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Edited by:
Miguel Baptista Nunes
Maggie McPherson

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INTERNATIONAL CONFERENCE

E-LEARNING 2014

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INFORMATION SYSTEMS 2014

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE

E-LEARNING 2014

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These proceedings contain the papers of the International Conference e-Learning 2014, which was organised by the International Association for Development of the Information Society, 15 – 18 July, 2014. This conference is part of the Multi Conference on Computer Science and Information Systems, 15 - 19 July 2014, which had a total of 738 submissions.

The e-Learning 2014 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:

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    - etc.
- Digital media studies

The e-Learning 2014 conference received 194 submissions from more than 35 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 33 full papers were approved which meant an acceptance rate of 17 %. 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 one keynote presentation from an internationally distinguished researcher. We would therefore like to express our gratitude to Neil Morris, Professor of Educational Technology, Innovation and Change and Director of Digital Learning, University of Leeds, UK, as the e-Learning 2014 keynote speaker.

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 Lisbon, and we invite all participants for the next edition that will be held in Las Palmas de Gran Canaria, Spain.

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KEYNOTE LECTURE

MOVING HIGHER EDUCATION FORWARD IN THE DIGITAL AGE: REALISING A DIGITAL STRATEGY

Neil Morris
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University of Leeds, UK

ABSTRACT

Digital technologies have matured rapidly over the past five years, and are commonplace in many sectors which affect our daily lives. In the Higher Education sector, digital technologies are still seen as an add-on to the learning experience, and are not always an integral and accepted part of the teaching and learning process. Many universities have developed e-learning or digital strategies to address this, and this paper will reflect on the success of these strategies from a range of perspectives, using the University of Leeds as a case study. The session will explore the adoption of digital technologies by staff and students, the impact on the teaching and learning process and the impact on student learning and experience. The aim of the paper is to illustrate the benefits of a strategic approach to integrating digital technologies into a blended learning curriculum for staff and students. The paper will use the author's experiences of VLE resources, mobile learning, Open Educational Resources, Massive Open Online Courses and social media to demonstrate the main arguments.

Full Papers

CULTURE, GENDER AND TECHNOLOGY-ENHANCED LEARNING: FEMALE AND MALE STUDENTS' PERCEPTIONS ACROSS THREE CONTINENTS

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ABSTRACT

With the on-going "Learning Culture Survey", we aim to foster the implementation of culture-sensitive education. The motivation of this study is based on the need of a better understanding of the reasons for intercultural conflicts in education. These issues are particularly pertinent to international learning scenarios, such as in urban education, or Internet-based e-Learning. The results of this research are geared towards a development of activities that prevent students from losing their initial learning motivation. With our standardized questionnaire, we collected and analysed data from Germany, Ghana, and South Korea. In such a comparative culture-related analysis, the population is usually considered as a whole, regardless of the respondents' socio-cultural differences and assuming a single representative value per item. In this paper, we first analyse and discuss the results of our questionnaire' section "*Gender Issues*". Afterwards, we analyse the overall questionnaire data to focus on the extent to which female and male students' answers differed. Finally, we engage in a discussion to what degree these differences impact the design of e-Learning scenarios.

KEYWORDS

Gender, Higher Education, E-Learning, TEL, Cross Cultural Study, Learning Culture Survey

1. INTRODUCTION

Increasing globalisation and mobility of learners and faculty is inevitably reflected in a cultural diversity in educational scenarios. On the one hand, increased cultural diversity presents itself as a very positive development: It helps learners to achieve competences in intercultural communication and collaboration. On the other hand, if the learners' experiences are not accordingly reflected, frustration through perceived intercultural conflicts could emerge. Loss of motivation could be a consequence, which is directly related to higher dropout rates. We consider education as a process in which learners are guided on their way to transform experiences into knowledge. Thus, we are looking for ways to support both students and educators, to better understand and deal with socio-cultural diversity in education. For this paper, we investigated learners' perceptions of education in different national scenarios through the lens on their gender as to understand its impact on e-Learning.

The "Learning Culture Survey" (LCS) is designed as an international study. The first data collection phase started in 2009/10; LCS is projected to continue for at least next decade. Our research focuses on supporting students to improve their learning outcomes by reducing cultural conflicts in education. For this purpose, we investigated learners' perceptions in different national and regional contexts. Originally, this investigation was designed to enhance the understanding regarding the relationship between culture and education. In particular, we were interested in answering questions how cultural bias affected the students' perceptions and expectations towards education and how we could improve the quality of education by taking such diversity into account when designing learning scenarios and materials.

Our hitherto accumulated insights led to a higher awareness regarding the character and impact of cultural diversity in education. We understand culture as "*the customs, beliefs, social structure, and activities of any group of people who share a common identification and who would label themselves as members of that group*" (Oetting 1993). As for practical scenarios, the results are being used to:

- Improve the preparative work of students and faculty members in terms of mobility;
- Support the students' and instructors' development of intercultural competences;
- Determine preventive activities to avoid cultural conflicts;
- Design culture-sensitive learning contents;
- Sensitise moderators of international learning groups regarding cultural conflict potential;
- Define conflict potential for learning resources that are to be adopted to new contexts.

The latter issue is eminent for the reuse of educational material, which is defined as one of the major advantages of e-Learning (Littlejohn 2003, Derntl & Motschnig-Pitrik 2003) and is particularly relevant for the further exploitation of Open Educational Resources (Richter & McPherson 2012; Richter 2011).

In the following, we use the term "Technology Enhanced Learning" (TEL) instead of "e-Learning". In the context of TEL, the Internet often is used to involve learners in a collaborative learning and authoring activities, provide learning material through Learning Management Systems or online publishing services, communicate with the learners via synchronous and asynchronous channels, and provide online assessments. Even in regions with low population density, the relatively low technological preconditions to provide TEL through the Internet often are fully met by both the institutions and the learners. Thus, involving students from very diverse contexts in a single course generally is feasible. In such settings, particularly the students' development of intercultural competences actually could be fostered. However, this option often keeps unused due several reasons: Prior research found that the most significant barrier for providers of TEL is the fear of unwillingly causing cultural (and other) conflicts (Richter & Ehlers 2011).

While we already were able to answer some general questions regarding the character of culture in education and educational culture (see section 2.2), raise our level of understanding regarding the impact of cultural influences on education, and determine improvement potential for several educational settings and scenarios, many issues still are not fully understood, and even completely new questions disclosed.

One of these not yet fully understood issues on which we focus in this paper, is the relationship between gender and culturally biased perceptions of students in education.

This paper is structured as follows: First, we provide an overview regarding the state of the art of research regarding "gender and TEL". Second, we introduce the design, setting and so far achieved general results of our Learning Culture Survey. Third, we present the analysis of results from our questionnaire's section "Gender Issues" and investigate our full data sets according to imbalances between female and male respondents. Finally, we discuss design implications for TEL.

2. THEORETICAL BACKGROUND

2.1 Gender and Technology Enhanced Learning

Gender differences and their effects on education have been thoroughly investigated in traditional classroom education. Issues regarded behaviour in groups, communication styles and patterns, generally different types of learning motivation, and barriers towards technology usage. While studies in the early 1990s indicated negative attitudes of women towards computers, in early two thousand, "*no significant differences between the genders in terms of competencies in the usage of general computer software as well as networking software*" remained (Atan et al., 2002, p.123). Bhushan (2008) confirmed these findings in the context of TEL in higher education. As major gender-specific issues in Computer Mediated Courses, Gunn et al. (2002) found differences in the self-reported levels of confidence, the ability to work successfully with technology, the use of support systems, different treatment according to laud and critique, and different patterns of interaction. Irani (2004) investigated differences in the self-reported levels of confidence in a longitudinal study. One of the findings of this study state that female learners felt frustration, particularly because of lacking support in technology-related tasks, such as completion of computer programming task. The study of Bostock and Lizhi (2005), which was focused on the use of asynchronous media, confirmed gender-related differences in communication patterns: Female students wrote more messages in all-female groups than in mixed-gender groups; while male students, in contrast, wrote more messages in mixed groups. However, the online discussions in all groups had a similar cognitive quality. Mikk and Luik (2005) analysed the perceptions of girls and boys (15-16 year old education) regarding the use of electronic textbooks and found that "*electronic textbooks with a high complexity of navigation and design of information endanger the* *learning efficiency of girls*" (p.178). McSporran and Young (2001) found males at a disadvantage, as their skills to self-organize their learning processes and to engage in multitasking (dealing with external interruptions) were less developed. Yukselturk and Bulut (2009) also investigated gender differences according to self-regulated learning: They found "*test-anxiety*" as a significant variable for female and "*self-efficiency*" and "*task value*" as significant variables for male learners' achievement (p.20).

Our chosen topics for the questionnaire utilize and extend the framework proposed by Gunn et al. (2002): We investigate the necessity of gender-sensitive content design, the perceived confidence according gender-specific abilities to study social or technological issues and the perceived entry barriers, perceived treatment at the end of tasks, and the value of mixed gender and gender-separated workgroups.

