaluate use of behavioral and cognitive approaches (two diff teachers)
• Create a photo illustration of a topic or concept covered in the text
• Design and implement a three-day/three hour cooperative learning activity

Indicate choice of grade and circle optional activities you plan to complete
____ A = required + 200 optional points
____ B = required + 150 optional points
____ C = required + 100 optional points

_____ _____ _____ _____
Student Date Instructor Date

CRITERIA EXAMPLES

Video
____ 5 - 8 minutes
____ detailed storyboard MUST be approved
____ title screen
____ credit screen
____ narration
____ introduction
____ body (3-5 scenes)
____ summary/ending
____ content accurate
____ lighting - not burned out, too dark
____ camera work - not jumpy
____ transitions - smooth

Interview
____ 15 -20 questions
____ intro statement for interviewee giving purpose for interview and how much time it will take
____ summary statement
____ most interesting finding
____ what is related/not related to course
____ improvements for next interview
____ start time and end time
____ personal evaluation of session (1 low, 5 high) with two paragraph narrative.
____ two-page session narrative describing what you found out and how teacher could improve
____ your notes taken during the interview

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ASSESSING THE STRUCTURE OF A CONCEPT MAP

Thanasis Giouvanakis[1], Haido Samaras[2], Evangelos Kehris[3] & Asterios Mpakavos[4]
Technological and Educational Institute[1,3,4], Serres, Greece
Anatolia College[2], Thesalloniki, Greece

ABSTRACT

This paper presents a framework for the evaluation of concept maps. We focus on supporting the student in dealing with ill-structured and complex problems. We argue that these problems require the application of *the modularity approach*. In view of this, the paper describes ways of providing student support for the implementation of this approach within the context of a concept mapping activity. As a basis we make use findings from the field of brain science and mathematical concepts and tools from the field of network theory, in order to present specific evaluation methods, the further development of which we consider extremely promising.

KEYWORDS

Concept map, assessment, modules, graph theory.

1. INTRODUCTION

In recent years we've increasingly witnessed a transition from the storage model toward the development of high-level skills (Perkins, 2000) in thinking and creativity. The ideas and the theoretical background underlying this transition are not new. They were first shaped at the beginning of the previous century (Dewey, 1925) and have been further confirmed and specialized by younger researchers in the field of learning. Cognitive tools, such as concept maps, play an important role in these approaches releasing the student from dealing with low-level mental functions and encourage a more creative way of thinking and synthesizing knowledge.

This article aims to contribute to this field by presenting a framework and proposing guidelines for the assessment of concept maps. Research from three different fields is made use of in order to create the framework: a) the field of learning, b) the field of brain science and c) the field of network theory. The article attempts to answer the following questions:

Why and how do students learn through the construction of concept maps?

In what ways could we support students and what kind of feedback and suggestions could we provide them with?

2. LEARNING AS STRUCTURE CREATION

We can educate students to represent and organize the information they receive more efficiently. This goal could be achieved through either strong or weak methods. Weak methods refer to methods which are independent of content. Particularly when solving problems that deal with the capacity for innovation and navigation within ill-structured domains, the use of such methods is essential. Strong methods refer to methods which are dependent on the knowledge domain. Specific formulas, algorithms, classifications, etc., help us to very quickly reach the solution of a problem on the condition, of course, that the particular problem is well structured.

Experts differ from beginners in the strong and weak methods they possess and apply. Experts organize information more efficiently and as a result the solution space becomes more coherent. In this context, evaluation methods that allow us to observe the process of the creation of structure by the student acquire particular importance. This means observing possible weak and strong methods which the student applied in

order to solve the problem. In the case of concept mapping: a) strong methods are reflected in the schema (diagram) produced by the student and are expressed mainly on a semantic level, while b) weak methods could be considered to be also portrayable in the characteristics of the structure produced.

A structure may or may not be modular. A non-modular structure of the natural world cannot be characterized as "well-structured" unless it is very simple (trivial) or if not assessed in relation to dynamic growth and enrichment. However, learning is an entity not subject to closure. Learning constitutes the creation of structures, the main qualities of which are the potential for expansion and enrichment. Its main feature is the change produced when the framework expands.

Structures with such features have documented in various ways (mental constructions, simulations, visualizations of complex structures, etc.) that the modular way of development is more efficient and effective (Newman, 2010; Lipson, Pollack & Suh, 2002) for a variety of reasons such as easy error recovery, easier expansion, etc. The human brain is modular both structurally as well as functionally (Bullmore & Sporns, 2009). This feature allows it to evolve and to enrich its structure. There are indications (Bassett, Wymbs, Porter, Mucha, Carlson, & Grafton, 2011; Fair, Cohen, Power, Dosenbach, Church, Miezin & Petersen, 2009) that ***when the brain undergoes learning processes, it becomes more modular***.

3. SEARCHING FOR STRUCTURE IN A CONCEPT MAP

3.1 Finding Modules

For the detection of modules, namely the ideas contained in a map, we could build on the progress that has been made over the last decade in the area of network theory, both on a theoretical as well as on an application level. The obvious premise for finding modules is that the concepts that compose the ideas contained in a map are connected to each other in a different way than with the meanings that are outside the framework that the idea defines. To be more specific, we can make the self-evident assumption that there should be a high density of connections among concepts within the idea, in relation to concepts that are outside it. Based on this distinction, unlike the case of text, ways of connecting ideas could be proposed.

For example, the most successful algorithm – it has been applied with great success in social and biological networks to detect communities or, more generally speaking, for the detection of structures which are distinguished on the basis of the different density of links embedded within the structure, compared with links commencing from the structure and ending in nodes of the remaining network – is the algorithm suggested by Newman & Girvan (2004), which is based on the concept of intermediate minimum paths (shortest-path betweenness).

In summary, the steps of the algorithm are:

1. Count the shortest distances (paths) between all pairs of vertices.
2. Calculate the number of shortest paths that pass through each edge.
3. Find the edge with the greatest number of paths and delete them from the network.
4. After deleting repeat step 1.

3.2 Assessing the Clarity of Modules

As mentioned above, experts differ from beginners in terms of how they organize their knowledge. This means that the structures the expert develops ought to be more distinct, i.e. characterized by greater clarity and precision. Pellegrino, Chudowsky & Glaser (2001, pp. 77) present the maps portrayed in Figure 1 as a typical example of concept maps that were created by an expert and a novice respectively. By examining the maps on the level of semantics, it is obvious that the best treatment for the subject of motion comes from the expert. However, it is worth examining further, the clarity with which the expert forms structures compared to the beginner.

The detection of modules in the context of a map should be accompanied by a valuation method measuring the clarity of these structures. For example, a widely acceptable approach in the area of network theory for quantitatively determining the clarity of structures is with the values of the *modularity index*.

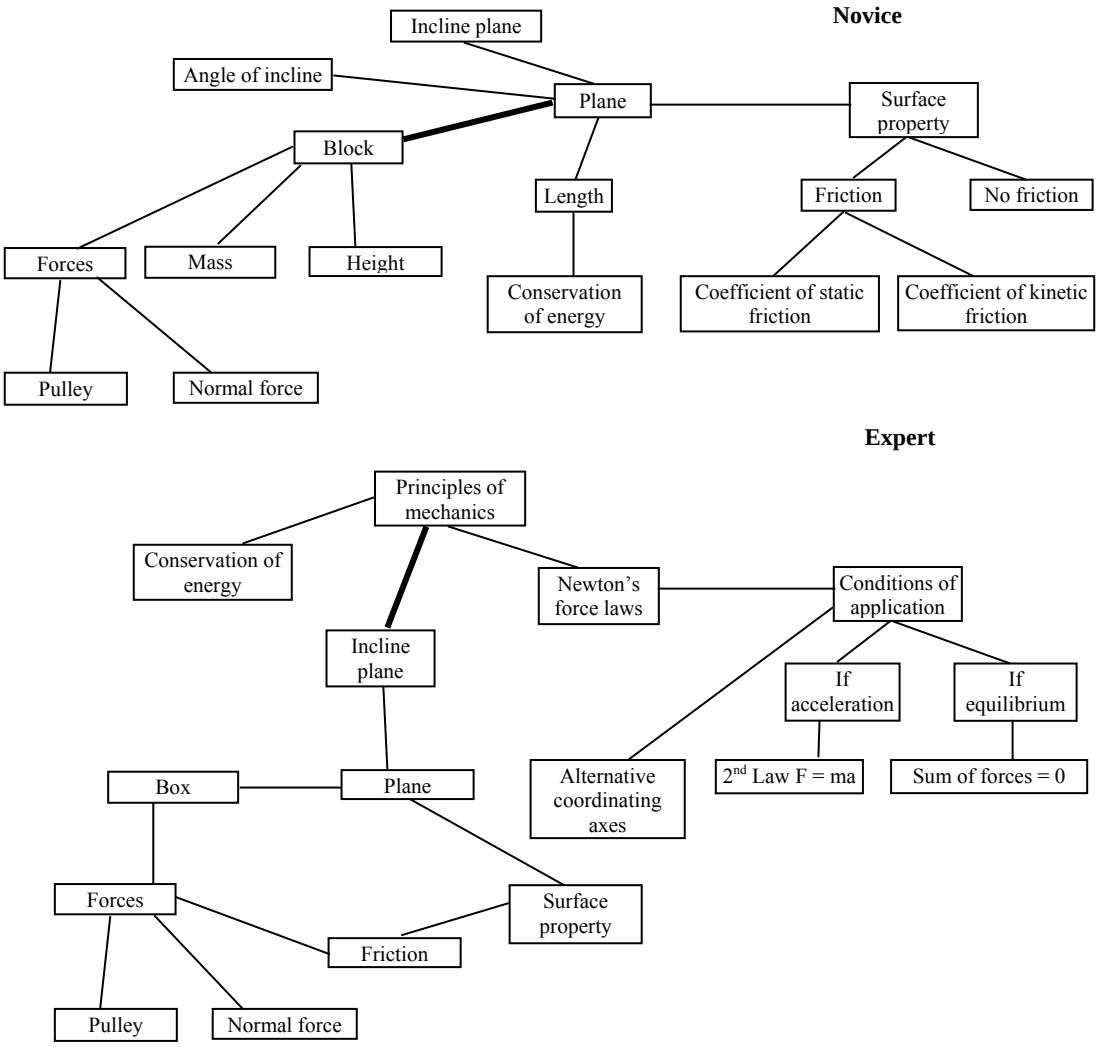

Figure 1. Novices' and experts' concept maps

The mathematical expression of this definition is:

$$Q = \frac{1}{2m}\sum_{ij}(A_{ij} - \frac{k_i k_j}{2m})\delta(c_i, c_j)$$

where m is the number of edges of the map, A_{ij} the adjacency matrix in the rows and columns of which is 0 or 1 depending on whether there is an edge between vertices *i* and *j*, k_i and k_j is the degree of vertices *i* and *j* (the number of edges that start from *i* and *j*), c_i and c_j the modules to which the vertices *i* and *j* belong respectively and $\delta(c_i, c_j)$ Kronecker Delta (for $c_i = c_j$ equals 1, otherwise 0).

The modularity indicator is equivalently expressed as:

$$Q = \sum_i (e_{ii} - a_i^2)$$

where the first term in parentheses expresses the total number of edges between vertices of the same module (*i* module) and similarly, the second term expresses the total number of connections for the same module, if the links were randomly distributed.

Let's suppose that an algorithm (like the one in the previous section) has discovered two modules. We refer to the modules that are separated by the bold line, as indicated in the figure 1.

Applying the index in order to evaluate the clarity of structure of the concept map of the novice in comparison to the expert concept map, we will take the following results:

The concept map of the novice has 16 concepts and 15 edges (30 endings of edges) and there are two modules having 10 and 6 concepts. The first module has 9 edges (18 endings of edges) between its vertices, the second module has 5 edges (10 endings of edges) and there is 1 edge between the first and the second module.

The clarity of modules is expressed as:

$$Q = \sum_i (e_{ii} - a_i^2) = 18/30 - (19/30)^2 + 10/30 - (11/30)^2 = 0{,}397$$

The clarity of modules, in the second case, is expressed as:

$$Q = \sum_i (e_{ii} - a_i^2) = 16/34 - (17/34)^2 + 16/34 - (17/34)^2 = 0{,}441$$

Applying the above method, we can prove in quantitative terms that the expert has developed more distinct structures in relation to the novice. ***The knowledge of expert is well-structured in relation to the knowledge of the novice.***

4. CONCLUSION

Recent discoveries in the field of brain science and the latest constructions of mathematical concepts and tools in the area of network theory constitute fertile ground for the development and evaluation of learning activities as that of concept mapping. The classical methods of assessment can be enriched and greatly upgraded in light of discoveries about the operations of the human brain. Learner support in open type learning activities and the development of weak methods to solve problems can be done with the further refinement and development of a modular-based framework.

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IMPLICATIONS OF IMPLEMENTING WEB 2.0 ON EDUCATION

Gabriel Valerio and Ricardo Valenzuela
Tecnológico de Monterrey

ABSTRACT

The Knowledge Society has altered the way humanity works, learns and amuses itself; from here the rise of the so called e-learning, an educational modality whose "innovation" has been questioned because of the tendency to simulate traditional ways to educate. This paper explores the concept of e-learning 2.0, the implications of implementing e-learning 2.0 in higher education, in terms of challenges, opportunities, and student readiness for this educational modality.

KEYWORDS

Web 2.0, E-Learning 2.0, Connectivism

1. INTRODUCTION

We live in a knowledge-based society, a society that revolves around information in all its presentations. Due to major advances in information technologies, society certainly relies heavily on information that flows in bytes. People who live in this society, and do not belong to the so-called net generation, had to add a lot of words and concepts to their vocabulary: Internet, Web 2.0, blogs, wikis, RSS reader, folksonomies, tags, podcasts, online social networks, hackers, spam, and so on. However, for the net generation, students who were born in the 1980s, this learning have been an easy process, one intrinsic to their own development. For them, Twitter, Skype, Facebook, and YouTube are just tools of everyday life. In this context, the academic world is trying to adapt its teaching and learning methods to the new needs of the marketplace, the technological advances, and the way students grasp these technologies in their process of knowledge generation.