2.2 The Learning Culture Survey: Background, Setting, and Priory Achieved Research Results

We designed and implemented a standardized questionnaire, which focuses on issues that generally are considered being culturally influenced. For our study, we defined the following thematic blocks:

- relationship between learners and instructors; perceptions towards laud and admonition; group building processes; communication style; behaviour in groups; (Hofstede & Hofstede 2005)
- time management; (Hall and Hall 1980)
- value of errors; the type of user activity; expectations towards personal coaching; (Henderson 1996)
- demand to influence learning contents; (Trompenaars and Hampden-Turner 2006)
- how and when feedback is to be provided. (Noelting et al. 2004)
- gender issues (Gunn et al. 2002)

As for the operationalization of these topics, we focused on issues that reportedly caused conflicts in educational scenarios. We eventually defined a total of 100 culture-related items, which we asked the students to evaluate on a four-point Likert scale (fully agree - fully disagree). We implemented a "force-choice" design (Lenski & Leggit 1960) because we wanted the participants to take a position that gets closest to what they actually think instead of expressing that they are undecided. With that decision we risked unwanted distortions (Garland 1991). Thus, we offered the opportunity to express if an item generally is not applicable to a particular context. This fifth option was positioned apart of the scale and, so far, has rarely been used. The questionnaire was pre-tested and was modified accordingly.

The first part of our investigation included Germany and South Korea, which according to the ATLAS survey from Müller et al. (2000) are the only countries that were considered being culturally homogenous. The questionnaire was provided in each of the national languages. In Germany, we designed the survey as an in-depth study and used the online version. We had the chance to take full samples (inviting all students) of three regionally distributed universities (1,817 completed questionnaires, 2-5 % acceptance rate). To determine the scope of our results we needed a sample where we could distinguish between the results of the various faculties. As for South Korea, we chose a broad-based design by drawing from 39 universities from which we obtained 286 completed questionnaires. In this study, we wanted to explore if the responses show significant differences amongst the universities. Due legal reasons, we had to conduct the questionnaire in its paper-based version. In order to achieve at least a quasi-random sample, we selected the students by following a random route algorithm (Kromrey 2006). The acceptance rate was around 50 %. For the analysis of the responses, we followed the recommendation of Baur (2008) for ordinal-scaled data: We binarised the results into positive and negative outcomes and focused our analysis on the percentage of positive answers.

One of the most relevant questions was related to the contextual transferability of our results. Hofstede & Hofstede (2005) suggest that culture, if related to value-systems, generally is a matter of national bias, and without regard of the context in which culture-specific results were achieved, these are transferable to any other context. This assumption, however, was challenged. Jandt (2004) for example expresses that "*cultures do not respect political boundaries. Border cities such as Juarez, El Paso, Tijuana, and San Diego can develop cultures that in some ways are not like Mexico or the United States*" (p.7). Inglehart and Wetzel (2010, p.555) argue that "*National means tell only part of the story. Measures of variance and skew within societies are also informative*".

Figure 1 illustrates three general results according to the questionnaire's topic "Role of the Lecturer", very similar answer patters between faculties (1), significant national differences and the value of the spectrum of answers (2), and fully explainable differences between the context of higher education and professional training in Germany (3). We contrasted the results of our in-depth study in Germany according to the different faculties within each university and the average results of the three universities. We found a certain level of variability between the answers of the different faculties (including outliers) but after visualizing the results in a net diagram, we found that all responses followed a certain pattern. In the upper left of Figure 1/1, the results from the different faculties of the University of Cologne are exemplarily displayed. The same result was found between the average values of the German universities.

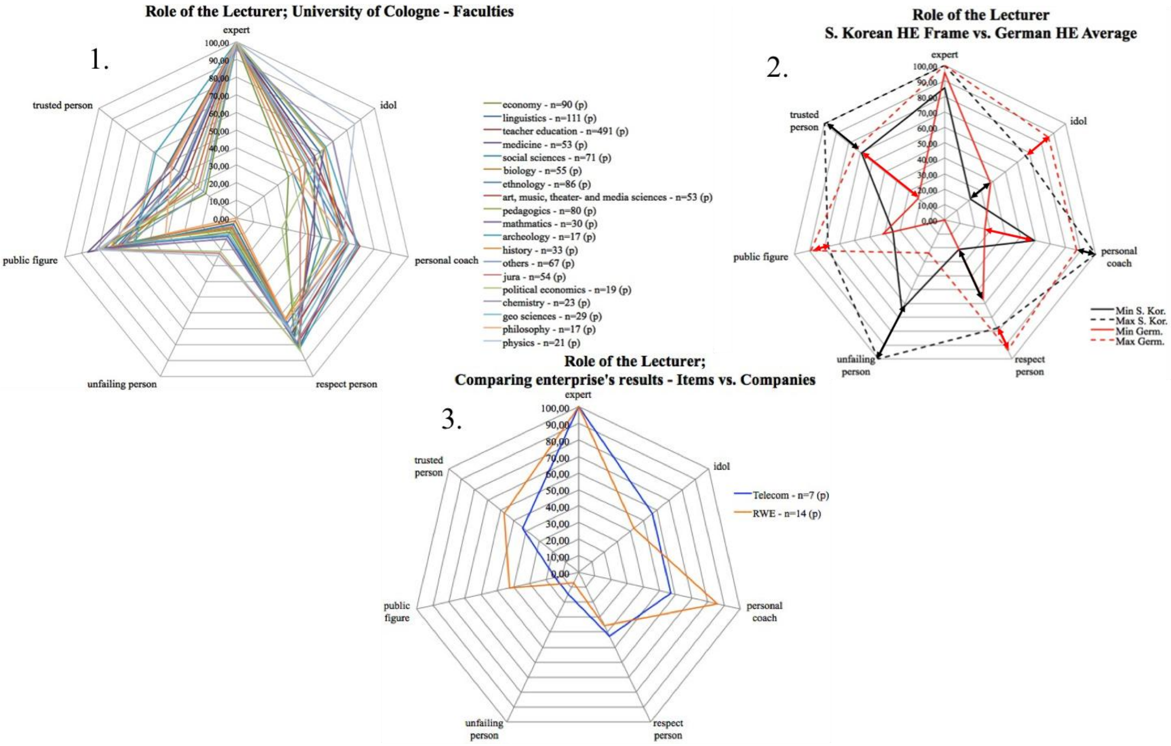

Figure 1. Role of the Lecturer: Learning culture in different settings

The answers that were received from students in the different universities in the South Korean sample also showed a particular answer-spectrum regarding most of the items. Yet each pattern again, was quite similar (apart of one university that just provided extra-occupational master programs. The patterns of the German and the Korean universities, however, were completely different from each other. In the upper right section of Figure 1/2, the answer-patterns from both, the German and the South Korean survey are displayed including each answer spectrum. What we can recognize in this figure is particularly that there are sections in each of the national contexts, which exceed the areas of the other. We came to the conclusion that the average percentage value is suitable to understand that generally there are differences but not sufficient to provide explanations for conflicts or emerging adaptation needs. Instead, we found that the spectrum of the answers within one context is a more meaningful indicator. Provided that local students are expected to cope with the educational style of any university within the country, and assuming that cultural bias at least to some extent is related to personal experiences (reflected in the answers), the answer-spectrum of all universities within a country could be understood as an indicator for the level of acceptance (Pless & Maak 2004) regarding diversity in education. If this is the case, then conflicts in intercultural education might particularly occur when a student from the one context meets conditions that are outside of the spectrum of his/her own context. In the figure, we marked related areas that accordingly indicate a high risk for conflicts with red and black arrows.

In the next step, we wanted to find out if higher education and professional training reveal similar results (Figure 1/3, centre). From the 30 invited German stock-noted enterprises, five granted their support and involved a small number of employees (each 25). From two of these enterprises, we eventually received seven and more completed questionnaires (pencil-and-paper form). Even though such small samples are far from representative, we found surprising results: The responses of the two enterprises were quite different based on the results across the universities. All found differences could be explained considering specific characteristic of each enterprise/context. We concluded that generalizing our results from higher education to other educational contexts is inappropriate (Richter & Adelsberger 2012).

Previous literature suggests that cultural bias does not yet have its full impact on children below an age of 12 years but instead their curiosity has a higher influence on decision taking. In this context, Mitra et al. (2005) reported from their research project, which was highly related to curiosity, that children above 12 years did not like to participate or at least, quickly lost their interest. Buehler et al. (2012) investigated culture-related perceptions towards the experimental use of unknown technology. They found that children above the age of twelve years compared to younger children, reacted with the (for their particular cultural contexts) expected wariness. Thus, we did not investigate the context of school education.

Even with the limitation to a single educational context, another issue emerged according to country-wide transferability: How about countries that can not be considered culturally homogenous, such as countries in which several societies were joined into a single nation during the times of colonialisation, or in which more than one national language was spoken (Condon & Yousef 1975)?

By chance, we conducted a paper-based test study (same questionnaire, translated to English and French) in two universities in Cameroon, one located in the English and the other in the French language region; we received 30 completed questionnaires from each. We conducted an a-priori analysis considering different thematic blocks of the questionnaire: With a chance of over 98 %, each student's dataset was correctly appointed to the one or the other university. This is a strong indicator that transferring locally achieved results to the whole population of a country that culturally is not homogeneous is questionable. If a comprehensive understanding of culture shall be achieved, at least, regionally more distinguished investigations are required.

3. STUDY DESIGN

For this paper, we use our results from the German and the South Korean context and focus on the thematic section "Gender Issues". In 2013, we collected data from another national context, which was Ghana. This sample included respondents from the University of Ghana in Accra. We conducted this survey in its English language online version. The general conditions and design were the same as for the German sample and as described in section 2.2. For the Ghana study, a separate questionnaire-instance was set-up and the related link to the questionnaire was included in the letter of invitation.

In contrast to Germany and South Korea, Ghana is not a culturally-homogenous country. More than 100 different ethnic groups were united into a common national context during the periods of colonialisation. Thus, the results neither allow to draw conclusions regarding the specific societies' cultures, nor are they representative for the "general culture" in the country (whatever this might be) but just reflect this particular university's population. Due to the following reasons, we think that the results still provide an insight regarding the country's culture in *higher education*: First, students in Ghana enter the universities with more or less common experiences from their earlier education: Ghana has nine years of compulsory education, a national educational system, and a national curriculum. Teaching usually takes place in the official national language. Second, the number of public universities without particular thematic specializations is quite limited (6 public universities in total, 3 without specialization). The collected demographic data showed that students from all over the country frequently attend the University of Ghana in its capital Accra. For a specific analysis regarding particular regions, the number of responses per region was too small (306, acceptance rate 1,54 %).

4. RESULTS

In Table 1, in the first column, the original statements of the question block "Gender Issues" are displayed as they were to be evaluated on the 4-point Likert scale. On the right side are three blocks, each with three columns that display the percentage of positive female, male and average responses from the countries

Germany, Ghana, and South Korea. According to an imbalance between female and male answers, we define a deviation below 5 % (absolute) between male and female responses as standard error.

Table 1. *Gender Issues*: results of universities from 3 continents (percentage of positive answers)

	Germany			**Ghana**			**South Korea**		
	female n=544	male n=1268	average	female n=126	male n=177	average	female n=153	male n=131	average
a. Learning content should be designed in the same way irrespective of the learner's gender.	94.12	92.91	93.29	86.51	90.40	88,89	76.47	75.57	75.79
b. Women and men have the same ability in understanding complex technical information (e. g. in the domains of engineering, mechatronics).	72.61	77.07	75.78	66.67	70.62	68,95	45.10	52.67	48.42
c. Women and men have the same ability in understanding social domains (e. g. in the domains of pedagogic, gerontology or primary education).	70.77	80.69	77.77	80.95	77.40	78,76	59.48	54.96	57.19
d. Women and men are treated the same way when completing a task successfully.	56.99	54.06	54.93	66.67	74.58	71,24	40.52	48.85	44.56
e. Women and men are treated the same way when failing a task.	47.24	47.75	47.61	58.73	66.67	63,40	35.29	47.33	40.70
f. Women and men have the same chances to access studies on all subjects.	75.74	75.97	75.89	79.37	82.49	81,37	64.05	72.52	68.07
g. Workgroups intellectually benefit if the genders are represented in a well-balanced ratio.	75.92	84.16	81.67	84.13	81.92	82,68	80.39	75.57	78.25
h. A separation of gender in the learning process eases the social interaction within groups.	10.66	7.2	8.64	46.83	42.94	44,44	31.37	27.48	29.47
i. It generally is not useful to implement a quota for the number of women in supposedly men dominated areas.	27.76	46.26	40.67	52.38	61.58	57,84	40.52	38.93	40.00

Figure 2 provides the first visualization of the gender-specific differences between the responses according to the results from the thematic section "Gender Issues". We used separate bar diagrams for each country. We found 10 cases amongst the three countries, in which the answers revealed to be significantly imbalanced in the gender-specific contrasting. Across the countries, however, there was no clear-cut pattern that would suggest imbalances regarding particular items. A similar result could be found throughout the whole datasets:

In the full South Korean sample (100 items), 27 items showed an imbalance above 5 % between the responses of the female (f) and the male (m) students; regarding 2 items, the level of imbalance exceeded 10 %:

1. Gender Issues: "*Women and men are treated the same way when failing a task*." (35.29f : 47.33m)
2. Motivation: "*I am easily discouraged because of others or situations*." (48.37f : 38.17m)

In the full German sample (100 items), we found 30 items in which the imbalance between the answers of the female and the male students exceeded 5 % and amongst those, the responses in 5 cases exceeded 10 %:

1. Feedback: "*For me, it is ok when critical feedback in the learning process is given in front of my colleagues.*" (77.39f : 63.99m)
2. Motivation: "*I am easily discouraged because of others or situations*." (42.28f : 53.11m)
3. Motivation: "*I experience being motivated if the imparted knowledge is strongly needed for upcoming examinations, tests, and/or presentations.*" (56.52f : 66.67m)
4. Gender Issues: "*It generally is not useful to implement a quota for the number of women in supposedly men dominated areas.*" (27.76f : 46.26m)
5. Group Work, evaluate statements: "*It should be possible to divide a given task into subtasks with*

similar complexity for being solved solely by each participant within the group." (58.64f : 71.47m)

In the full sample of the university of Ghana, we found 29 cases where the answers from female and male students diverged accordingly (over 5 %) and in 4 cases, the 10 % were exceeded:

1. Motivation: "*I am easily discouraged because of others or situations*." (26.98f : 37.29m)
2. Group building process: "*I try not to actively exert influence on the arrangement of the group members but wait until I am invited to participate in a group*." (51.59f : 39.55m)
3. Group Work, evaluate statements: "*When working in a group, I feel confident in presenting my own opinion to the other group members*." (95.24f : 84.75m)
4. Role of the Teaching Assistant: "In my opinion a teaching assistant occupies the role of a respect person" (26.98f : 41.24m)

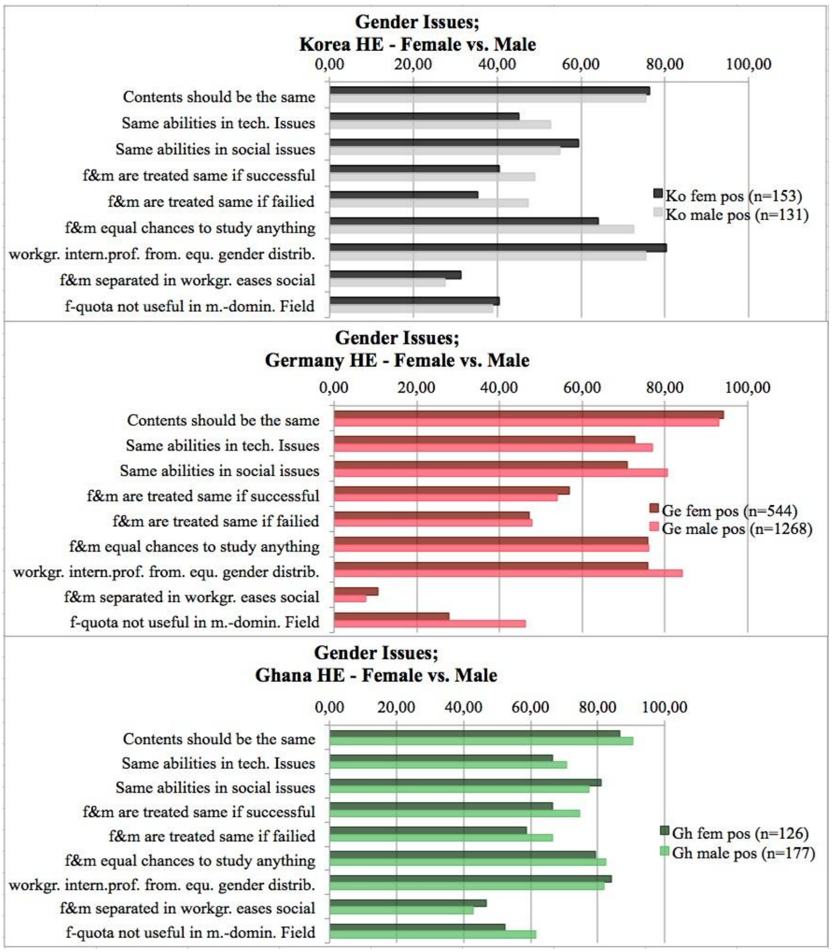

Figure 2. Gender Issues: Contrasting results from female and male students per item

There was a single item in which the responses of the female and the male students from all thee countries showed a similar high imbalance, which was "*I am easily discouraged because of others or situations*" in the thematic block "Motivation". While the level of imbalance was similar, the answers generally were not. In the South Korean sample, less female students felt the risk of being discouraged than male students. The samples from Germany and Ghana revealed the opposite. We have no explanation for this phenomenon; also Hofstede's Masculinity Index cannot provide an explanation, since in this dimension, Germany (66/100) and South Korea (59/100) are quite close to each other and Ghana is not included.