2. BODY OF PAPER

2.1 Literature Review

The term Web 2.0 is used to describe applications that distinguish themselves from previous software generations, by a set of principles that take advantage of Web-based networks. Such applications encourage participation; and they are inherently and socially open. Even though Web 2.0 is not characterized by a change in technology, in recent years the Web has changed from being a reading Web to be a read-write Web (Borau et al., 2008).

The collaborative nature of Web 2.0 is consistent with educational theories such as constructivism and Connectivism. This makes Web 2.0 applications attractive to students and instructors. Wikis, blogs, and social bookmarking are now commonly used in learning. The popularity of Web 2.0 is growing and so are the number and variety of applications (Borau et al., 2008). For McLoughlin and Lee (2008), the advent of Web 2.0 invites us to reflect on how social software tools can transform industrialized models of learning, to a model focused on students' individual achievement based on collaboration, network communication, and interaction. A new concept has been growing as a result of a better understanding of the possibilities of Web 2.0 in education: e-learning 2.0.

The e-learning 2.0 concept aspires to become the next generation of e-learning by incorporating the theory of Connectivism and social software in education (Hauttekeete, Méchant, Veevaete, & De Wever, 2007; Reig, 2008; Siemens, 2004). Instructors are beginning to explore the potential of blogs, multimedia sharing services, and other social programs, which, although not designed specifically for e-learning, can be used to motivate students and create new and exciting learning opportunities (O'Hear, 2006). By using the new Web services, e-learning has the potential to become more personal, social, and flexible. For O'Hear, e-learning 2.0 combines the use of Web tools and services that complement the creation of fitted learning communities, such as blogs, wikis, and other social programs.

Traditional e-learning resembles the typical classroom with an instructor and students. The instructor provides high quality content, accessible through a learning management system (LMS). The learning process is carried out through communication tools and interactive exercises. The traditional way of teaching is accomplished through new media (Ebner, 2007).

Ebner (2007) warns that by simply adding Web 2.0 to e-learning will not take us to e-learning 2.0. For him, there is a third component that we should take into account: the human factor. Firstly, there is a learning curve for Web 2.0; these social tools are relatively new and only a small percentage of people know how to use them. Secondly, changing the behavior of teaching and learning that has been used for decades will be much more problematic than generating new applications.

2.2 Challenges, Benefits and Preparation for Web 2.0

With the interest of understanding the implications of implementing e-learning 2.0 at a college level, three questions were explored:

- What are the major challenges or problems that professors have to face when using Web 2.0 and e-learning tools for learning purposes?
- What are the major advantages that professors have when using Web 2.0 and e-learning tools for learning purposes?
- How ready do you think students are to take advantage of the Web 2.0 and e-learning tools for learning purposes? In spite of the common beliefs of young generations, do you think students have the knowledge for using such tools in an effective way?

2.2.1 Challenges for the Implementation of e-learning 2.0

The major challenge in implementing e-learning 2.0 is not so much the development of students' computer science skills, but the development of general skills.

To the challenge of promoting e-learning 2.0:

- Develop an attitude of innovation. Try to really change the current academic paradigm, in which the professor normally is the one producing knowledge and the students are receptive of it; and not just do the same paradigm with modern tools. A common temptation is to implement what is new out there but still in the traditional way, so professors tend to do what they always do now through new technology.
- Construct a good instructional design. The key to efficient use of new technologies lies in the capacity to make base what is taught on an appropriate instructional design. Networks and Web 2.0 per se are not merely academic tools, with the exception that a user directs them to achieve a learning objective. It is even possible professors get lost if they are not capable to give students the proper guidelines to where we want to take them, to where we want to lead them.
- Help students to focus on the academic subject matter. The challenge is to make things not related with the class appear. The key can be found into taking advantage of the playful environment, while assuring the effectiveness of learning.
- Have the capacity of using technological tools of Web 2.0. It is important that professors know how to use Web 2.0 tools in an academic environment, since in that way students will fulfill their learning objectives.

In relation to e-learning challenges faced by academic administrators:

- Provide access to Web 2.0 tools. One in which all students have access e-learning 2.0 tools, through sufficient bandwidth to use multimedia.
- Have an open mind regarding implementation of new technologies. Sometimes managers of the infrastructures oppose to use that type of technologies because they require computational resources.

In relation to implementing e-learning 2.0:

- Social skills. Students who engage in e-learning 2.0 may lose interpersonal skills. One of the challenges is that several social skills do not get lost but strengthen. These social skills that were referred by the participants included the ones of communicating, listening, perception and willingness to serve others.
- Interest. The use of Web 2.0 to arouse and maintain students' interest and engagement in class issues.
- Intellectual property issues. A challenge for professors is to ensure students avoid unauthorized use of copyrighted materials and infringement of others' privacy.

2.2.2 Benefits of Web 2.0 Tools in Learning

Although many challenges were identified in order to implement Web 2.0 in learning, there are many benefits that make it worthwhile to tackle such challenges. Among these advantages are the following:

- Permanence of evidence. These tools allow students to create a sort of learning evidence portfolio. For example, the use of blogs as a periodical portfolio of learning reflections.
- Communities' creation. This sort of tools is conducive to community creation, as students go on identifying for example, through the profile or trough certain types of content, similar interests.
- Multiple resources. Such tools provide access to a variety of information resources: presentations, documents, videos, images, etc. These resources often provide some learning activities.
- Massive and rapid scope. Students often access them several times a day, which is not usually the case with traditional learning platforms (LMS) or with the use of email address use for academic affairs.
- Creating and sharing knowledge. These tools help to foster the desire to create and share their knowledge with peers. By using these tools all peers see what each student does is important, because in the process the students feel more involved in their own learning, while contributing to the generation of knowledge in the course and sharing it with their colleagues.
- Playful environment. For students, a tool such as YouTube or Facebook makes them feel in their own environment, or at least in a neutral space, and not in an institutional one, a place where besides connecting with colleagues and friends for any given social event, you can also find out about other official activities.

2.2.3 Preparing for College Students for e-learning 2.0

In relation to the question of whether college students were prepared for e-learning 2.0:

- Sometimes, college students are prepared for e-learning 2.0. College students are ready for this type of learning because they know how to use technology and they have the necessary attitude to take advantage of it. The environment of e-learning 2.0 is natural to the students because, in addition, the new educative models go on preparing them, for example, in their own knowledge management.
- Sometimes, college students are prepared for e-learning 2.0, but professors are not. Many college students are prepared for e-learning 2.0, but very few professors are. The greatest challenge to implementation of e-learning 2.0 is more the professor than the student. Besides the lack of technological skills, many professors do not have the necessary attitude needed for this type of learning.
- Sometimes, college students are not prepared for e-learning 2.0. Although college students have no problems in terms of technology skills, professors perceive them to lack sufficient maturity to cope with the responsibility of e-learning 2.0.

3. CONCLUSION

The e-learning 2.0 implies that those who learn, rather than the those who teach, are the ones who contribute with content and discuss those contributions with their contacts, whether these are classmates, professors or friends; engages their contacts as repositories of information; and socializes to strengthen bonds of trust with their contacts. Above all, learning is self-managed, with students deciding what is good for them to learn and identifying who to contact regarding that knowledge.

Any person, registered or not in an educational institution, can take advantage of Web 2.0 technologies, and specifically in online social networks to favor their learning. For this matter, a fundamental requirement is that the student and professor have the necessary computer science skills. Some professors tend to think that college students have computer science skills because they heavily use information technologies. However, while college students have the ability to quickly learn the technological skills required, they are not always aware of what technology skills are needed. Moreover, the computer skills needed to participate effectively in the e-learning 2.0 are not just technological. Cognitive and attitudinal skills are also required. It is in this area where professors face a greater challenge.

Apparently, now only a few students understand the philosophy of Web 2.0 tools. However, once the students understand how these tools work, they will have the ability to make efficient use of them in their learning process. Professors themselves must understand the nature of these tools to obtain tangible benefits..

We face significant challenges if we want to implement Web 2.0 tools in formal learning initiatives – challenges for both administrators and professors to enable students to make efficient use of Web 2.0 tools. None the less, it seems that there are greater benefits that could be achieved by implementing e-learning 2.0 initiatives.

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STORYTELLING: DISCOURSE ANALYSIS FOR UNDERSTANDING COLLECTIVE PERCEPTIONS OF MEDICAL EDUCATION

Yianna Vovides and Sarah Inman
Georgetown University

ABSTRACT

Using discourse analysis, the goal of this exploratory project was to determine what practitioners of medical education in Sub-Saharan Africa considered key achievements, within the scope of their Medical Education Partnership Initiative (MEPI) activities, after their initial two-year implementation efforts. To do so, a series of 58 video stories were analyzed from a 2012 symposium that took place in Addis Ababa, Ethiopia. Analysis of the video stories followed an ethnographic method of analysis. Through this analysis common themes emerged from the collective discourse, which unsurprisingly were tied directly to the MEPI themes themselves. The use of discourse analysis helped confirm that the project themes were very much aligned with actual practice. It also enabled a level of transparency of results across all stakeholders. This approach is therefore recommended for informing and supporting future programmatic decisions.

KEYWORDS

Video research, ethnography, discourse, medical education

1. INTRODUCTION

Alongside decreasing costs related to video recording devices comes an increase in the availability of audiovisual qualitative research methods for data collection and analyses. In the past decade there have been major advancements in making qualitative research more sophisticated than traditional manual ways of coding data (Walsh, 2003; Jones, 2007). These advancements offer an opportunity to examine collective discourse in a more holistic way. For this reason, we have chosen to analyze the 58 video stories of participants who were in attendance at the 2nd Annual Medical Education Partnership Initiative (MEPI) Symposium that took place in 2012 in Addis Ababa, Ethiopia. In doing so, we aim to explore the collective perceptions in relation to the key MEPI themes of retention, capacity building, research, communities of practice, and sustainability.

2. BODY OF PAPER

MEPI's 2012 2nd Annual Symposium, *Building Partnership and Enhancing Sustainability*, was designed to bring together a network of 33 African, 17 U.S., two British and one Canadian medical schools and teaching hospitals as well as policy-makers from 13 countries and local and international partners to enhance the sustainability of the initiative's outcomes by building synergies between the medical education network and other local, national, regional and international stakeholders. Additionally, this conference focused on innovations and best practices with particular attention to capacity development, retention and regionally relevant research.

Because dialogic interaction yields co-constructed knowledge, a social constructivist approach can help explain how knowledge and perceptions of knowledge are related within a particular context. The study of dialogue, and the ways in which interactions around others as well as one's own thoughts, is incredibly complex and critical to understanding collective intelligence and knowledge transfer in that it is an "issue of language, talk and communication" focused on the "interplay of action and interpretation" (Weick et al., 2005, p. 409).

To capture this complexity and understand the themes highlighted in the symposium, we selected a grounded theory methodology. Grounded theory is a qualitative research method first conceptualized by Glaser and Strauss as a way of studying data without preconceived assumptions. Glaser and Strauss' (1967) strategies develop theory from research data instead of from existing theories. An ethnomethodological approach is one in which the world is not studied in abstract terms but rather, "on the level where reality is being performed" (Cruickshank, 2012, p. 40). Accordingly, we understand reality as a "product of our own mental constructions" as it is "constructed by people and society, as is the case in the theory of practice, symbolic interactionism, phenomenology, ethnomethodology and hermeneutics" (Cruickshank, 2012, p. 40). This approach allows the researcher the flexibility of engaging in simultaneous collection and analyses of data.

To gather information on how participants define the achievements of MEPI, we relied on interpretive inquiry through interviews and storytelling. As part of the interpretive approach, those who chose to tell their story were simply asked to share their achievements over the two-year span of MEPI efforts in their own countries. This approach allowed the perspective of the storytellers to emerge. By coding and analyzing the individual's response, we were able to assess the collective knowledge environment within the symposium and in relation to the MEPI themes. This is critical to assessing future areas for development and outcomes of a highly diverse, international deliberation—one in which communication is critically important.

To analyze the discourse in the 58 videos, we used NVivo 10, a qualitative analysis software. Though discourse analysis has its limitations, it offers a transformational opportunity as a driver for further exploration in systems of learning and knowledge transfer. The 58 video narratives, which were on average 5 minutes long, were viewed and listened to by a single researcher from the research team and coded accordingly, using the five MEPI themes (retention, capacity building, research, communities of practice, and sustainability) along an iterative timeline.

As Silver & Pataschnick (2011) illustrate, the synchronicity between transcripts and visualization of audio waveforms can help mitigate the limits of using a single source of data. Figure 1 illustrates the way in which transcripts can be viewed alongside the coding process, keeping the analysis an active process. Furthermore, the transcripts alongside coded material can help further explain the researcher's process for coding specific information.

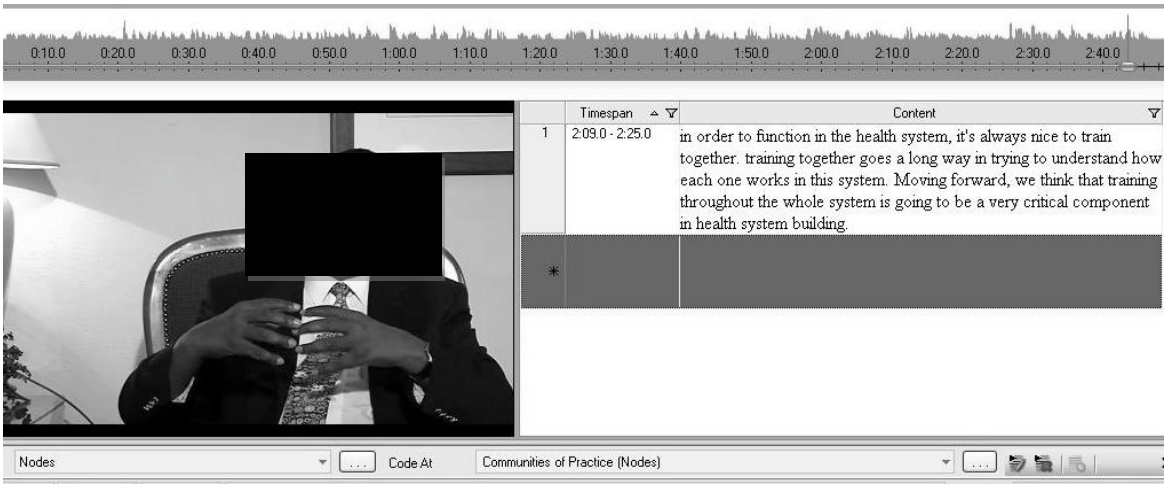

Figure 1. Screenshot of the video analysis layout in NVivo 10

We approached the research analysis by coding for the five core MEPI themes: capacity building, communities of practice, research, retention, and sustainability. Through the process of coding, a node was created when a specific mention of one of the core terms. In addition, after the initial mention of the core term, additional indicators (sub-nodes) were coded within NVivo 10 which provided a much more robust definition of the core themes. The following table (Table 1) shows the thematic nodes and indicators (sub-nodes).