We display the results of the thematic block "Gender Issues" in a net diagram in Figure 3. It shows that between the three countries, there generally are cultural differences regarding most considered items. An exception is the item "*Workgroups intellectually benefit if the genders are represented in a well-balanced ratio*" where the distance between all three national samples is below 5 %. The largest cultural distance can

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be found between Germany and South Korea (27.36 %) regarding the item "*Women and men have the same ability in understanding complex technical information (e. g. in the domains of engineering, mechatronics)*", directly followed by the item "*Women and men are treated the same way when completing a task successfully*" (26.68 % difference between Ghana and South Korea).

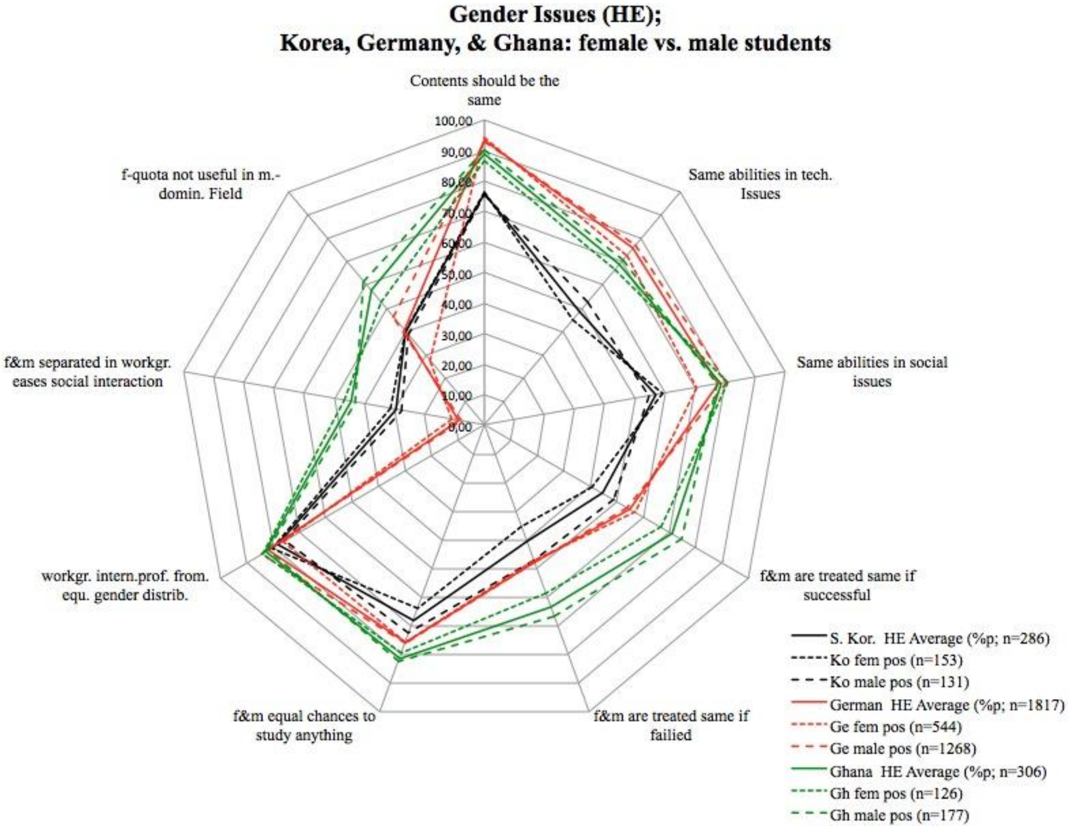

Figure 3. Gender Issues: Students' responses from South Korea, Germany, and Ghana contrasted in a net diagram

Regarding the treatment in cases of failed and succeeded tasks, a major imbalance between the female and the male students' responses from Ghana and South Korea were found. In both countries, the male students show a significantly higher confidence that both genders are equally treated than the female students. As for Ghana, this seems not to be a larger issue because both responses are in the positive interval of the scale (above 65 % positive). In Korea, in contrast, almost 65 % of the female students report an imbalance in treatment (35.29 % positive answers). In accordance of the almost 50 % of positive answers regarding easy discouragement (Motivation), this result is somewhat alarming. The corresponding result from the German sample also is not fully reassuring: Particularly regarding the treatment in case of failures, less than 50 % of all students expressed a balanced treatment according to the gender (but their assessment is similar).

According to the perceived confidence of female and male students in relation to gender-specific abilities to study in particular fields, the results were consistent across all three countries. In contrast to our expectation that male students (particularly in rather masculine societies) would generally express technological issues as their particular domain, more male students expressed that gender has no significant influence on the ability to study technical issues. Female students concordantly expressed a higher confidence that both genders can cope with study fields that are related to social issues.

5. LIMITATIONS OF THE STUDY

The general limitations of our survey have already been introduced in the sections 2.2 and 3. In this study, we applied an analysis in which we distinguished the results according to the gender of the respondents. We did not take into consideration the extent to which gender of the instructor might play a role for the students' perceptions of education. This could particularly be relevant when it comes to questions like the role and tasks of the instructor and shall be investigated in future (but separate) studies.

We did not try to explain the differences found amongst the specific cultures. Such explanations require a very profound understanding of each culture, and should keep reserved for local people. For our purposes (recognising conflict potential) it is sufficient to identify such differences.

6. CONCLUSION AND IMPLICATIONS FOR TEL

What our investigation generally showed is that analysing cultural phenomena can help recognizing patterns on how a particular society functions. However, such patterns do not reveal a complete story: Even if results can be considered representative for a society, they still do not reflect particular gender differences according to the investigated perceptions. In the context of higher education we found that even if following the same or very similar cultural patterns, such differences in perceptions of male and female students can actually be substantial. When aiming to reduce conflicts in educational scenarios and support students to keep their motivation on the highest possible level, such gender-related differences in perceptions of education can turn out to be significant and thus, need to be considered in the educational design. All reported findings of our study are relevant for both traditional education and TEL. Thus, implications and recommendations as provided in this paper can serve as recommendations for education in all settings.

Gender-related fairness regarding treatment after completed tasks in general and particularly after failure needs to be addressed in the German context. For Germany this is a major issue because what appears to be commonly recognized by both female and male students, violates the law. In the German context, no further peculiarities were found. All other items are located in the positive area, mixed gender workgroups are preferred, and the implementation of a female quota is somewhat undecided (almost normal distribution).

In the sample from Ghana, gender-related issues were all answered on a positive level from both female and male students. A higher divergence between the genders was found regarding the treatment after failing a task but both groups expressed a positive impression of fair treatment. In contrast to Germany and South Korea, students seemed to recognize a certain value in gender-separated education and workgroups.

In the context of South Korea, several items are located in the area between 40 % and 60 %, which indicates a rather individual than culturally biased evaluation. Equal treatment after finalized tasks is also an issue. Korean students do not prefer gender-separated groups but would rather have a female quota when it comes to the accessibility to male-dominant fields of study.

7. FURTHER STEPS

The Learning Culture Survey is driven forward by chance and is highly dependent on (mainly) voluntary support through universities. Since the questionnaire is to be conducted in the local languages, the availability of translated versions is a crucial precondition for investigations. Currently, questionnaire versions are available in Bulgarian, English, French, German, Greek, Japanese, Korean, Portuguese, Russian, and Turkish. All language versions are (being) implemented in our online survey system.

Due to data protection regulations, we cannot directly address the students in foreign universities. Thus, in order to proceed, we would like to invite universities from all over the world to support the Learning Culture Survey, be it through sending invitations for participation to their local students (after making an arrangement with us) or through contributing further translations. Once, the data collection in a particular university is completed, we are willing to share the results with the supporting university.

Our long-term objective is to provide our data in a publicly available database.

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IPADS IN LEARNING: THE WEB OF CHANGE

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ABSTRACT

Research in learning technologies has often focused on the affordances of single technologies such as pcs, smartphones or interactive whiteboards. However, in most learning environments technologies do not stand alone but are embedded in activity structures and webs of materials that make up the learning activity. This is specifically relevant when the object of study is mobile learning, where devices are flexible and follow the learner in his/her shifting learning activities and needs. This paper focuses on the ways in which iPads as learning technologies become involved in sociomaterial practices that are emergent and improvisational and how this contributes to educational change. The paper proposes that the introduction of tablets into classrooms will enroll devices in networks of learning that establish new and significant relationships between learning technologies such as iPads, whiteboards, pcs as well as books, pens and paper. These relationships challenge the idea that iPads can act as isolated and unique actors in educational development. The paper focuses on the ways in which teachers negotiate material cultures in schooling when iPads are involved in learning, i.e. how they become central actors in linking, translating and creating trajectories between the artefacts of learning. I study these processes from three perspectives that I identify as respectively capturing, bricolaging and building knowledge.

KEYWORDS

Mobile learning, material learning, Actor-Network Theory, teachers' professional competences

1. INTRODUCTION

John is a biology teacher in a school in the west of Denmark where teachers and pupils have recently been given iPads to use in the school year 2012-13. John likes to use both the interactive whiteboard and the blackboard to illustrate and explain processes such as the photosynthesis to pupils. He uses PowerPoints, illustrations from the internet, his own word files and chalk to work on the two boards at one end of the classroom. John also requires pupils to take notes on their iPads while he is talking, and sometimes to look in their books and check factual information while he is explaining the processes of photosynthesis.

John is one of several teachers in the teacher community at Middletown school in Denmark who organize their teaching by associating learning activities with different kinds of artefacts such as blackboards, whiteboards, pens, books, paper and iPads. The iPads, a promising new technology recently invested in by the school, are activated within this set of complex material and organizational practices that make up the learning of biology. In this web of learning materials, every artifact contributes to shaping the learning experience by adding to and acting in the chain of associations that John competently creates while he is teaching.

John's teaching is an example of practice that illustrates how learning technologies gain their significance by participating in a web of relationships which are materially and socially enacted as a part of schooling. As an example, John's teaching contradicts the idea that technologies such as the iPad are isolated agents of change in the culture and practice of schooling. In fact, such an idea will, as formulated by John Law, "conceal for a time the process of translation itself and so turn the network from a heterogeneous set of bits and pieces each with its own inclinations, into something that passes as a punctualised actor" (Law 1992, p 386, in Fenwick and Edwards 2012).

This paper aims to identify and follow the 'heterogeneous bits and pieces' orchestrated in teaching and how they make sense through links and translations. The paper builds on data from a research project that investigated the role of iPads in the learning of five classes of seventh graders (age 13-14) of which two were special needs classes. I followed these classes of seventh graders for 3 months of the school year, doing observations and interviews with teachers and pupils.The paper builds on the argument that schooling is a material culture in which artefacts are embedded in different kinds of activities that make up the learning and that iPads make specific contributions to these material cultures of learning.

2. SCHOOLING AS A MATERIAL CULTURE

Materialities and their significance in cultures of education are rich and relevant points of departure for studies in educational technologies as resources and their social meanings, qualities and agencies are central to the ways in which teaching and learning can be envisioned and performed (Waltz 2006, Nespor 2002). In fact, without the aid of materials for e.g. writing, drawing, listening, calculating and laboratory work teaching can neither, it seems, be envisioned nor enacted (McGregor 2003, Meyer 2013). Highly profiled technologies such as the iPad is just a recent addition to this complex web of artefacts in schooling which shapes the ways in which learners can learn and teachers can teach.

Though studies in the materiality of schooling can provide rich empirical knowledge about the ways in which artefacts are embedded in learning and learning environments, material objects and their agencies have, according to a number of recent studies largely been disregarded. Most prominent among these studies is research inspired by Actor-Network Theory (ANT) (Latour 2005, Sørensen 2009, Johri 2011, Fenwick, Edwards and Sawchuk 2011, Fenwick and Edwards 2012). These studies in various ways argue for the legacy of ANT in foregrounding the role of material cultures in learning.

According to Bruno Latour one of the significant contributions of ANT has been “to have transformed the social from what was a surface, a territory, a province of reality, into a circulation” (1999, 17). In education studies this can be translated into an understanding of how artefacts are enrolled in webs of sociomaterial negotiations that constitute processes of learning such as for instance writing, reading or doing biology (cf. the example above). In this understanding, according to for instance McGregor (2004) artefacts should not be understood as passive presences or mechanistic manipulators, but as actively participating in constituting spaces, trajectories and relationships in education. The legacy of ANT in education is therefore to provide both thick and multi-directional descriptions of networked chains of activities in schooling as well as a renewed understanding of the ways in which artefacts participate in these networks.

As a separate but related approach to the study of material cultures in education, historians of education have studied the ways in which objects have figured in and configured educational practices from the beginning of schooling until the present day (Lawn & Grosvenor 2001, 2005, Burke et al 2010). Lawn and Grosvenor (2001, 2005) for instance argue, through historical approaches to the materialities of schooling, that relationships between teachers and material technologies have existed since the formation of schools as specialist institutions in the early 19th century. Schools, they argue, usually come equipped with – or develop – material cultures in which teachers have had to constitute learning by linking activities to different kinds of artefacts. These include basic tools such as pencils, textbooks, rulers and blackboards, but have recently incorporated a variety of technologies such as recorders, computers and mobile devices.These material cultures – established through centuries of material practices - are essentially sedimented material cultures that teachers and learners can draw on when engaging in a variety of educational practices. As material cultures, artefacts in schooling are often enrolled in “a system of the teachers’ own devising” (2001, 122) where teachers design or improvise with the artefacts available to them in classrooms. In this way teachers become central actors in linking, translating and creating trajectories between the artefacts of learning, i.e in negotiating the educational significance of material cultures in schooling.

In this paper I want to look specifically at three ways in which IPads participate in teacher devised systems of related technologies. I identify these systems as respectively capturing, bricolaging and building knowledge through the linking of artefacts in networks of learning activities. Each of these systems provide different negotiations of iPad participation in learning – and therefore of different teachers’ associations of iPads with learning activities.

3. MATERIAL CULTURES IN MIDDLETOWN SCHOOL

Looking at schooling through the lens of material cultures can address the ways in which resources are acquired, circulated, preserved or discarded in educational cultures where educational change is associated with the investment in technologies (Lawn & Grosvenor 2001). IPads are, as highly profiled digital devices, intimately associated with the ways in which schools can invest in resources, implement them in practice and organise them as part of the teaching.

In Middletown school the issue of resources and their significance for learning has recently affected the practice of teaching in a number of ways. As is often the case with municipally funded schools in Denmark, Middletown school had for some time had no significant financial resources of its own. Over the years, the school has made some investments in laptops and interactive whiteboards, however, these were mostly made to support specific learners or to enhance classroom management through whiteboard technologies. When resources are scarce, teachers have to be resourceful and manage with whatever is available in school repositories, they are forced to preserve and engage with existing materials within the everyday practices of teaching. This is highly observable in the activities of teachers in Middletown school, cf. the example of John above.

The introduction of iPads into Middletown school in the summer of 2012 brought a new generation of devices into the school that in a very short time enabled teachers and pupils to take advantage of the learning potentials promised by mobile learning devices. As an educational resource the iPad from the beginning stood out from the materials and educational technologies teachers had been used to working with in the classroom for many years, i.e mostly low-cost, dependable and reusable resources such as books, jotters and pens.

As an educational resource, the iPad promised to link Middletown school with the educational innovation and school development associated with mobile devices – a link that, according to the school leader, might over time improve the profile and financial situation of the school. However, the leap into a potentially flexible, personalized and learner oriented educational environment was not generally followed by sufficient professional development of the teachers, as they were only given a couple of introductory courses to the use of apps which did not really relate to their teaching practices. As a result, teachers were generally forced to cope with the new technology on their own in the time allocated for the preparation of lessons, which did not leave much incentive or potential for changing the everyday practices of teaching. Therefore, the systems of practice that had already been established with regards to linking learning processes to a variety of dependable and available resources was largely maintained, and the iPad was enrolled as an additional educational resource in these practices.

As an initiative to modernize schooling the incorporation of iPads into Middletown school may therefore be interpreted as a relative failure. However, as I shall argue, the circulations of materials in Middletown school nevertheless became potential systems of change, as teachers turned out to be highly competent in orchestrating, organizing and enacting learning processes that involved elaborate systems of activities in which the iPad could participate.

In the following I shall give examples of and discuss the ways in which the iPad acted as a significant element in teaching in Middletown school.

4. CAPTURING CONTENT THROUGH THE IPAD

According to Schön (1983) professionals such as teachers constitute practices through the constant experimentation with and reflection in and through practice. In this way professionals become reflective practitioners who continually build on and expand their theories of practice. In Middletown school, teachers connect with both established ways of engaging artefacts in learning and transform these practices by incorporating artefacts in new ways through improvisation and reflection in practice.

As mentioned above, pencils, books and blackboards constitute the basic tools of schooling, especially in literacy practices which are intimately related to these artefacts. In a historical perspective, "The pencil, like the slate pencil, was engaged with 'imitation' of the teachers' work on the blackboard but it then allowed the use of copybooks to be developed and integrated with blackboard activities. Combining the blackboard, the pencil, and the copybook into an effective method of teaching, especially of the teaching of writing, was a 'device' or system of related technologies which has continued in modified form since" (Lawn & Grosvenor 2005, 11). Learning through literacy practices can therefore be understood as a system that involves several artefacts in copying from one 'device' onto the other.