Table 1. Thematic Nodes and Sub-nodes

Themes (nodes)	**Sub-nodes**
Retention	• Faculty • Graduates • Health Worker
Capacity Building	• Quality • Quantity
Research	• Curriculum development • Faculty Development • Grants • Research Training
Communities of Practice	• Community Engagement • Tacit Knowledge • Curriculum Development • Increasing Diversity • Rural Training • Situated Learning
Sustainability	• Collaboration • ICT • Partnership • Scalability • Standards

2.1 Findings and Discussion

The analysis of the discourse resulted in a few additional key themes that emerged from the data. These were e-Learning and Medical Education. The five core themes as defined by not only the MEPI program but many of the principal investigators were 'communities of practice', 'retention', 'capacity building', 'research', and 'sustainability.' Working with these stories led to greater depth of understanding in how these core themes are illustrated in practice (see Table 1). Additionally, a few other themes emerged from the data such as an emphasis on e-Learning, which was not initially cited as a core theme but rather spans across the themes. Medical Education was also coded as a general overarching theme. The sub-nodes for e-Learning included ICTs, and Monitoring and Evaluation. The Medical Education sub-nodes were Formal Education, and Specialist Training.

Capacity building and research were the themes that had the most specific references. A word frequency query showed that the term 'research' was mentioned 48 times in the transcribed data. However, the most commonly coded themes, or nodes, were 'retention' with 37 references in 20 sources, 'capacity building' with 38 references in 23 sources, and 'communities of practice' with 33 references in 23 sources. Within 'communities of practices' terms coded as indicators were 'community engagement', 'curriculum development', increasing diversity', 'rural training' and 'situated learning.' Among these, 'rural training' with 25 references and 'community engagement' with 20 references were most common. For retention, separate indicators were mentioned on the retention of faculty, graduates, and health workers. For 'capacity building' there were more references to quality (39) than quantity (25). This discrepancy alerted us to explore why this might be; it became clear that capacity building in terms of quality was precipitated by an increase in quantity of students, which explains an increased occurrence of references to quality over quantity.

For sustainability—the most difficult term to define—we had to explore outside sources as the specific term was not mentioned frequently enough to build a definition. Etymologically, the word is derived from Latin *sustinere,* which means 'to hold up.' The most common definitions found for the word are 'maintaining' and 'enduring'. Historically, the term has primarily been used to refer to human-environment relations and sustainable economic development (Ratner, 2004); however, in the context of this research, the term was used to refer to making educational interventions sustainable and enduring. We found that the best way to code the term was with its more general definition as 'something that endures.' When we ran a text query on 'endure' and words similar to endure, the most common result was 'capacity.' This suggests that capacity building and sustainability are two themes that are closely related and overlap. In determining sustainability indicators (sub-nodes), we primarily looked for mentions of scalability and implementation of

information and communication technologies. Given the ambiguity of the term, coding in this area was the most organic and open-ended. We found that the most commonly noted factors in sustainability were information and communication technologies (ICTs) and partnerships both with 18 references. This mostly included telemedicine and e-learning initiatives so often the codes were also found under ICTs in the 'elearning' node. Other themes related to sustainability were collaboration, patient care, which coincided with communities of practice, scalability, and standards.

The research theme was coded for 'research training' and 'curriculum development'. Under research training we also included training for responsible research methods. It became clear that there are overlaps between responsible research methodologies and the retention of faculty. A possible explanation for this is that by providing faculty avenues for publication in world-class journals, faculty are incentivized to remain in their respective fields and locations. This is especially true considering an increased emphasis on rural training and retention of faculty and graduates in rural areas. The analysis showed that a focus on rural training and communities of practice have led to greater rates of retention of faculty in rural areas where medical support is critical.

3. CONCLUSION

In addition to functioning as a digital repository for individual accounts, the 58 MEPI videos illustrate a collective intelligence that is distinct. By coding and analyzing each story, we were able to determine the major themes as well as identify areas in need of greater clarity. This research informed a need for better methods of understanding individuals within diverse, deliberative groups, particularly in the area of international partnerships for medical education. This is especially important when considering curriculum development, student retention, and capacity building.

As the purpose of an international symposium is to collaborate with a diversity of participants, communication and transmission of knowledge is critical to the success of the event itself and its aftermath. In the future, it would be informative to compare the number of codes from video analyses with tags from the initiative's website (http://mepinetwork.org). In this way, one could observe the gaps between organizational understanding and actual implementation of individual efforts. In addition, this type of research makes collective intelligence more transparent and enables a continuing dialogue of key issues that emerge from the analysis. As a result, such analysis supports knowledge transfer and has the potential to support better future decisions of stakeholders.

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PERCEPTION AND PRACTICE OF TAIWANESE EFL LEARNERS' MAKING VOCABULARY FLASHCARDS ON *QUIZLET*

Chin-Wen Chien
National Hsinchu University of Education, 521, Nan-Da Road, Hsinchu City 300, Taiwan

ABSTRACT

The new generation is digital natives and they enjoy using the latest technology such as online resources, mobile phones, and applications. Linking technology and English learning can be an alternative to motivate the new generation to learn English. The participants in this study included 76 freshmen in a university in Taiwan. The major data in this study included flashcards, learning records and self-reflection on making vocabulary flashcards. This study examined 76 freshmen's perceptions and practices of making vocabulary flashcards on *Quizlet*. Three major findings were determined. First, participants' word selection was based on not knowing the meanings of the words, rather than by their content or majors. Second, *Space Race* was regarded as the most helpful activity in terms of vocabulary learning. Third, "finding the appropriate definitions for words" was the biggest challenge when making *Quizelt* flashcards. In order to make more effective vocabulary and content words learning through online websites such as *Quizlet*, three suggestions are made: integration of different elements of word knowledge with online word activity designs; direct instruction on specific terms; and learners' awareness of word selection.

KEYWORDS

Content words, Quizlet, vocabulary flashcards, word knowledge

1. INTRODUCTION

Freshmen English is one of the requirement courses in universities in Taiwan. College students in Freshmen English classes major in different subjects, such as education, educational psychology, science, physical education, etc. Through the required textbooks, learners not only learn English words, sentence structures, and reading strategies, but also content knowledge. These freshmen read English textbooks and encounter content words in their disciplines. Vocabulary development is strongly related to academic achievement, so systematic and comprehensive vocabulary instruction is necessary for freshmen.

The new generation is digital natives and they enjoy using the latest technology such as online resources, mobile phones, and applications. Linking technology and English learning can be an alternative to motivate the new generation to learn English. Scholars have investigated the integration of computer and technology into vocabulary instruction and its effectiveness on learners' vocabulary learning (Al-Harf, 2007; Kaur & Hegelheimer, 2005; Yip & Kwan, 2006). Basoglu and Akdemir's (2010) study concludes that using vocabulary learning programs on mobile phones is more effective to improve students' vocabulary learning than using flashcards on paper. These sixty college students in Turkey responded that learning English vocabulary on mobile phones was effective and entertaining. The 78 college students in China in Zhang, Song, and Burston's (2011) study had easy access to mobile phones, so they had repeated exposures to and frequent practice of the vocabulary items in a spaced manner on a daily basis. Therefore, the short-term spaced vocabulary learning via mobile phones became more effective than massed vocabulary learning through the paper medium. Moreover, the personalized mobile English vocabulary learning system can enhance fifteen Taiwanese college juniors' English vocabulary abilities and promote their learning interests. More significantly, the personalized mobile English vocabulary learning system provides a ubiquitous learning environment for English learning without constraints of time or place by mobile devices (Chen & Chung, 2008).

Flashcards are sets of cards that bear information. Language teachers often use flashcards when introducing new vocabulary words. Flashcards usually have words on one side and pictures or definitions on the other side. This study aims to integrate online flashcards into vocabulary learning, particularly as regards English content words. The participants in this study included 76 freshmen in a university in Taiwan. The major data in this study included flashcards, learning records and self-reflection on making vocabulary flashcards. This study focuses on how freshmen can learn content words in their specific disciplines and majors through making vocabulary flashcards on website *Quizlet* and review content words through their mobile phones.

2. METHOD

This qualitative case study aims to discuss freshmen's perceptions and practices of making vocabulary flashcards on *Quizlet*. This study aims to discuss the following issues. First, how did college freshmen choose content words? Second, how did the exercises provided by *Quizlet* help them review words? Third, what problems did freshmen encounter when making vocabulary flashcards on *Quizlet*?

2.1 Setting and Participants

The study was conducted for one semester from September to December 2012. The participants included one instructor and two freshmen English classes of 76 students in a university in Taiwan. The class met two hours per week in 2012 fall semester. The majority of the students were Education majors, followed by Chinese majors. Only one student was from the Department of Applied Science.

2.2 Data Collection and Analysis

The major data in this study included flashcards, learning records and self-reflection on making vocabulary flashcards. In the first class, the instructor explained the steps of making vocabulary flashcards and grading rubric as. Freshmen chose one topic covered in the textbook and made words related to that topic. They practiced three learning activities provided on *Quizlet* (Speller "listen and spell," Learn "read the definition and spell out the words," and Test) and two games (Scatter "match words with definitions" and Space Race "speedy spelling"). The instructor created a community on the *Quizlet* and all the participants could read the flashcards made by other students. Participants were asked to visit flashcards created by other students on the same topic and one different topic. Students could review words either on *Quizlet* or through their mobile phones.

Qualitative data were categorized into units of information. Once the data were coded, tables were constructed to summarize the data and allow it to be checked for patterns and themes based on the research questions.

3. RESULTS AND DISCUSSIONS

The data were analyzed and discussed in terms of word selection, activities on Quizlet, and challenges and problems on making *Quizlet* flashcards, and learning vocabulary via mobile phones and websites.

3.1 Word Selection

In terms of word selection, the top reason why students chose these words was "I did not know the meanings of these words, (27)" followed by "These words were useful (20)," and "These words were important and marked in red in the textbook (9)." Other reasons why students chose these words included "These words looked fun to me (6)," "These words were difficult (5)," "I randomly chose these words (3)."

Learners should be taught how to choose words for making flashcards. They do not have to memorize all words that they do not know from reading an article. Freshmen in specific majors can focus on Tier 2 words. Tier 2 words are those high-utility terms that often change meaning in different contexts, e.g. globe, hemisphere, legend, or region. So they can be familiar with specialized vocabulary in their field.

3.2 Activities on the *Quizlet*

While 37 students found *Space Race* helped them the most in terms of vocabulary learning, 21 students chose *Speller*. Students found that they could not only memorize vocabulary words but also practice typing skills through *Space Race*. Moreover, students liked *Speller*, because they could improve their listening and spelling skills. Twelve students particularly liked *Test*, because they felt that *Test* helped them practice vocabulary through different types of exercises. Only four students liked Scatter and two students felt that they liked all the activities on the *Quizlet* website.

While 37 students found *Space Race* helped them the most in terms of vocabulary learning, on the other hand, 36 students found *Space Race* helped them the least in terms of vocabulary learning. These 36 students complained that they only practiced typing in *Space Race* and the game seemed to have no ending. They disliked Scatter because matching a word and its definition was boring. Moreover, students disliked *Test* because they did not like to be tested as in the traditional paper and pencil test.

Teaching or learning words in isolation or only word meanings is insufficient in building learners' word knowledge, and research demonstrates that building knowledge requires more than accumulating facts about specific elements such as word definitions (Baumann & Kammeenui, 1991; Benjamin & Crow, 2010; Nagy & Scott, 2000; Stahl, 2005). Therefore, teaching vocabulary should go beyond word meanings, and include linguistic, social, and cultural factors of academic language. Teachers should provide definitions, translations, parts of speeches, sentences, word families, synonyms, same word but different meanings, or expression when teaching a word or academic language.

3.3 Challenges and Problems of Making *Quizlet* Flashcards

With regard to the challenges and problems of making *Quizlet* flashcards and playing games, 36 students responded "No problem." One student replied, "It was as easy as eating rice in Chinese (this means it was as easy as pie in English)." The top challenge that students faced while making *Quizlet* flashcards and playing games was "I had difficulties in finding the appropriate definitions for words," followed by "I was too slow at typing words," and "I did not know how to play the games because *Quizlet* was designed in English."

Many words have different meanings (e.g., sage: a wise person; a herb) and serve different functions in different sentences, texts, and even conversations (e.g., "give" in "give a hug," or "give a presentation") (Nagy & Scott, 2000; Stahl, 2005). When creating word sets on *Quizlet*, participants first typed in words and words' related definitions appeared on the screen. They could then choose one definition from among these definitions. Since many words have different meanings, participants found it difficult to choose the appropriate definitions for the words as these words were used in the reading passage.

3.4 Learning Vocabulary via Mobile Phones and Websites

All 76 college freshmen visited the *Quizlet* website only three times during this study and 15 of them visited *Quizlet* website bi-weekly for reviewing words and playing word games. Only eight students used mobile phones to review vocabulary words and did the activities provided by *Quizlet* because they thought *Quizlet* was convenient and fun. The major reason why 57 students did not review vocabulary words through *Quizlet* on their mobile phones was because their mobile phones did not provide Internet access. Seven students did not download this *Quizlet* application. Four other reasons why students did not review vocabulary words through *Quizlet* on their mobile phones included "I liked to write down new words on my notebook," "I was too lazy," "The Internet service was too slow," and "I did not think I can improve my vocabulary by playing games on *Quizlet*."

Compared with traditional book-based vocabulary learning, vocabulary learning through mobile phones is more effective (Nation, 2001), because it allows learners to be exposed to vocabulary items and motivates them to review vocabulary (Basoglu & Akdemir, 2010; Chen & Chung, 2008). Such effectiveness may result from the affordances of the technology such as "immediacy in receiving the learning content, flexibility and portability of learning in time and place and very low cost" (Song, 2008, p. 95). However, without Internet access and the relevant application on mobile phones prevented freshmen in this study from learning and reviewing vocabulary via *Quizlet*.