As most of his colleagues, John, the biology teacher, has a practice based theory of learning that works as an often tacit basis for his orchestration of sociomaterial enactments in teaching. As most of his colleagues, John requires pupils to learn as a result of translating knowledge from authoritative learning resources such as books or PowerPoints onto their own paper or iPad. This can be observed both in John's classes and in those of his colleagues, where materials abound, and where teachers orchestrate relationships between artefacts and activities in the process of teaching. These orchestrations define trajectories in the sociomaterial enactments of learning, as when John asks pupils to copy information from the blackboard or whiteboard onto their iPads.

According to John the newly required iPads are user-friendly, easily accessible devices that generally support pupils' learning in biology and other subjects. However, the iPads, he feels, also contribute negatively to pupils' learning by eliminating or shortcutting trajectories of learning that were available to pupils before the shift to the tablets. For instance the pupils have discovered that they can take photos with their iPads when John explains something on the blackboard or whiteboard. John, however, feels that the activity of saving information through photographing eliminates a significant process in learning, i.e the process of copying down information through hand-activated note taking. In this sense, according to John, the addition of the iPad to the chain of material practices represents an inferior translation of subject knowledge and therefore constitutes inferior learning. As a consequence, John does not allow pupils to take photos with the iPad in class, he requires them to take notes by hand.

Like John, his colleagues at Middletown school have discovered that pupils take pictures of and save notes with their iPads when they are in class. However, unlike John, the majority of his colleagues feel that it is an advantage for most pupils to photograph and save information on the iPad instead of copying by hand from the blackboard or whiteboard. Photographing, as a translation from the blackboard to the iPad, will enable pupils to listen more attentively to what the teacher is saying, these teachers argue, and in addition to this, pupils who are slow readers and writers, will not slow down the teaching when photographing replaces hand-activated note taking. These examples illustrate how different translations of iPad and blackboard relationships constitute learning in different ways, according to teachers' theories of practice. These theories of practice contribute to defining the ways in which iPads can be added to the circulations of materials in Middletown school.

In digitalized cultures where mobile devices are increasingly embedded in everyday practices, media convergence is, according to Kress (2010), a central and ubiquitous phenomenon. Smartphones and other portable devices for instance bring together the functionalities of formerly separate digital devices, such as cameras and telephones. One of the consequences of this convergence is that the capturing of images and copying of semiotic material from the internet has gained priority over producing written content. Kress argues that this process of convergence "changes the way we conceive of representational means and meaning-making in the world, favouring selection, 'capture' and transformation rather that 'production from scratch'" (2010, 188). This capturing of content adequately describes the processes associated with translating and saving material onto the iPad in John's class, and the ways in which pupils transform note-taking from a production from scratch activity to an image that can be saved. Capturing therefore becomes a significant activity that the iPads add to the system of sociomaterial enactments in Middletown school, an activity that in different ways feeds into the visual culture in the school.

5. IPADS IN VISUAL CULTURES; CRAFTING AND BRICOLAGE

As argued by Kalthoff and Roehl (2011) classroom teaching makes extensive use of the sense of sight. In teaching, knowledge is for instance often made visible by teachers' blackboard illustrations or by objects, maps or diagrams designed to represent knowledge areas such as geography, science or biology. In classrooms, visual cultures are both part of teachers' use of educational tools and of learners' end products.

John's colleague Lucy is a teacher who often uses visual representations such as posters in her teaching. Posters, unlike capturing, are creative, often pupil-produced visual representations made from scratch to illustrate and collect aspects of a specific theme or issue.

Posters are visual representations of the ways in which learning is constituted through sociomaterial processes. Posters involve the association of both simple objects such as pens, paper, cardboard and technologies such as iPads. As assemblages of materialities and modes, posters both represent and involve a number of translations between materials, modes and activities that make up a topic or a field of knowledge. As a representation the poster is a "socio-material bricolage" (Johri 2011), i.e. it is produced as the result of a number of processes in which translations are made between different kinds of materials that act as mediators for learning. In Middletown school, posters are deeply embedded in the teaching and learning processes, partly as an aspect of project pedagogy, which usually involves some kind of crafting where pupils are required to work on their own in finding knowledge about a specific topic.

An example of Lucy's teaching is a project based learning process in geography where pupils have to find information about a country of their own choice and illustrate their knowledge by making a poster. Lucy presents the assignment to the pupils by giving them a colourful poster she has copied from a book she uses in school. The poster both visualizes topic areas such as population, nature, economy, and environment and in simple textboxes suggests relevant questions the pupils can work with. The poster presents itself as a teacher directed illustration of how visual and written representations can be assembled to make up a country description.

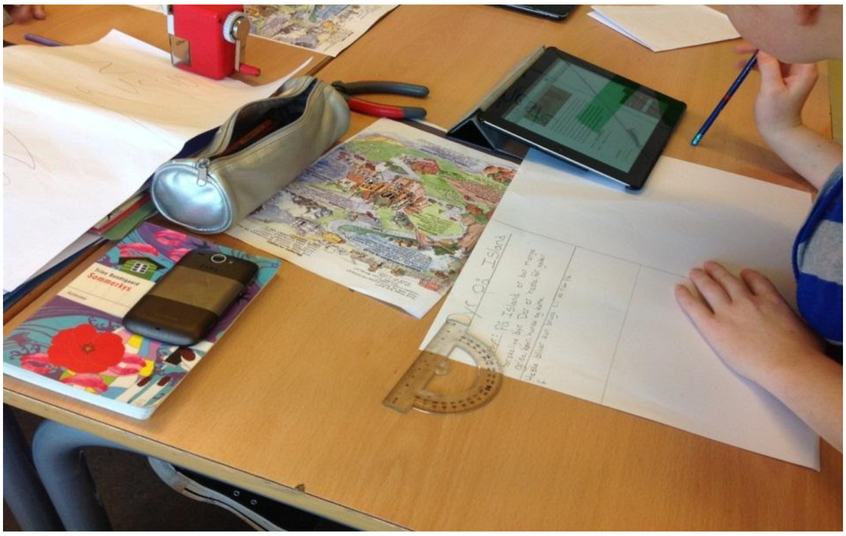

Figure 1. Working on the poster

In class I follow a couple of the groups of pupils and their work on the geography project. One group is working on Iceland as a country, describing aspects of for instance nature and animals. The group consists of a girl and two boys, the boys work together on making a flag and finding factual information about Iceland. The girl collects and copies material onto their joint poster. In order to produce the poster, the pupils use a number of resources, for instance paper, cardboard, pencils and iPads.

Making the poster involves the iPad in different ways. In the chain of materialities that are enrolled in the making of the poster, the iPad acts as a repository of different kinds of information that can be accessed through the internet. The girl for instance uses the iPad to access Wikipedia and other webpages where she can find information about natural phenomena and animals in Iceland. This information is translated, i.e. written, onto the poster by pencil and hand. One of the boys in the group is making a cardboard representation of the Icelandic flag. He uses Google to find pictures of the flag that he translates onto coloured cardboard. This translation creates links between the screen image and the cardboard which are different representations of the Icelandic flag as a materiality that 'represents' Iceland. In both cases, the pupils create their (visual and written) productions from scratch, i.e. they do not shortcut the learning process by capturing. The process of making the poster becomes a "socio-material bricolage" (Johri 2011), in which several modalities and materialities are activated.

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In Lucy's system of educational tools assembling and bricolaging itself becomes a potential end product of learning as is illustrated in the making of the posters. Bricolaging becomes the system that holds teaching and learning together as networks of sociomaterial enactments. Bricolaging also becomes the practice that enrolls iPads in learning as part of the circulations of materials in the classroom.

6. BUILDING AND CRAFT CULTURES IN MATH AND HISTORY

In Middletown School low-key technologies co-exist with cutting-edge technologies such as the iPad and interactive whiteboards. The process of building new knowledge therefore often involves an association of these different resources and incorporates their potential 'affordances'. Building also becomes a metaphor for learning itself, as will be illustrated by the following example.

In project work learning processes are often linked to artefacts that have specific qualities for learning or practicing particular skills. In Middletown school the history and math teacher have collaborated on planning a project that integrates a number of material resources that will help learners to understand mathematical and historical aspects of buildings and architecture. The history teacher tells me about the project. In class, he says, the pupils will be working with papercraft, i.e. cardboard, to understand scaling as a mathematical aspect of buildings. Before working in class the pupils have visited a square in the local city that they have measured and are reproducing in different scales in class. In class they have learned how they can work with cardboard by gluing the sides of cardboard together to make three dimensional buildings. In order to work with this skill they have cut out and built a church in cardboard. On top of the square they built from their visit to the city, pupils are constructing a number of different buildings that fit the scale of the square. Some of these buildings have a historical significance, for instance Big Ben and Brandenburger Tor. These buildings are built in Lego, the plastic toy brick made in Denmark.