4. CONCLUSION

This study examined 76 freshmen's perceptions and practices of making vocabulary flashcards on *Quizlet*. Three major findings were determined. First, participants' word selection was based on not knowing the meanings of the words, rather than by their content or majors. Second, *Space Race* was regarded as the most helpful activity in terms of vocabulary learning. Third, "finding the appropriate definitions for words" was the biggest challenge when making *Quizelt* flashcards. In order to make more effective vocabulary and content words learning through online websites such as *Quizlet*, three suggestions are made: integration of different elements of word knowledge with online word activity designs; direct instruction on specific terms; and learners' awareness of word selection.

This case study involved only 76 EFL learners and one English teacher. The small number of participants limits the findings, and means that they are not generalizable to larger English learner populations. Based on the learners' learning records, flashcards, and learners' answers on self-reflection, however, the instructional procedure and suggestions for integration of online tool on vocabulary flashcard learning and teaching do provide practical suggestions for EFL classroom practice.

This study focused on making *Quizlet* flashcards as tools to review and practice vocabulary learning. Different websites offer online tools for learners and teachers to make flashcards, such as *Ediscio*, *Study Stack*, *iKnow*, *Study Blue*, ProProfs, and *Word Dynamo*. Different online tools have different functions and features. A further study can focus on comparisons and contrasts of two vocabulary apps on digital natives' vocabulary learning. Such study can discuss the following issues: first, what features can these online tools or mobile phone applications provide in terms of vocabulary learning? Second, what are the strengths and weaknesses of online tools or mobile phone applications in terms of vocabulary learning and instruction? Third, how do these online tools or mobile phone applications improve digital natives' vocabulary learning?

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A STUDY OF PERCEPTIONS OF ONLINE EDUCATION AMONG PROFESSIONALS

Parviz Ghandforoush
Virginia Tech

ABSTRACT

In this paper we research the perceptions of professionals towards the acceptability of online degree programs in their work profession. Although online education is prolific, its acceptability has been slow and has often been attributed to be a poor quality alternative to traditional brick and mortar education. In this paper we attempt to understand the reasons behind the lack of acceptability and set future directions for remedying some of the adverse perceptions. We develop and research an approach for measuring background, online technology familiarity, characteristics of instruction and distance as primary drivers that would affect online education effectiveness and its resulting perception.

KEYWORDS

Online Education, Perceptions of Quality, Empirical Study

1. INTRODUCTION

Online accessibility to higher education has allowed working professionals, military personnel in isolated locations and those living in rural areas to earn degrees that were wholly inaccessible just a few years ago (Grenzky and Maitland, 2001; Li, 2007). Furthermore a number of traditional institutions report that residential students, seeking to increase their course load, or take advantage of the flexible scheduling and convenience of online programs, account for a significant portion of their online sections (Carnevale and Olsen, 2003; Rungtusanatham, et al., 2004). The objective of the current study is to assess the role that perception plays in the acceptability of online offerings in a higher education setting. Although technology proponents have advocated the use of online learning over the past two decades, its acceptance in academia as a quality offering has been very slow (Adams and Maitland, 2007). Traditional, well-regarded academic institutions have been very skeptical regarding its effectiveness and have converted few if any degree programs to online instruction.

When students' perception of quality, and their performance, were compared during traditional and online deliveries in the same course (the blended or hybrid model), it was found that the online segments were as effective as the traditional segments (Kock, et al., 2007; Meyer, 2003; Ryan, 2000). The next logical step is a comparison of online and traditional offerings of the same course. A study by Gagne and Shepherd (2001) compared two class sections in an introductory graduate level accounting course, one section was traditional, the other online. The performance of both groups was similar. Furthermore, student evaluations of the respective instructors were similar. The only caveat was that students in the online section were less satisfied with instructor availability than the traditional offering.

2. AN EMPIRICAL STUDY OF PERCEPTION

The literature indicates that there are several factors that influence the effectiveness of online instruction. One of the clear indicators seem to be exposure and experience in online education (Sonner 1999). In order for online education to be effective both instructors and students must have experience with online instruction. It is expected that the perception towards online education is influenced by experience. Other factors influencing the effectiveness of online instructions are technology background, familiarity with online technology, and distance.

2.1 Online Education – A Case Study

Around the year 1999 the Commonwealth of Virginia in the United States asked one of its large state universities to develop a fully online degree program in information technology to meet the growing demand for IT professionals in the Commonwealth. The university responded to the need by developing a fully online Masters in Information Technology program. This program is an interdisciplinary degree program consisting of courses in business, computer science, and electrical engineering. The curriculum design for such a program required consideration to be given to variation in content and format among the three disciplines. For example, courses in computer science and engineering typically involve higher degree of quantitative and scientific content than those taught in business. Often computer science and engineering courses rely heavily on lecture-based presentations and hands-on laboratory experiments. Whereas, business courses involve greater level of faculty-student interactions on such things as group presentations and case analyses.

Courses in the program are designed to meet live over the internet using software called Centra Symposium allowing direct interaction between students and faculty. These sessions are recorded allowing students to play and replay the lecture sessions as needed. Course materials are posted on software like Blackboard. To create a classroom "feel" the online technology used for instruction enables student teams to set up discussion forums. It permits texting between the instructor and students during class meetings, and enables case and project presentations in real-time by student groups using PowerPoint slides or dynamic web pages. For example, the Cyber Security course within the engineering discipline includes students accessing a virtual computer to hack a pre-designed system (environment). This simulation activity is performed real-time by students while simultaneously participating in the live class lectures delivered online.

Initially there was faculty resistance to the program based on the perception that a fully online program would not be able to meet desirable quality standards. However, because of the Commonwealth's mandate the program moved forward and was successfully implemented. The program has enjoyed several years of success and has continued to grow. Quality issues have been resolved using technology and appropriate training of faculty. To date over 600 students have graduated from the program and enrollments keep increasing.

Based on the success of the online implementation of this program, it was then considered for possible delivery to students in Mumbai, India in collaboration with a reputed business school. In spite of India's rapid growth in the information technology area, there has been little acceptance of online degree programs in that country. As such, program delivery format was modified from a purely online format to a hybrid approach. In this delivery method at least 30% of the course is offered online and the remainder is delivered using traditional in-class instructions by U.S. faculty traveling to Mumbai. Over the last few years, following the initial offering of the program in India, Indian students and faculty have developed a favorable perception toward online courses and are willing to accept that online programs can be offered without jeopardizing quality. As an indicator of program quality, students in India have been placed in highly desirable jobs and are recruited into corporate positions that offer competitive salaries similar to graduates of highly respected institutions in India. Another measure of success for this program is the exponential growth in the number of applications received from prospective students. Similar to their counterparts in the U.S., students in India are able to participate in class meetings with the faculty lecturing online from the U.S. home base. Course materials, classroom discussions, lectures and presentations, and other requirements have remained identical between the two groups despite the online format and geographical and cultural differences.

Despite the favorable perception of the program among applicants and students, and the successful placement of its graduates in the IT industry, it is not yet clear whether the perception and acceptability of online education among corporate managers and executives who hire graduates of such programs has improved. To examine the perception of professionals with respect to effectiveness of online degree programs data was collected by trained investigators in data collection using a questionnaire. One hundred and fourteen professionals agreed to participate in the experiment and were interviewed.

This paper will analyze the perception of online learning using data collected from the subjects described in the case study. Using regression analysis the relationship between experience, technology background, familiarity with online learning, professional characteristics and distance are tested and analyzed. Results of the study indicate that with the exception of background in information technology all other factors play an important role in the perception of learners toward online courses. These results will be demonstrated in more detail in the conference presentation and recommendations will be made for possible extensions to the methodology used in this paper.

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THE DESIGN OF THE TEST FORMAT FOR TABLET COMPUTERS IN BLENDED LEARNING ENVIRONMENTS: A STUDY OF THE TEST APPROACH-AVOIDANCE TENDENCY OF UNIVERSITY STUDENTS

Takeshi Kitazawa
School of Motivation and Behavioral Sciences, Tokyo Future University

ABSTRACT

This study analyzed effective test formats that utilized tablets for tests in university information basic subjects in blended learning environments. Specifically, three types of test were created: (1) multiple-choice, (2) fill-in-the-blank, and (3) a mixture of multiple-choice and fill-in-the-blank. An analysis focusing on university students' approach-avoidance tendency was conducted to see how the question formats affected the students' motivations toward the tests. The results showed that regardless of the test approach-avoidance tendency, the students had a low perception of their understanding of the content of multiple-choice tests, even though they reported that they did not feel burdened in answering the questions. Additionally, although the students had a high perception of knowledge retention with fill-in-the-blank questions, their willingness to answer the questions and the percentage of questions they answered correctly were low. On the other hand, students had a high perception of continuity and a high percentage of correct answers on the test with a mixture of multiple-choice and fill-in-the-blank questions. Additionally, they had a high perception of knowledge retention in the mixed test, suggesting that this format had the strongest effect among the three test formats.

KEYWORDS

Tablet computer; test format; test approach-avoidance tendency; motivation; information education

1. INTRODUCTION

As a result of faculty development being made compulsory, Japanese universities have been asked to improve their classes with the aim of promoting student learning outside of class (i.e., after-class hours learning) as well as improving student academics and knowledge retention (Central Education Council, 2008). Furthermore, for information technology (IT), a subject that became compulsory for high school in 2003, the number of subjects and teaching content were revised in the 2013 academic year. Therefore, it is necessary to improve information education classes that are aimed at new students enrolled in IT courses. Blended learning, which integrates face-to-face lessons with an e-learning system, has been proposed as a method to resolve this issue (e.g., Akkoyunlu et al., 2008). It is anticipated that constructing an environment in which students can access an e-learning system using mobile terminals will encourage after-class hours learning, as it will allow student to engage in learning anywhere and at any time.

Moreover, administering tests effectively can be considered as a method of knowledge retention (Bloom, 1971). For example, when teachers give advance notice of a test, students are externally motivated to study, which promotes their learning (Kuramitsu, 1980). Based on this finding, one can expect that asking students to take tests in a mobile environment outside of class hours will produce a knowledge retention effect and promote after-class hours learning. However, since learners' perception of tests, or their perception of the objective of conducting tests and their roles, affects their learning behaviors, it is important to administer tests that take into account learners' approach-avoidance tendencies (Suzuki 2011).

Based on the above findings, the authors previously constructed a blended learning environment by integrating face-to-face classes and an e-learning system that utilized mobile terminals, focusing on the test approach-avoidance tendency in first-year university information education classes. Having constructed this environment, the authors explored the motivations toward and learning effects of tests conducted using

mobile terminals outside of class hours; however, an analysis of the validity of test formats has not yet been conducted (Kitazawa et al., 2012). Therefore, this study experimentally constructed a blended learning environment by integrating face-to-face classes with an e-learning system using mobile terminals in first-year university information education classes and gave tests using a tablet (iPad), a type of a mobile terminal. This study then aimed to explore the relations between test formats and the test approach-avoidance tendency of university students and their motivations toward tests.

2. METHOD

2.1 Participants

The participants were 60 Japanese university students (30 men and 30 women). The research was conducted on October 14, 2012. The students attended a lecture on the introductory section of the course “Introduction to Information Science” was held. The lecture lasted approximately 15 minutes; it was designed to resemble an information education class held during the first year of the university course.

2.2 Administering Tests via Tablets

After the lecture was over, the students took a test using a tablet terminal. The tests were distributed during after-class hours. The tablet terminal used in this study was the iPad (3rd generation), 16 GB, Wi-Fi model.

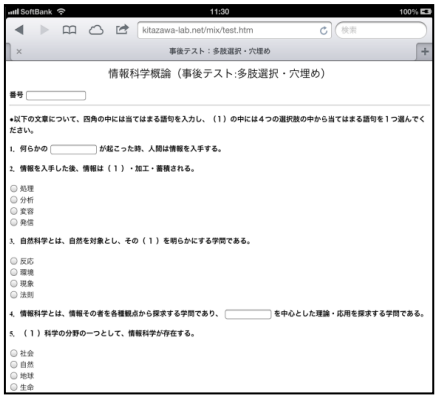

Figure 1. A mixed test format of multiple-choice and fill-in-the-blank questions

Although there are various types of test formats, this study focuses on multiple-choice and fill-in-the-blank formats, which are considered easy to use autonomously. Each participant took three tests, each with a different format: (1) multiple-choice, (2) fill-in-the-blank, and (3) a mixture of multiple-choice and fill-in-the-blank questions (Figure 1). In consideration of the order effect, the participants were divided into three groups, with the orders of test taking different for each group. Regarding the number of questions, since five questions seemed to be too few (Kitazawa et al., 2012), 10 questions were created for each question format in this study. Each of the three tests took approximately 20 minutes to complete.

2.3 Questionnaire

To analyze the university students’ test approach-avoidance tendency, the test approach-avoidance tendency scale (a 7-item scale totaling 10 questions) developed by Suzuki (2011) was used as a pre-questionnaire. A post-questionnaire survey (a 5-item scale totaling 20 questions) was administered to assess the students’ “burdens of taking tests,” “willingness to take tests,” and “self-efficacy” as their motivation regarding tests (approx. 10 minutes). The data were analyzed by an overall trend analysis comparing them with the median values. A t-test was also conducted to analyze the differences between approach-avoidance tendencies.

3. RESULTS

3.1 Pre-questionnaire

A principal component analysis of the results of the test approach-avoidance scale with factors limited to two was conducted with the data of 58 out of the 60 participants, after excluding two participants with missing data. The numbers of people with a test-approach tendency or a test-avoidance tendency, respectively, were counted. There were 29 people with a test-approach tendency and 29 with a test-avoidance tendency.

3.2 The Percentage of Correct Answers in Tests

A two-way factorial analysis of variance was conducted on the test-approach and test-avoidance tendencies for the correct answer rates of the tests for each format of multiple-choice questions (average of test approach: 80.7, average of test avoidance: 77.9), fill-in-the-blank questions (average of test approach: 55.9, average of test avoidance: 54.8), and mixture (average of test approach: 76.2, average of test avoidance: 74.5). The results showed a significant main effect of test formats ($f(2,112) = 32.7$, $p < .01$). When Tukey's multiple comparison test was conducted thereafter, a significant difference was found between the average values of multiple-choice and fill-in-the-blank questions ($p < .01$), and between fill-in-the-blank and a mix of multiple-choice and fill-in-the-blank questions ($p < .01$) for both test approach tendency and avoidance tendency. Furthermore, no significant difference was found between test approach tendency and avoidance tendency.

3.3 Post-questionnaire

Table 1 shows the results of the post-test questionnaire survey on the burden of test-taking, willingness toward tests, and self-efficacy. To analyze the overall trends, comparison analyses were conducted with a median value (3.0) using a t-test for the average values of each item. A significant difference was found for 15 items at below the .01 significance level. A significant difference was found for 2 items at the .10 significance level.

Among the items related to multiple-choice questions, items such as (1) "Taking tests with only multiple-choice questions is a burden (reversed item)" (average value: 4.22) ($p < 0.01$) had significantly high values. This shows that most students do not think taking tests with only multiple-choice questions is a burden. On the other hand, items such as (16) "By taking tests with only multiple-choice questions, I have become able to explain to others what I have learned in this class (average: 2.19) ($p < .001$)" had significantly low values. This shows students perceive that tests with only multiple-choice questions do not promote knowledge retention and sufficient understanding. Concerning the items related to fill-in-the-blank questions, items such as (8) "Tests with only fill-in-the-blank questions lead to knowledge retention (average: 3.93) ($p < .001$)" had significantly high values. This shows that students that perceive tests with a fill-in-the-blank format achieve knowledge settlement. On the other hand, items such as (2) "Taking tests with only fill-in-the-blank questions is a burden (reversed item) (average: 3.93) ($p < .001$)" had significantly low values. This suggests that the fill-in-the-blank format is a burden and has little test continuity.

Furthermore, concerning the post-test survey questionnaire results, the t-test analysis did not show a significant difference in any item when the difference between test approach tendency and avoidance tendency was analyzed. Therefore, when tests were distributed during after-class hours, using a tablet within an autonomous testing situation, among the three test types, the mixture of multiple-choice and fill-in-the-blank questions showed test continuity and knowledge retention effects, regardless of whether the student tendencies were test-approach or avoidance.

4. CONCLUSION

This study analyzed the effectiveness of test formats that utilized tablets for tests in university information foundation subjects in a blended learning environment. Specifically, three types of test were created: (1) multiple-choice, (2) fill-in-the-blank, and (3) a mixture of multiple-choice and fill-in-the-blank. An analysis focused on university students' approach-avoidance tendency was conducted to investigate how the question formats affected students' motivation toward the tests. The results showed that regardless of the test approach-avoidance tendency, students showed a low understanding of the content of multiple-choice tests,

even though they did not feeling burdened in taking them. Additionally, for fill-in-the-blank tests, although the students had high perceptions of their knowledge retention, their willingness to answer the questions and the percentage of questions they answered correctly were low. On the other hand, students had a high perception of continuity and the percentage of correct answers was high on the test with a mixture of multiple-choice test and fill-in-the-blank questions. Additionally, they also perceived the mixed test to give them high knowledge retention, suggesting that this format had the strongest effect among the three.

Future research should include exploring a valid number of questions. Furthermore, since smartphones have become prevalent as mobile terminals, it is necessary to investigate the difference between smartphones and the tablets used in this study (iPad: 3rd generation). In addition, a long-term study in actual classroom environments, and not just within the experiment environment, is required.

Table 1. Results of the post-questionnaire (Comparison analysis with medium values)

	Items	Avg.	SD	
1.	Taking tests with only multiple-choice questions is a burden (reversed item).	4.22	.65	***
9.	Tests that combine multiple-choice and fill-in-the-blank questions lead to knowledge retention.	3.95	.71	***
8.	Tests with only fill-in-the-blank questions lead to knowledge retention.	3.93	.99	***
14.	Tests with only fill-in-the-blank questions make me feel that I have sufficiently understood what I have learned in this class.	3.88	.94	***
4.	Tests with only multiple-choice questions make me answer the questions willingly.	3.83	.96	***
10.	Tests with only multiple-choice questions are easy to answer.	3.78	1.04	***
15.	Tests with both multiple-choice questions and fill-in-the-blank questions make me feel that I have sufficiently understood what I have learned in this class.	3.78	.86	***
17.	By taking tests with only fill-in-the-blank questions, I have learned to explain to others what I have learned in this class.	3.67	1.00	***
12.	Tests with both multiple-choice questions and fill-in-the-blank questions are easy to answer.	3.50	.88	***
6.	Tests with both multiple-choice questions and fill-in-the-blank questions make me answer the questions willingly.	3.43	.92	**
18.	By taking tests with both multiple-choice questions and fill-in-the-blank questions, I have become able to explain to others what I have learned in this class.	3.43	.94	**
3.	Taking tests with both multiple-choice and fill-in-the-blank questions is a burden (reversed item).	3.17	.94	
19.	I sufficiently understood what I learned in this class.	3.12	.94	
11.	Tests with only fill-in-the-blank questions are easy to answer.	3.02	1.12	
7.	Tests with only multiple-choice questions lead to knowledge retention.	2.72	1.07	+
13.	Tests with only multiple-choice questions make me feel that I have sufficiently understood what I have learned in this class.	2.71	1.14	+
5.	Tests with only fill-in-the-blank questions make me answer the questions willingly.	2.64	.93	**
20.	I am confident of the content I learned in this class.	2.57	.84	***
2.	Taking tests with only fill-in-the-blank questions is a burden (reversed item).	2.24	.94	***
16.	By taking tests with only multiple-choice questions, I have become able to explain to others what I have learned in this class.	2.19	.89	***

*** $p < .001$; ** $p < .01$; + $p < .10$

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Posters

BLENDED LESSONS OF TEACHING METHOD FOR INFORMATION STUDIES IN WHICH STUDENTS PRODUCE A LEARNING GUIDANCE PLAN

Isao Miyaji
Faculty of Informatics, Okayama University of Science
Ridai-cho 1-1, Kita-ku, Okayama-city, Okayama, Japan

ABSTRACT

Adopting exercise-making and evaluation activities, we conducted a teaching method of Information Studies which is a teaching-training course subject. We surveyed the learners' recognition rate of terms related to lessons at both the beginning and the end of lessons. Then we tested the significance of the differences between both rates. Those results revealed that the participants' amount of knowledge had increased significantly. The participants' awareness related to ability had surveyed. Significant difference tests about their awareness revealed that they had improved significantly.

KEYWORDS

Teaching method for information studies, Teaching guidance plan, Evaluation activity, E-learning, Blended lesson

1. INTRODUCTION

Academic education using manufacturing and evaluation activities to cultivate students' ability to solve problems has been advanced by the author (Miyaji 2009). To help students taking college lecture courses, methods developed in earlier studies supported them so that they can prepare and review their lessons anywhere and anytime on a personal basis, thereby increasing learning opportunities for various students (Miyaji 2011). As a part of that effort, the author implemented blended lessons related to the introduction of computer science. Moreover, development of lectures combining lecture process notebooks, e-learning, and a quiz elicited some effects (Miyaji et al. 2005). In Japan, such blended learning lessons are often conducted. Mutual reinforcement between lectures and e-learning is beneficial (Miyaji 2009).

Some have compared and reported trial runs of educational curricula for teacher-training course subjects (Matsuda 1999). However, few reports have described educational methods that have been actually introduced, or their effects (Miyaji 2011).

An intensive training course for teaching methods used in information studies was conducted at A University. It uses blended lessons, in which students can learn lesson contents using lecture slides with e-learning outside lessons. We report herein that such lessons increased their amount of knowledge and improved their awareness.

2. CONTENTS AND PLANS OF LESSONS

A University, the teaching methods course for Information Studies is a teacher-training subject. The methods are taught in this subject so that students in high school collect proper information from a large amount of information, subsequently they can sort it and can use the "information". For students in high school to solve problems, they must be able to build their own knowledge from that collected information, to communicate it properly with others, and to transmit it to others. In other words, teachers in Information Studies must be able to have their students in high school think about large amounts of information, conduct repeated trial and error, and improve what they have worked on and expressed. In the lessons, the teaching methods were taught the students based on a textbook (Miyaji 2004).

The purposes of the lessons offered at A University were that a student came to be able to do the following: to know teaching goals and composition of the subject "information," to know the subject outline and instruction points, to master practical method, to teach students Information Studies, and then to evaluate their knowledge. The students must be able to understand the teaching method for information studies and be able to produce a teaching guidance plan under which they will actually conduct classes. Additionally, they must increase their necessary capability to administer and conduct classes, and to master the capability to solve problems that can be predicted to occur in information studies lessons.

The information studies teaching method was conducted in a closely packed series of 15 lessons of 90 min for four days. Using a textbook (Miyaji 2004), face-to-face classes were conducted by projecting slides on the screen. The contents were given in order of the textbook's chapters 1–7. During the fourth, eighth, and twelfth lessons, the last lessons of the respective days, assignments related to a learning guidance plan were done: the students were asked to produce a report and submit it. Furthermore, by the twelfth lesson of the third day, they were obligated to produce their own learning guidance plan including PowerPoint (Microsoft Corp.) slides.

For the thirteenth lesson of the fourth day, they were asked to make a presentation with the slides and to evaluate it with other students. For the fifteenth (final) lesson, the final examination was administered: 15 students took the test.

To intensify the effects of this lecture and to enable the students to make a peer assessment, e-learning functions were added as follows: (1) learning with 254 lecture slides; (2) documents and templates of seven kinds which can be downloaded; (3) exercises of seven kinds to submit and be uploaded; (4) uploading opinions to a bulletin board and browsing them; and (5) sending question mail.

Students were asked to download the template to produce a report. Later, they submitted the report printed on A-4 size paper during the lesson period.

We requested that they make and submit reports by the four exercises: (1) explain the reason why they want to be an information studies teacher; (2) produce a learning guidance plan for an information studies' lesson; (3) make slides for the learning guidance plan; and (4) write a presentation manuscript for the learning guidance plan and then present. Only in terms of the presentation in assignment 4 did we have them make peer assessments.

With exercise 2, participants were asked to design concrete lessons in Information B and Information C so that their students can solve their problems. They were requested to make a learning guidance plan for two-unit lessons (100 min). To the 16 items, participants filled out a file presented on Excel software (Microsoft Corp.).

With exercise 3, based on exercise 2, the students compiled their teaching guidance plan to be executed in two unit hours (100 min) on six slides of PowerPoint software (Microsoft Corp.).

With exercise 4, students presented their own prepared slide on the screen in front of other students after making a presentation manuscript. The allotted time was five minutes, of which three minutes were allotted for the presentation and two minutes were allocated for questions and answers. Subsequently, they mutually evaluated what had been presented. After the evaluation, they filled out their evaluations of others on the evaluation sheet and submitted it.

3. ANALYTICAL RESULTS AND DISCUSSION

After conducting lessons of teacher-training methods for Information Studies, we surveyed the recognition rate to ascertain the change of the participants' knowledge amount and conducted a consciousness survey to elucidate the extent of change of their awareness. We analyzed the data using tests of significant difference. We explained the results.

With regard to 50 terms related to the lecture content of teacher-training methods for information studies, we conducted a pre-survey of the recognition rate at the first lesson and the post-survey at the fourteenth lesson. All 15 participants responded to both surveys. The recognition rate responses were the following three: 1. I do not know it; 2. I do not know the details, but I have heard of it; 3. I know it.

The pre-average and post-average rating values were, respectively, 1.9 and 2.8. From results of *t*-tests corresponding to 50 items, we were able to infer significant differences. Because the recognition rate of the terms became higher overall, it was found that the amount of knowledge about the terms had increased.

In terms of the pre-average and post-average rating values, the results of the *t*-tests corresponding to each term are presented. Results show significant differences for 45 out of 50 terms. From this result, we infer that knowledge about the terms increased.

In terms of the awareness related to the ability of 30 items, we conducted a pre-survey at the first lesson and a post-survey at the fourteenth lesson (Miyaji 2005). The rating scale values were of following nine stages: 1. no ability; 3. little ability; 5. a little ability; 7. not a little ability; 9. sufficient ability.

Respondents to both the pre-survey and the post-survey were 15. The results of *t*-tests assessing between the pre-rating scale value and post rating scale value for 30 items related to the ability showed a significant difference: awareness related to ability had improved as a whole.

The *t*-tests between pre-average and post-average rating scale values of each item of awareness related to ability were conducted compared, revealing significant differences for 11 items. Furthermore, we found a tendency of significant differences for three items.

One purpose of the lecture is to develop the ability necessary to conduct classes. In other words, it is to solve problems that might arise when giving lessons in information studies. Because “ability to solve problems” and the rating scale values related to many other abilities increased, results suggest that the abilities necessary to conduct classes in information studies courses should have also increased.

4. CONCLUSION

For students of teacher-training in the information studies at A University, we requested that students use e-learning, produce a learning guidance plan and its slides, and give a presentation. Furthermore, we had them mutually evaluate the presentations along with other students.

Analysis of the educational information obtained through conduct of those classes revealed the following:

(1) Because the recognition rate survey of the terms showed that the knowledge amount of the terms increased overall and the knowledge amount of almost terms increased, it suggests that the students became to be able to understand the teaching method for information studies and be able to produce a teaching guidance plan.

(2) Because a survey of awareness related to ability showed that the awareness improved significantly overall, it suggests that the students have increased their necessary capability to administer and conduct classes, and to master the capability to solve problems that can be predicted to occur in information studies lessons.

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FACTORS AFFECTING TEENAGER CYBER DELINQUENCY

Young Ju Joo, Kyu Yon Lim, Sun Yoo Cho, Bo Kyung Jung and Se Bin Choi
Ewha Womans University
Ewhayeodae-gil 52, Seodaemun-gu, Seoul 120-750 Korea

ABSTRACT

The study aims to investigate structural relationships among teenagers' peer attachment, self-control, academic stress, internet usage time, and cyber delinquency. The data source was the Korea Youth Panel Survey, and the responses from 920 teenagers in the 12th grade provided the study data. Structural equation modeling was used for the analysis. The results indicated that teenager self-control significantly affected the internet usage time. Also, peer attachment, self-control, academic stress, and internet usage significantly affected teenager cyber delinquency. The research results imply that the development of peer attachment and self-control is important to reduce cyber delinquency.