Onto this heterogeneous chain of materials the iPad is added as a new element that can further qualify the process of conceptualizing and visualizing the processes of building and scaling and the historical significance of buildings. The history teacher tells me how at the end of the chain, pupils are asked to build in Minecraft, using the original idea of the square as a basis on which to build. What building in the Minecraft app can add to this process is enabling the pupils to see the building from the inside, i.e. in a 3D perspective. Through Minecraft, pupils can build architecture, for instance tunnels, that they can look at and understand from the inside.

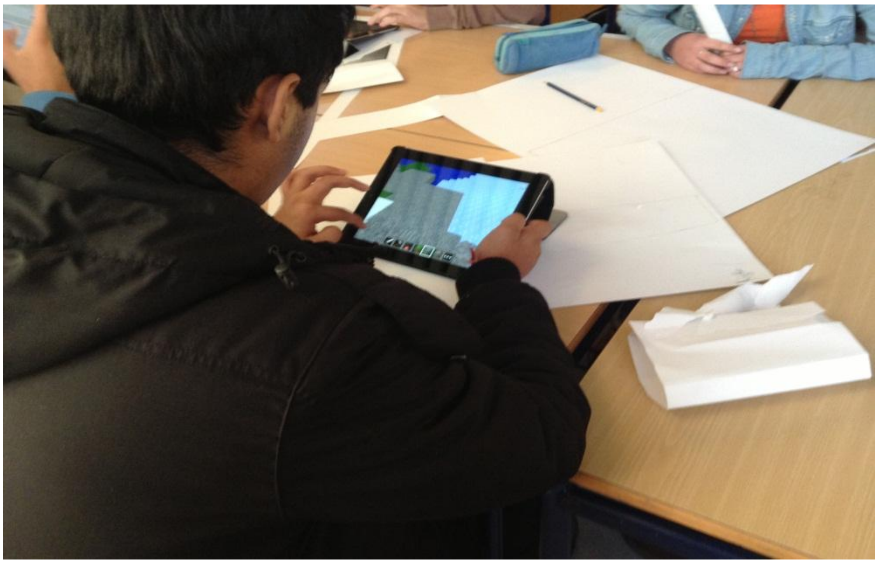

Figure 2. Building in Minecraft

The chain of learning through building is – as a system – similarly to the processes described above - a multi-purpose chain of learning that links not only heterogenous materials such as cardboard, glue, scissors, rulers, software etc., but also different subject areas, skills and aspects of buildings as a historical and material phenomenon. In addition to this the chain of learning links local buildings with buildings in other parts of the world, combining the different aspects of their historical and functional significance in the study of 'building' as a learning activity. The complexity of this process of linking, associating and translating between materials becomes even more complex in class, where individual pupils link up in different ways at different paces and with different materials in the chain - and where more artefacts are linked to the system. In class, I for instance observe how some pupils prefer to work with the iPad, and others are continually occupied with building in Lego. In class, I also observe how one boy, who is very competent at building in Minecraft, links his iPad to the class projector which displays his process of building Brandenburger Tor to the class. This performance of 'building Brandenburger Tor' is an activity, supported by the teacher, that takes place simultaneously with other building processes and trajectories through the chain. The generic work with building can in this way be constructed individually or specifically, as 'chains within the chain' of learning through sociomaterial enactment and bricolage.

7. CONCLUSIONS

In this paper I have identified ways in which teachers activate iPads and other kinds of resources in learning by linking them to systems of their own devising in which artefacts and their modalities constitute significant nodes in the web of learning. As a resource in the classroom the iPads participate actively in and in different ways contribute to both maintaining established ways of learning and innovating learning through for instance the processes of capturing, bricolaging and building. In the examples given, the iPad never acts as an isolated actor in learning but is continuously enrolled and made significant in pupils learning as an aspect of teachers' construction of sociomaterial systems of learning. These systems of material learning engage both basic tools and technologies such as the iPad, and enable pupils to link onto different parts of the chain. Building in this way becomes both a metaphor for learning process itself, and for the ways in which the pupils can construct their individual learning trajectories and incorporate or give priority to specific learning materials.

As a flexible, mobile device the iPad may be specifically suited to engaging in fluid and emergent teaching and learning practices and to combine with heterogeneous content, modalities and learning rhythms. Bricolaging and capturing are examples of such processes where the iPad adds to and innovates the visual culture of Middletown school and where modalities are combined in new associations of literacy practices (ie. capturing). However, as the examples illustrate, teachers are nonetheless central in initiating, negotiating and managing these chains of resources and in understanding how the links between learning activities and materials support the learning needs of different learners. The paper therefore suggests that teachers' digital literacy must include not only the ability to use and manage specific educational technologies in the classroom but to understand the significance of the ecology of learning, i.e. of the web of relationships between resources (including 'technologies') and how these resources can be linked to make sense in pupils' learning. Such an approach to teachers' digital literacy will make room for processes of translation and association between the "heterogeneous set of bits and pieces" that make up learning.

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A BLENDED APPROACH TO CANADIAN FIRST NATIONS EDUCATION

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ABSTRACT

The purpose of this research study was to investigate if and how a blended approach to Canadian First Nations education could be used to foster student engagement and success. The study examined the SCcyber E-Learning Community program (2012) through the lens of the *Seven Principles of Effective Teaching* (Chickering & Gamson, 1999). Data was collected via an online survey, interviews, and site visits. The study participants indicated that the deliberate and intentional integration of local learning centers and mentors with online teachers, who provide synchronous tutorials through the use of a web-based learning management system and conferencing tool, was the key to academic success.

KEYWORDS

E-learning model, Remote Access, Blended Learning, Canadian First Nations, Synchronous

1. INTRODUCTION

The Sunchild First Nation Reserve (40) is located in the western central part of Alberta, Canada. The reserve has an area of 52.18 square km. As of 2008, the First Nation has a registered population of 1209 people, of whom 732 live on their reserve (Government of Canada, 2008).

In 1999, members of the Sunchild First Nation considered the lack of education in their community and decided alternative methods were needed to reach First Nations students. They discovered that:

- First Nations students faced unique challenges including family and legal situations, time away from class and relocating to new homes.
- Many First Nations students were adults. These students wanted to upgrade and build a better future while meeting their current schedules and responsibilities (SCcyber E-Learning Community, 2012).

In order to address these challenges the SCcyber E-Learning Community Program was established. This program adopted a blended learning approach for high school courses by combining the use of learning centers and local mentors with online teachers who provide synchronous tutorials through the use of a web-based learning management system and conferencing tool.

2. BODY OF PAPER

2.1 Blended Learning

The idea of blending different learning experiences has been in existence ever since humans started thinking about teaching (Williams, 2003). What has recently brought this term into the limelight is the infusion of web-based technologies into the learning and teaching process (Clark, 2003). These technologies have created new opportunities for students to interact with their peers, teachers, and content.

Blended learning is often defined as the combination of face-to-face and online learning (Williams, 2002). Ron Bleed, the former Vice Chancellor of Information Technologies at Maricopa College, argues that this is not a sufficient definition for blended learning as it simply implies “bolting” technology onto a traditional course, using technology as an add-on to teach a difficult concept or adding supplemental

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information. He suggests that instead, blended learning should be viewed as an opportunity to redesign the way that courses are developed, scheduled and delivered through a combination of physical and virtual instruction, "bricks and clicks" (Bleed, 2001). The goal of this redesigned approach to education should be to join the best features of in-class teaching with the best features of online learning to promote active, self-directed learning opportunities for students with added flexibility (Garnham & Kaleta, 2002). This sentiment is echoed by Garrison and Vaughan (2008) who state that "blended learning is the organic integration of thoughtfully selected and complementary face-to-face and online approaches and technologies" (p.148). A survey of e-learning activity by Arabasz, Boggs & Baker (2003) found that 80 percent of all higher education institutions and 93 percent of doctoral institutions offer hybrid or blended learning courses (Figure 1).

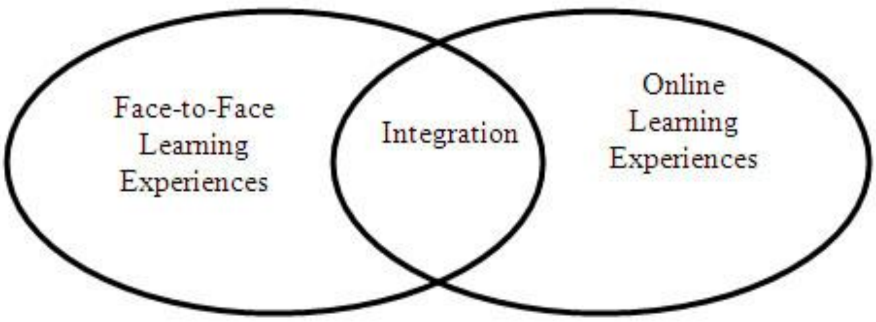

Figure 1. Campus-based blended learning approach

Campus-based environments have their roots in educational systems where classes have been delivered by teachers in synchronous class lecture settings. Initially, blended learning has been used to complement these synchronous lectures through the use of asynchronous discussion forums and learning management systems such as *Blackboard* and *Moodle*. With the advent of synchronous tools, such as *Blackboard Collaborate* and *Adobe Connect*, opportunities have been created to provide students with both synchronous and asynchronous communication possibilities.