KEYWORDS

Internet usage; cyber delinquency; academic stress; self-control

1. INTRODUCTION

Internet has become a critical part of our daily lives. Recent research reported that 99.9% of the Korean teenagers are using the internet (Korea Internet & Security Agency, 2011). The issue here is that some of the teenagers may use the internet in an inappropriate manner, which results in cyber delinquency, for example, distributing false or misleading information, sharing software illegally, and being aggressive ignoring netiquettes. This study tried to understand the phenomenon of teenager cyber delinquency by investigating predicting variables for online misbehaviors. From the theoretical perspective, Hirschi (1969) proposed 'social bonding theory', focusing on attachment, commitment, involvement, and belief as critical factors for reducing teenager delinquency. Bowlby (1982) also claimed that attachment, especially with peers, plays an important role for teenagers to shape their behavior. On the other hand, Gottfredson and Hirschi (1990) suggested 'general theory' to explain self-control as a predicting factor for delinquency, and the significant effect of self-control on delinquency has been echoed by previous studies such as Pratt and Cullen (2000), and Higgins (2004). 'General strain theory' by Agnew (1992) and 'opportunity theory' by Osgood, Wilson, O'Malley, Bachman, and Johnston (1996) proposed, respectively, that stress level and the exposure to the opportunity would affect the degree of delinquency.

Based on the extensive literature review, researchers suggested peer attachment, self-control, academic stress, internet usage time as tentative predictors for cyber delinquency. Prior research in the context of teenager cyber delinquency indicated that peer attachment and self-control negatively predicted the internet usage time and cyber delinquency (e.g. Higgins, 2004; Mesch, 2002). Leung (2007) claimed that teenagers are likely to reduce their stress level by surfing the internet and interacting with peers online, which is closely related to the hours spent online. Lastly, Ybarra (2004) reported that the internet usage time significantly predicted cyber delinquency.

Hence, the researchers investigated the causal relationships among the suggested variables. Research questions are as follows: (1) Do teenagers' peer attachment, self-control, and academic stress level predict the internet usage time? (2) Do teenagers' peer attachment, self-control, academic stress level and the internet usage time predict cyber delinquency?

2. METHODOLOGY

The data source was the Korea Youth Panel Survey, and the responses from 920 teenagers in the 12th grade provided the study data. Survey participants were sampled by stratified random sampling in terms of the province. Demographically, 58% of the respondents were male and 42% female.

Survey questionnaire for the variables, peer attachment, self-control, academic stress, internet usage time, and cyber delinquency was developed by Korea National Youth Policy Institute, and develop and reviewed by academic and field experts. Regarding peer attachment, self-control, and academic stress, Cronbach's α from the study data ranged from .73 to .81, and used 5 point Likert scale. Internet usage time was measured by hours spent for the internet per day, while cyber delinquency was measured by the frequency of behaviors relevant to the indicators of cyber delinquency during the recent 12 months.

Structural equation modeling was used for the analysis, and SPSS and AMOS were used.

3. RESULTS

Descriptive analysis indicated there were significant correlations among all the variables at the significance level of .05, and the assumption of normal distribution was met. As factor analysis confirmed that each variable is unidimensional, item parceling was adopted to minimize measurement errors in structural equation modeling.

As a result of maximum likelihood estimation and structural model testing, the relationships between peer attachment and internet usage, and between academic stress and internet usage were insignificant. Therefore the modified model was tested again, and it provided a good fit to the data (e.g., TLI= .990; CFI= .995; RMSEA= .019 (.000~.040)). Figure 1 presents the modified model with significant path coefficients.

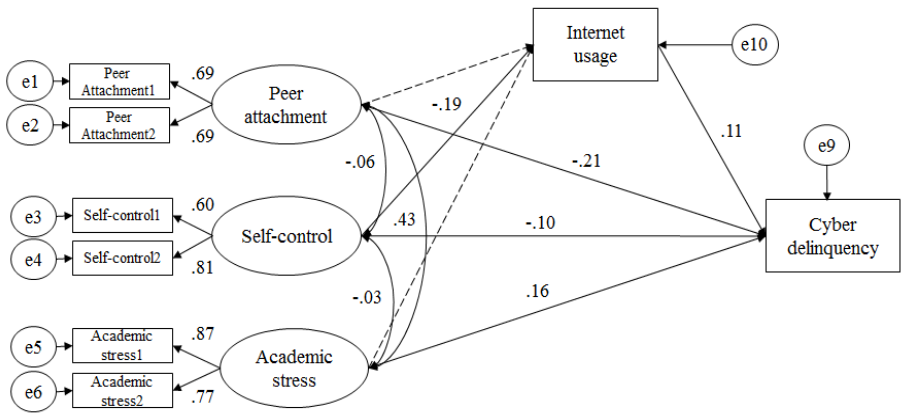

Figure 1. Modified model with standardized path coefficients

4. CONCLUSION

The researchers tried to provide more elaborated understanding on teenager cyber delinquency. Unlike the results from prior studies, peer attachment and academic stress did not affected internet usage time. It is likely that peer attachment these days is maintained or even increased through online social network services. Academic stress is another variable reflecting research context. As Korean teenagers, especially 12th graders, are highly focused on college entrance exam, they may try to reduce the hours spent online regardless of their stress level.

Overall, the results provide implications on which aspects we should focus on in order to intervene teenager cyber delinquency. Also, the results indicate that we should explore peer attachment from a new perspective, since a variety of social network services are influencing the perceived level of attachment with peers online and offline as well. Further studies are required to investigate more elaborated model with social and environmental variables as predictors.

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PERSONALIZED VIRTUAL LEARNING ENVIRONMENT FROM THE DETECTION OF LEARNING STYLES

Martínez Cartas, M. L.*, Cruz Pérez, N., Deliche Quesada, D. and Mateo Quero, S.
Department of Chemical, Environmental and Materials Engineering
Higher Polytechnical School of Linares. University of Jaen
C/ Alfonso X, el sabio,28-23700 Linares (Jaen) Spain
Phone number: +34953648546*

ABSTRACT

Through the previous detection of existing learning styles in a classroom, a Virtual Learning Environment (VLE) has been designed for students of several Engineering degrees, using the Learning Management System (LMS) utilized in the University of Jaen, ILIAS. Learning styles of three different Knowledge Areas; Chemical Engineering, Materials Science and Environment Technology, have been analyzed. From learning styles detected in the classroom, the introduction of optional and compulsory activities to be developed by the student permits to develop the VLE. In this "optionality", the student can choose the activities more suitable to his learning style. As a consequence of the implementation of the virtual learning style, the assessment results must improve, as well as the students' motivation because they are selecting their particular learning way.

KEYWORDS

Learning styles, e-learning, virtual learning environment

1. INTRODUCTION

In the context of the European Higher Education Area (EHEA) an important change in the way of carrying out the teaching-learning process is necessary. So that the virtual learning plays a primordial role making possible the following of the subject in case of the student cannot attend to the class, at the time as it involves a valuable complement during the class.

Learning styles represent the personal way that each person has in order to acquire learning. The detection of them in the class is going to allow us to design a virtual learning environment where the considered activities were oriented to the detected styles, basically. This fact has to have positive effects in the assessment outcomes of the students and in the process of knowledge acquisition [1].

2. DEVELOP

The learning styles analysis has been realized in three Engineering subjects belonging to the Knowledge Areas of Chemical Engineering, Material Science and Environment Technology in the Higher Polytechnical School of Linares, corresponding to the degrees of Chemical Engineering, Mechanical Engineering and Mining Engineering, respectively.

The learning management system ILIAS is available for all students registered for this University, in this VLE is used to distribute contents of the subjects and to propose the different activities. It is used as a mean of on-line collection of the proposed activities, as a mean of evaluation through on-line test and as a mean of communication between students and lecturer and among students. Both a complement of classroom teaching and in distance learning course, the use of this learning management system supposes a fundamental tool to develop the VLEs.

2.1 Detection

The detection process of learning styles has been done using the Honey-Alonso Learning Styles Survey [2] based on the learning styles classification of Honey and Mumford [3] where four styles have been defined: activist, reflector, theorist and pragmatic.

The Table 1 shows the activities to which the student will react positively from the general behavior expected for each type of learning styles [4], considering the personal characteristics of the student. Besides, the list of proposed activities in the virtual learning environment designed.

Table 1. Suitable activities for each learning style and proposed activities

Learning Style	Activity types	React positively to:	Proposed activities
Activist	Activities that demand a prompt solution (e.g., solving problems)	▪ Action learning ▪ Business game simulations ▪ Job rotation ▪ Discussion in small groups ▪ Role playing ▪ Training others ▪ Out door activities	• Provide the student specific information: facts, data, results • Provide industry media abstract concepts: principles, theories, mathematical models • Methods of resolution of practical problems, with an emphasis on understanding the same • Observation of surroundings, empirical experimentation, attention to detail. • Provide concrete examples of the phenomena the theory describes or predicts • Application of theoretical models • Using diagrams, graphics, pictures, sketches, films; before, during and after the presentation of verbal material • Provide demonstrations. • Use computer-assisted instruction • Assign some drill exercises to provide practice in the basic methods being taught but do not overdo them and some open-ended problems • Motivate learning. Talks and conferences with graduates, which allow you to view the implementation of studies. • Theoretical models applications • Practical troubleshooting methods with an emphasis on understanding the same • Empirical experimentation • Provide intervals for students to think about what they have been told. • Assign some drill exercises to provide practice in the basic methods being taught but do not overdo them and some open-ended problems • Given students the option of cooperating on homework assignments to the greatest possible extent. • Theoretical models applications
Reflector	Activities to think before acting (e.g., developing a project)	▪ E-learning ▪ Learning reviews ▪ Listening to lectures or presentations ▪ Observing role plays ▪ Reading ▪ Self-study/self-directed learning	
Theorist	Activities with clear objectives and relative to a schema (e.g. searching of information or interpretation of a theory)	▪ Analytical reviewing ▪ Exercises with a right answer ▪ Listening to lectures ▪ Self-study/self-directed learning ▪ Solo exercises ▪ Watching 'talking head' videos	
Pragmatist	Activities with practical applications (e.g. laboratory sessions).	▪ Action learning ▪ Discussion about work problems in the organisation ▪ Discussion in small groups ▪ Problem-solving workshops ▪ Group work with tasks where learning is applied ▪ Project work	

2.2 Results

After carrying out the analysis of results in each one of the classrooms, it has been observed that although every learning styles are present, only two styles prevails over the rest; the theorist and reflector styles. Figure 1 shows the distribution of different learning styles in a classroom corresponding to the Knowledge Area of Environmental Technology, it is possible to see some isolated cases of predominance of activist and pragmatic styles, but theorist and reflector styles are more important. This behavior also has been observed in the others engineering class studied (Mechanical, Chemical and Mining Engineering).

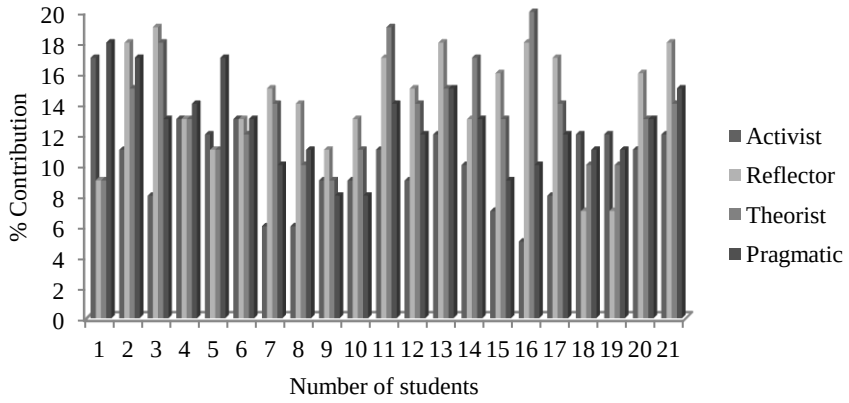

Figure 1. Distribution of different learning styles in a classroom

When the comparison of the learning styles is realized among Knowledge Areas the reflector and theorist styles stand out the others styles (Figure 2). In case of Chemical Engineering students the theorist style is more important, while in Materials Science and Environmental Technology the reflector style prevails.

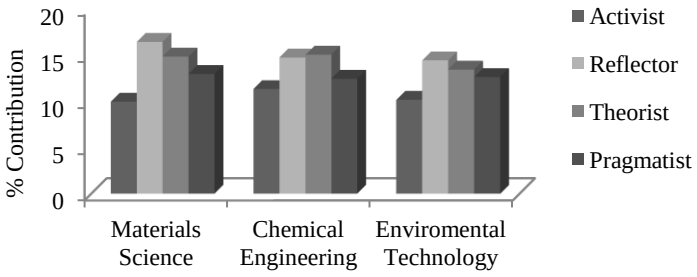

Figure 2. Distribution of different learning styles in each analyzed knowledge area

Considering all evaluated engineering students in the comparison, the reflector styles is the more significant style followed by the theorist style and the activist is the style with less representation. This behavior is shown in Figure 3.

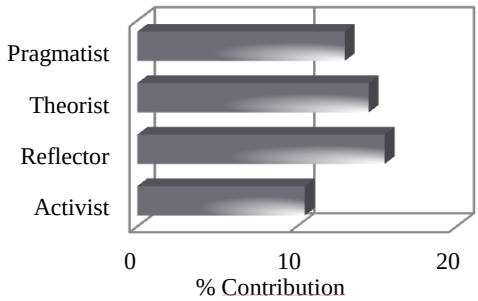

Figure 3. Overall distribution of different learning styles

3. CONCLUSIONS

The four learning styles defined by Honey and Mumford are present in the evaluated classroom, however and the opposite of what it is expected for Engineering students [5] the more significant styles are the reflector and the theorist.

Making the comparison among Knowledge Areas, in Materials Science and Environmental Technology the reflector style is the more widely represented, while the theorist style prevails in case of Chemical Engineering students.

In the Virtual Learning Environment designed, the on-line teaching using the Learning Management System, ILIAS perform a fundamental role as a mean to show contents and activities. The proposed activities must be oriented to the four learning styles, but the activities that involve thinking before acting and activities with clear objectives, more connected with the reflector and the theorist styles, must be more significant.

Considering the characteristics of the taught subjects, it is necessary to raise mandatory activities closer to activist and pragmatic styles, nevertheless in the designed VLE the possibility of choosing others optional activities, adapted to the learning special characteristics of the student, will allow improving the learning and assessment results, unavoidably.

Though the development of a Virtual Learning Environment involves an increase of the teacher work, also implicates an improvement of the motivation and the involvement of the student in their own teaching-learning process. The use of ILIAS makes possible that in this personalized model allow can be translated to any other type of university teaching, both to distance learning and present learning in the classroom.

ACKNOWLEDGEMENT

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DISTANCE ONLINE COURSE FOR LIBRARIAN IN MONGOLIA, REFLECTION AND LEARNED LESSON

Uranchimeg Tudevdagva[1] and Garamkhand Surendeleg[2]
[1]*Power Engineering School, Mongolian University of Science and Technology, P.O.B. 46/520 Ulaanbaatar, Mongolia*
[2]*National Learning Resource Center, P.O.B. 46/520 Ulaanbaatar, Mongolia*

ABSTRACT

This paper presents about online course for librarians of Technical and Vocational Education and Training institutions. Target group was librarians who work in rural regions of the country. The libraries plays important role in population's education development. The general digital literacy of population is increasing very fast. Relating with this background we need to give corresponding attention to e-library. One of the basic factors for e-library development is human resource sector. According by appeared request we organized online course for librarians. Main target was to give opportunity learns and increase computer skills on working place in regional place. Main sponsor for this project was Millennium Challenge Account-Mongolia. It was first, distance and full online course whose target group was librarians from rural regions of the country.

KEYWORDS

E-learning, online course, librarian, distance learning, online learning.

1. INTRODUCTION

Mongolia is located in the center of Asia, which is 19th biggest country by the ground size in the world. Mongolia has about three million populations. Big distance between capital cities and small towns is a main problem in continuously education for adults. The libraries in rural regions of country is playing main role for education. "The Millennium Challenge Account-Mongolia (MCA-Mongolia), funded through a grant from the Government of the United States of America, was established to support economic development and the reduction of poverty" noted in the brochure of project(2012). In this course 20 participants attended from different aimakas and cities (Ulaanbaatar-4, Central region–3, West region 4, Region "Khangai"–3, Region "Gobi"–5 and Eastern region–1).Course content was focused on information and communication technology and e-library. The librarians had big opportunities to attend in advanced training course from working place. It was first distance and online learning course for all participants. Online service of library is very important sector in other countries; too for instance we refer to (Alli, A. S. Mcharazo, 2000; Britt , 2004; Technical Report, 2013).

2. DISTANCE ONLINE COURSE FOR LIBRARIAN

National Learning Resource Center (NLRC) at the Mongolian-Korean Polytechnic College was established by Vocational Education and training (VET) project, MCA-Mongolia (Brochure of MCA-Mongolia,2013). The project founded many activities and sub projects which oriented to development of information and communication technology for education sector. Inside the project activity, we planned two piloting online courses. One of these courses was focused on the target group of librarians.

We conducted training needs survey from 40 librarians who are from36TVET institutions. The 63% of the librarians' background were professional degree in librarian field. The main criterion of the selection participants was: some technical requirements like internet connection, computer and other. Additionally we requested basic ICT knowledge: email using skill, typing on computer and working skills with office applications. The subject of online course was: "Usage of library and Information and communication

Technology". It was tutored by three tutors and has a consult expert. Learning management system was supported by Mongolian e-Knowledge campus.

Course content was included following subjects:

- Influence of high technology development in library and information systems, effective usage of web 2.0 technology in library, e-Library, its services, trends of library development in electronic version, e-resources and management, online and offline catalog
- The management of copyright problems in library services, Introduction about a Union Catalog of Library –World Cat, creation and organization of electronic readings, Introduction of EBSCO system and Introduction about worldwide famous libraries and their experiences

Course content was developed by library experts. Whole content covered 40 hours of online course.

Reflection and learned lessons:

- This first online course was good opportunity for participants to develop professional education on the working places using internet and online learning management system
- The video conference done between Mongolian rural regional towns and Europe, successfully first time. This event very engaged organizers and participants.
- Computer skill of participants was very different. Sometimes it was problem in management of course schedule and synchronized activities with participants
- The course content has to improve in next course. Get experience sustainable and flexible e-learning content for librarians in the future.

After online course we did summative evaluation using checklist. Chart 1 and Chart 2 are showed some result from summative evaluation. Question: "Are you satisfied on the course content?"

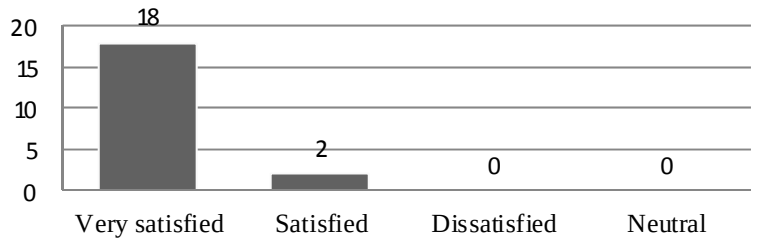

Chart 1. Satisfaction of learners (course content)

The 90% of participants answered "very satisfied" on course content. Question: "Quality of reading materials and level of exercises evaluation and barriers in learning". From participants 66.6% had distinguished problems with learning.

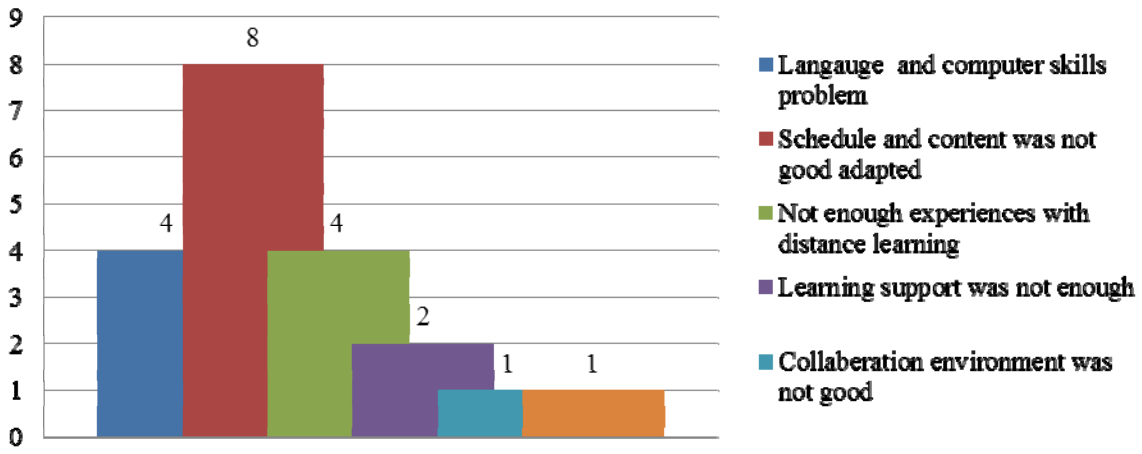

Chart 2. Reading materials, exercizes and barriers in learning

3. CONCLUSION

This project was first online course for "librarians" as target group. The librarians who are working in rural region of country had opportunity to attend to professional advanced course from working places. Aim of project was suggested with mission of MCA-Mongolia. A professional advanced training course for librarians is organized not so often, especially from distance. In this case our project was reflected very positive from participant side. By summative evaluation it proofed by 90% satisfaction result.

Online course organized well and the satisfaction of participants was very positive. But some participants were dropped out and some participants could not adapt in distance and online learning. Summative evaluation after course useful for us to recognize elements which we need to improve in next same courses. For example, evaluation result showed that we need to redesign course content and have to support participants to adapt in distance and online learning. Have to improve collaborative learning environment and learning support helps and hints in course.

It was big challenge for us MCA-Mongolia. It was big opportunity to collect online and distance learning experiences for participants. All participants first time attended to online course which targeted to librarian. Every participant confirmed own satisfaction by summative evaluation checklist. The organizers, the participants and sponsors, each involved interested part learned a lot of from this distance online course case.

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THE DESIGN AND DEVELOPMENT OF A COMPUTERIZED ATTENTION-TRAINING GAME SYSTEM FOR SCHOOL-AGED CHILDREN

Tsui-Ying Wang[1] and Ho-Chuan Huang[2]
[1]*Department of Occupational Therapy, National Cheng Kung University*
[2]*Department of Information Management, National Kaohsiung University of Applied Sciences*

ABSTRACT

A computerized attention-training game system has been developed to support attention training for school-aged children. The present system offers various types of computer games that provide training in different aspects of attention, such as selective attention, sustained attention, and divided attention. The N-tier architecture of the Web-based applications was applied for the development of this system. Children can access the system to play interactive games in a Web-based environment by using smart phones, tablet computers, or personal computers. A complete set of training information is collected in which the system provides a training portfolio mechanism to record the training progress and performance of the player. Children may benefit with the challenging features of attention demands during game-playing and the observer may gain detailed information of the training process. The game scenario helps motivate children to practice attention tasks with interactive play and immediate feedback.

KEYWORDS

Computer games, Attention training, Training portfolio, Attention assessment

1. INTRODUCTION

Attention is very important to the progress of children's memory and learning skills because it affects the development of cognition. Therefore, attention training is considered an effective approach to improving the cognitive development of school-aged children. The major principle is that repeated practice of attention tasks can produce adaptations in the underlying neuroanatomical networks linked to these processes and can improve the attention performance (Kerns, et al, 1999; Posner and Raichle, 1994). Attention training employs different kinds of cognitive-behavioral tasks (e.g., self-monitoring, self-reinforcement, neurofeedback or biofeedback, and cognitive training methods) to train various types of attentions (e.g., selective, sustained, and divided attention) and to improve concentration in different cognitive tasks (Lévesque et al, 2006; Sohlberg and Mateer, 1989; Zoefel et al, 2011). Klimkeit et al (2004) investigated the development of attention and executive functions on normal children aged between 7–12 years old (n = 40). Their study results revealed that the largest improvement in selective attention and executive functions occurred between the ages of 8–10 years and rose to a plateau in performance between 10–12 years of age.

Computer-based training uses computer programs to coach learners to achieve better performance by employing cognitive strategies and processing. There are several potential benefits of the computer-based training approach, including the ability to train anywhere and anytime, cost-effective, and easy control of the training. In addition, computer and video games also facilitate participation and practice in a personalized training environment towards a successful experience, which may be impossible in real life (Verenikina et al, 2003). Using computer games as training methods can have several advantages due to the interactive elements of computer games, along with the computer's function to present multiple types of media. Therefore, games were utilized as an interesting and motivating environment of attention training, and may offer different kinds of simulated situations (such as iterated practices of attention-cognitive operations) to improve the cognitive performance during attention training.

The purpose of this paper presents the computerized attention-training game system, which is targeted at school-aged children to improve the performances of the visual attention and working memory. The game-based attention training system can provide children not only with fun scenario games but also with exercise to practice attention training.

2. DESIGN AND IMPLEMENTATION

The architecture of the present system consists of five modules: a user interface module, user profile management module, game management module, training portfolio module, and performance management module. The user interface module includes three different interactive interfaces for children, instructors, and administrators. The user profile management module mainly stores the user's basic information such as name, age, and education. The game management module is used for the management and integration of different attention training games. The training portfolio module provides users with the information of training progress. Users can query detailed information of their individual responses for each game. Instructors or administrators also can analyze the progress trend regarding an individual user or a group of participants from the data extracted from this module. The performance management module computes and manages the results of individual game playing. The module can provide users with the scores of a single game or the whole game.

Five games have been developed in the system (see Figure 1) and a series of attention-training tasks, such as selective attention, sustained attention, and divided attention, are involved in each game. For selective attention training in the game, the visual stimuli included a group of animals, such as sheep, cows, chickens, ducks, and pigs, which are placed in a farm where the player has to help the farmer identify the chicken from the other animals (i.e., leading the chicken out apart from the other animals in the farm). These animals might have similar features in color and shape (such as chickens and ducks) or different features (such as chickens and cows) to distinguish the level of selective difficulties in the same game (see Figure2). Between different game levels, animals can be maintained in the farm in a lower game level or moved to a different spot in a higher level. The moving targets increase the difficulty for the player to capture the target animal in the farm. Similar to a common video/computer game, a visual and audio feedback will appear showing correct, wrong, or missing responses after each response during the game.

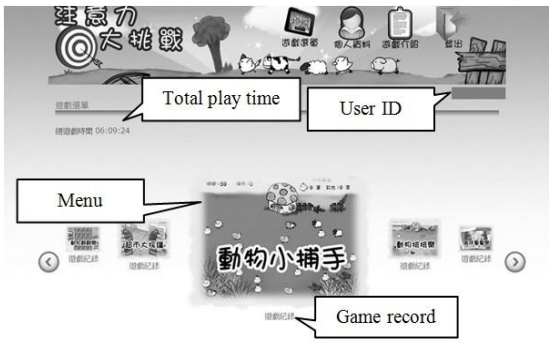

Figure 1. Game menu

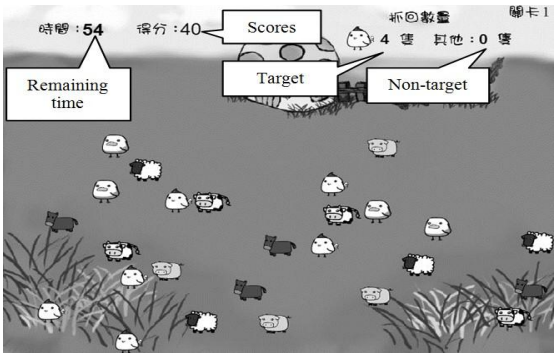

Figure 2. Chicken catcher

This system also provides a training portfolio mechanism to manage players' training progress. School children (players) or teachers can access the record in the training games, such as frequencies, scores, response types (correct, error, or omission), and play time for each program, to keep track of their session performances and training progresses through sessions.

The implementation of the system includes JavaScript and PHP as script languages, Flash as an authoring tool, Apache as a web server, and MySQL as a database. Training progresses and session performances are recorded in MySQL database. The database contains three kinds of relational tables including user profiles, portfolio data, and result data.

3. CONCLUSION

This study proposed a computerized attention-training game system to train attention-related function in children. The Web-based applications own the merit of "anytime and anywhere accessibility" for attention training practice at home, school, and clinical settings. To evaluate the performance of attention training in the present system, we are currently conducting experimental sessions of attention training in school-aged children to verify the efficacy of the system.

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DISCOVERING VISUAL SCANNING PATTERNS IN A COMPUTERIZED CANCELLATION TEST

Ho-Chuan Huang[1] and Tsui-Ying Wang[2]
[1]*Department of Information Management, National Kaohsiung University of Applied Sciences, Taiwan, R.O.C.*
[2]*Department of Occupational Therapy, National Cheng Kung University, Taiwan, R.O.C.*

ABSTRACT

The purpose of this study was to develop an attention sequential mining mechanism for investigating the sequential patterns of children's visual scanning process in a computerized cancellation test. Participants had to locate and cancel the target amongst other non-targets in a structured form, and a random form with Chinese stimuli. Twenty-three children aged between 10–12 years were recruited and took part in this experiment. Sequential pattern analysis for stimulus cancellation revealed that the structured form has a visual guiding effect producing a maximum of 18-sequence in a horizontal scanning pattern. The sequential pattern of the random form, showed no guiding effect, was vertical and yielded only 2- to 4-sequence patterns. The results demonstrated that the organization of stimulus layouts (i.e., structured or random forms) might have implicit visual guiding effects in visual scanning.

KEYWORDS

Cancellation test, Sequential pattern mining, Visual scanning, Computerized assessment

1. COMPUTERIZED CANCELLATION TESTS

Visuospatial attention is how someone attends to the visual stimuli in a specific space. Cancellation tests have been largely used to evaluate the performance of visuospatial attention in education and medical settings. Individuals are required to cancel the target scattered randomly throughout the structured or random array. A computerized cancellation test system can trace and record the sequence of cancellation mapping onto the test screen. The response path would represent a visual scanning pattern in a series of lines connecting the positions by order of the cancelled stimuli.

Sequential pattern mining is one of data mining technologies concerned with interesting sequential patterns based on time series among a large database (Chand et al, 2012). With huge amounts of data continuously being collected and stored by a computerized cancellation test system, sequential pattern mining can be used to discover the potential interesting sequential patterns of the visual scanning paths. In this study, a K-sequence is an ordered list of items I_i ($i = 1\sim k$) such that $S = <I_1, I_2, \ldots, I_k>$. Sequence S in a cancellation task that contains k sequences of cancellations (i.e., k successive responses) is called a frequent sequential pattern if it occurs more than the minimum support threshold value.

Previous studies suggested different findings regarding the patterns of visual searching in visuospatial tasks. Abed (1991) explored eye movement among subjects with different cultural backgrounds. The study showed that East Asian subjects used more vertical than horizontal movements comparing with American or Middle Eastern subjects. Woodword (1972) addressed that the distance between the stimuli would influence the scanning pattern and lead the individual to search for the next closest target. A previous study found that a structured form with the Chinese stimulus elicited a more organized visual scanning pattern, but a randomized form did not (Wang et al, 2006). However, the traces of visual scanning in both forms were not quantitative data and thus, cannot be compared statistically to examine the differences between scanning patterns.

Therefore, the purpose of this study was to develop an attention sequential mining mechanism to discover the sequential patterns of children's visual scanning process in order to validate the discrepancies of scanning patterns in different layouts.

2. EXPERIMENT

2.1 Subjects

A total of 23 participants (9 boys, mean age = 11.33 years; 14 girls, mean age = 11.43 years) participated in the experiment. All recruited participants were free of any physical illness, neurological deficits, visual or motor problem, or perceptual disorders. Participants were instructed and allowed to practice until they understood the procedure before starting the test.

2.2 Materials

Two different stimulus layouts (i.e., structural array and random array) with the Chinese stimulus were used in this experiment. The target on the Chinese test was the radical "日" (meaning "sun"). Other Chinese radical, such as "月" and "目", were used as non-targets in the test. In the structured form, the spacing of any two adjacent stimuli in a row or column was equivalent, but for the random form, the spacing of any two adjacent stimuli varied.

To mine the frequent sequences for visual scanning patterns, a user-specified minimum support was required as the threshold for discovering all sequences having a frequency greater than the minimum threshold. Based on the testing result, a minimum support threshold was set as 0.2 in this study.

3. RESULTS AND DISCUSSIONS

A total of 2650 records of participants' responses were analyzed: 1322 records for the structured form and 1328 records for the random form. The results showed that the structured form has a visual guiding effect, and a maximum of 18-sequence horizontal pattern was found (see Figure 1). Most horizontal patterns were left-right or right-left tracing as an S-shape with top-down order in the structured form. However, the random form showed no guiding effect and only a maximum of 4-sequence vertical pattern was found (see Figure 2). Table 1 shows part of the results of K-sequence in structured and random forms. For the structured form, one maximum 18-sequence was found (S = <217, 210, 207, 200, 221, 225, 236, 240, 257, 248, 267, 272, 277, 282, 306, 301, 292, 287>), followed by two 17-sequences, three 16-sequences, and so on. For the random form, only 2-sequence (S = <64, 65>) to 4-sequence (S = <142, 163, 204, 220>) were found.

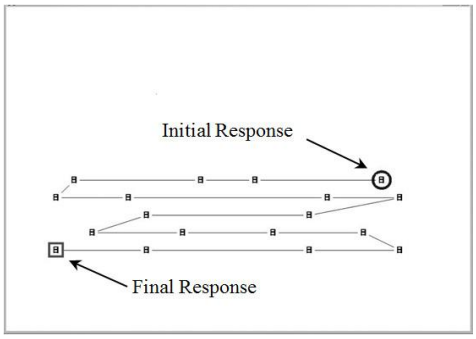

Figure 1. A sequential pattern for a structured form

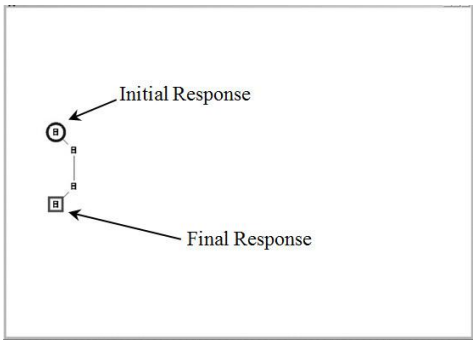

Figure 2. A sequential pattern for a random form

From the sequence length results, we conclude that the stimulus layouts may have implicit visual guiding effects. In the random form, the individual showed very inconsistent scanning patterns from each other, and a change was found in the orientations for cancelling the next target without following any horizontal or vertical direction. Woodword (1972) indicated how the short and vertical scanning pattern was influenced by each individual's searching orientation and majorly by the next possible stimulus one attended around. The sequence results found in this study supports the layout effects for visual scanning.

Table 1. Comparisons of the number of K-sequence on the two stimulus layout

Structured form		Random form	
K-sequence	No. of K-sequence	K-sequence	No. of K-sequence
18	1	-	-
17	2	-	-
16	3	-	-
4	35	4	1
3	46	3	11
2	84	2	75

4. CONCLUSION

In this paper, a visualized sequential pattern mining approach to visuospatial attention has been developed. The results of the preliminary experiment also revealed that the stimulus layout would affect the sequential patterns of visual scanning in attention process, which causes significant discrepancies in sequential patterns between the searching behavior in structured and random arrays. Further issues for the relationship between the patterns of visual scanning and the performance of visuospatial attention will be explored.

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THE EFFECTS OF SELF-DETERMINATION ON LEARNING OUTCOMES IN A BLENDED LEARNING

Young Ju Joo, Kyu Yon Lim, Sang Yoon Han, Yoo Kyoung Ham and Aran Kang
Ewha Womans University
Ewhayeodae-gil 52, Seodaemun-gu, Seoul 120-750 Korea

ABSTRACT

The purpose of the paper is to examine whether the sub-constructs of self-determination, that is, learners' perceived level of autonomy, competence, and relatedness, predict learning flow, persistence, and achievement in a blended learning context. Participants are 102 adult learners who voluntarily registered for a Chinese language learning seminar, which consisted of weekly offline meetings and supplementary online activities for 24 weeks. A series of regression analysis revealed that autonomy, competence, and relatedness significantly predicted learning flow, which significantly predicted persistence. Also, competence and relatedness, and learning flow predicted achievement.

KEYWORDS

Self-determination; learning flow; persistence; blended learning

1. INTRODUCTION

Adult learners initiate and maintain behaviors to the extent that they believe the behaviors will result in desired outcomes. Self-determination theory, according to Deci and Ryan (1980, 2000), is related to this human motivation, concerned with supporting intrinsic tendencies to behave in effective way. Self-determination addresses three psychological needs: autonomy, competence, and relatedness. Autonomy is a tendency toward self-organization and self-regulation. Without autonomy, learners may experience failure since they hardly recognize what they want or should do. Competence is a psychological construct seeking to control the outcome and experience mastery. It is important because it is necessary for the enjoyment of the activity. While autonomy and competence are essential for intrinsic motivation and interest, relatedness adds another value to the perspective of motivation. Relatedness means a desire to interact and be connected to others. All these sub-constructs of self-determination are influential to learning process as well as outcome, according to previous studies (e.g. Deci & Vansteenkiste, 2004; Ryan, Kuhl, Deci, 1997). Especially when online learning component is added on, learners are given more flexibility in organizing learning path, scope and interaction, which might increase the importance of self-determination.

Based on the literature review, this study selected learning flow, persistence, and perceived level of achievement as outcome variables, since flow and persistence are theoretically relevant to self-determination. Learning flow has been reported as a construct that predicts the effectiveness of learning. According to Csikszentmihalyi (1996), learning flow is the optimal experience of a mental concentration. When a task is demanding enough to be interesting, but not too difficult to cause frustration, it offers the possibility for a positive experience of being fully engaged in an activity. Persistence is intent-to-persist, and has been considered a noteworthy variable for evaluation of success in learning (Martinez, 2003). Prior studies reported that autonomy and relatedness affects flow (Evelein, Korthagen, & Brekelmans, 2008; Fu, Su, & Yu, 2009), while the relationship between competence and flow has not been consistent (Zhao et al., 2011). Also, self-determination consistently affected persistence and achievement.

However, most of the previous studies were conducted in K-12 or formal education settings. Hence, the researchers aimed to investigate the effects of self-determination on flow, persistence, and achievement of adult learners who voluntarily participate in and self-regulate their learning process and outcome in a blended learning environment. Research questions are as follows: (RQ 1) Does perceived level of self-determination (autonomy, competence, and relatedness) predict learning flow? (RQ 2) Does perceived level of

self-determination (autonomy, competence, and relatedness) and learning flow predict learner persistence? (RQ 3) Does perceived level of self-determination (autonomy, competence, and relatedness) and learning flow predict learners' perceived level of achievement?

2. METHODOLOGY

Participants are 102 adult learners who voluntarily registered for a 24 week-long Chinese language learning seminar, consisting of weekly offline meetings and supplementary online activities. The topic of the seminar is Chinese grammar, vocabulary, and speaking, while the online community provided resources, q & a, and discussions among learners. Initially there were 106 learners, but 4 of them provided incomplete responses.

All of the research variables were measured by survey questionnaires. A Work-related Basic Need Satisfaction Scale developed by Broeck, Vansteenkiste, Witte, Soenens and Lens (2010) was used to measure the self-determination variables. The instrument had 7, 6, and 10 items for each sub-category, and the Cronbach's α from the study data were .65, .70, and .88, respectively. The Short Flow State Scale developed by Martin and Jackson (2008) was used, and the scale had 9 items. Cronbach's α from the study data was .77. For learning persistence, 6 item instrument developed by Shin (2003) was used, with the Cronbach's α of .87. Lastly, perceived level of achievement was measured using the instrument by Korean National Institute for Lifelong Learning (2010). 13 items were used and Cronbach's α from the study data was .93. The survey questionnaires were reviewed and validated by academic and field experts.

A series of multiple regressions was used for the analysis.

3. RESULTS

Descriptive analysis indicated there were significant correlations among all the variables at the significance level of .05, and the correlation coefficients ranged from .23 to .71. Also, the assumptions of normal distribution and multicollinearity were met. Table 1 presents the regression analysis results.

Table 1. Multiple regression analysis results

(n=102)

Criterion variables	Predicting variables	Unstandardized		Standardized	*t*	*p*	VIF
		B	Std. Error	β			
Learning Flow (RQ1)	Autonomy	.25	.08	.23	2.98*	.00	1.31
	Competence	.36	.06	.49	6.24*	.00	1.35
	Relatedness	.14	.06	.19	2.37*	.02	1.34
	(Constant)	1.03	.28		3.64	.00	
	R^2(adj. R^2)=.55(.53), F=39.12, p=.00						
Persistence (RQ2)	Autonomy	.22	.12	.18	1.85	.07	1.43
	Competence	.03	.09	.03	.26	.79	1.89
	Relatedness	-.06	.08	-.07	-.73	.47	1.42
	Learning flow	.63	.14	.54	4.57*	.00	2.20
	(Constant)	1.17	.41		2.87	.01	
	R^2(adj. R^2)=.40(.37), F=15.82, p=.00						
Achievement (RQ3)	Autonomy	.05	.09	.04	.54	.59	1.43
	Competence	.19	.08	.21	2.50*	.01	1.89
	Relatedness	.27	.07	.31	4.14*	.00	1.42
	Learning flow	.47	.11	.40	4.31*	.00	2.20
	(Constant)	.17	.33		.51	.61	
	R^2(adj. R^2)=.63(.61), F=40.38, p=.00						

* $p < .05$

As illustrated above, regression analysis results indicated that autonomy, competence, and relatedness significantly predicted learning flow with R^2 of .55, regarding the research question 1. On the other hand, only the learning flow was a significant predictor for persistence with R^2 of .40. Lastly, competence relatedness, and learning flow predicted the perceived level of achievement with R^2 of .63.

4. CONCLUSION

The researchers aimed to apply self-determination theory to adult learners who participated in a language learning seminar program delivered in a blended learning mode. Especially, competence and relatedness predicted both flow and perceived level of achievement. However, all of the self-determination variables failed to directly predict persistence, partly because of the research context, that is, the characteristics of seminar program and participants. During the poster presentation, detailed descriptions on the research context and blended learning intervention will be provided in order to draw meaningful interpretation and implications from the results. Suggestions for further study will also be discussed.

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