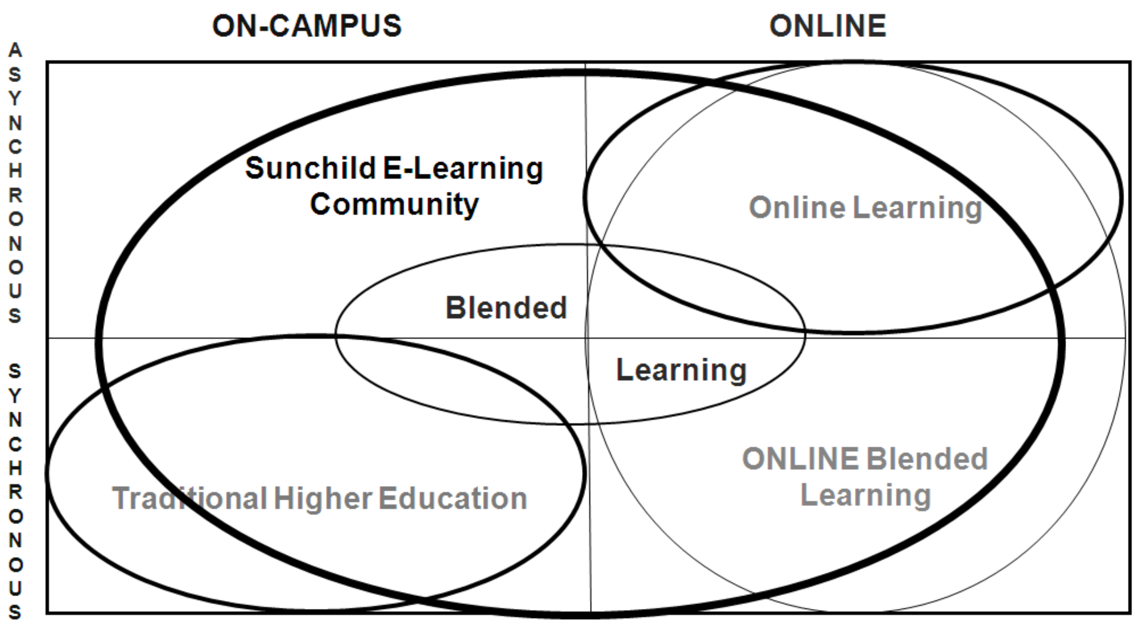

Figure 2. SCcyber E-Learning Community Program Framework

Power (2008) has coined the term Online Blended Learning to describe the simultaneous and complimentary integration and implementation of an asynchronous-mode learning environment (i.e. a course management system, or CMS) and a synchronous desktop conferencing environment (i.e. virtual classroom). The SCcyber E-Learning Community framework has further expanded this conception of blended learning by fully integrating face-to-face and online synchronous and asynchronous learning opportunities for their students through the use of local mentors at physical learning sites and highly qualified online teachers (Figure 2).

2.2 Methods of Investigation

An action research (Stringer, 1999) and case-based method (Creswell, 1997) were utilized for this study. This approach consisted of a mixture of quantitative and qualitative data collection methods. All students enrolled in the SCcyber E-Learning Community program were invited to complete an online survey in the fall 2011 semester and then follow-up online interviews were conducted in December 2012 with four of the students who completed this survey. In the winter 2012 semester, these online interviews were expanded to include seven mentors, two online teachers, and the principal of the program. Two site visits were also conducted (Chinki Adult Education Center and the Calgary Aboriginal Futures Center).

The educational research literature strongly suggests that student engagement is the key to academic success and retention (Astin, 1999; Kuh, 2008; Pace, 1980; Pascarella & Terenzini, 2005). The National Survey of Student Engagement (NSSE) defines student engagement as the amount of time and effort that students put into their academic studies that lead to experiences and outcomes that constitute student success, and the ways that programs allocate resources and organize learning opportunities and services to induce students to participate in and benefit from such activities (NSSE, 2011). The NSSE is constructed on the Seven Principles of Effective Teaching (Chickering & Gamson, 1999):

1. encourages contact between students and teachers,
2. develops reciprocity and cooperation among students,
3. encourages active learning,
4. gives prompt feedback,
5. emphasizes time on task,
6. communicates high expectations, and
7. respects diverse talents and ways of learning

These seven principles are based on over fifty years of educational research (Graham et al., 2001) and they were used to guide the data collection and analysis for this study.

2.3 Findings and Recommendations

This section begins with a demographic profile of the student participants followed by a summary of the results for each of the three research questions based on the seven principles of effective teaching framework:

1. What are the advantages of a blended approach to Canadian First Nations education?
2. What are the challenges?
3. Recommendations for improving this approach to Canadian First Nations education?

2.3.1 Demographic and Technology Profile of Student Participants

There were approximately three hundred students enrolled in the SCcyber E-Learning Community in the fall 2011 semester. In order to establish a context for the study findings, the initial online survey asked a series of demographic questions (n=24, 8% response rate). Table 1 compares the demographics of the SCcyber E-Learning Community students to students at a university in Calgary, Alberta who had recently completed a similar survey (Vaughan et al., 2011).

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Table 1. Student Comparison of SCcyber E-Learning Community and Mount Royal University Students

Student Item	SCcyber E-Learning Community	Mount Royal University
Gender		
Female	68%	55%
Male	32%	45%
Age		
Under age of 24	54%	89%
Over age of 24	46%	11%
Place of Residence		
Living with parents	46%	62%
Living with own family with children	42%	0%
Living alone	0%	10%
Living with roommates or partner with no children	13%	23%
University residence	0%	5%
Employment Status		
Currently not working	83%	23%
Currently working part-time	16%	65%
Currently working full-time	0%	23%

Two-thirds of SCcyber E-Learning Community students were female and one-third were male. The students surveyed ranged in age from 18 to over 41. There appeared to be a bi-modal age distribution with two-thirds of the students between the ages of 15 to 27 and one-third between the ages of 31 to 41 plus. In terms of place of residence, 46% of the students lived with their parents, 42% lived with their own family with children, and 12% lived with roommates or partner with no children. With regards to employment status, 83% of the students were not currently working compared to only 23% of the Mount Royal students (the remainder have either a part or full-time job).

A similar comparison was made between SCcyber E-Learning Community and Mount Royal University students with regards to access to technology and self-reported skills (Table 2).

Table 2. Comparison of Technology Access and Skills between SCcyber E-Learning Community and Mount Royal University Students

Technology Item	SCcyber E-Learning Community	Mount Royal University
Home access to the Internet	37%	100%
Access to high-speed home Internet connection	33%	98%
Have your own a mobile communication device (e.g., cell phone)	62%	90%
Have your own laptop computer	38%	89%
Have your own a mobile communication device with Internet access (e.g., Smart Phone)	29%	82%
Personal Rating of Computer Skills		
Novice (not really comfortable using computers)	0%	5%
Intermediate (comfortable using computers)	70%	59%
Advanced (have developed some expertise and enjoy using a computer)	30%	36%

In terms of technology access, only 37% of the SCcyber E-Learning Community students surveyed had home internet access. Two-thirds of the students had a mobile communication device (e.g., cell phone, Blackberry, iPhone), 38% had their own laptop, and 33% had access to a desktop or laptop computer at home that they share with others. Despite this lack of home and personal access to computer technologies, through participation in the SCcyber program, 70% percent of the students rated themselves as intermediate with regards to their computer skills while 30% rated themselves as experts.

2.4 Seven Principles of Effective Teaching Practice Framework

Below are the seven principles analyzed qualitatively in regards to the successful framework in which Sccyber E-learning model operates and highlights how this has resulted in successful course completion rates.

2.4.1 Principle 1: Good Practice Encourages Student-Teacher Interaction

Synchronous and asynchronous communication technologies are being used by students in the SCcyber E-Learning Community to increase access to their online teachers and mentors, help them share useful resources, and provide for joint problem solving and shared learning that is being combined with face-to-face mentoring at the learning centers. These communication technologies are strengthening online teacher interactions with all students, but especially with shy students who are reluctant to ask questions or challenge the teacher directly. These students find that it is often easier to discuss values and personal concerns in writing rather than orally, since inadvertent or ambiguous nonverbal signals are not so dominant.

The roles and responsibilities of the online teacher in this program can become overwhelming and a recommendation has been made to have each of the online teachers log their daily activities for a one week period. Then, at one of the monthly team meetings the results can be shared and strategies developed for managing the workload of an online teacher in the SCcyber E-Learning Community.

2.4.2 Principle 2: Good Practice Develops Reciprocity and Cooperation among Students

The SCcyber E-Learning Community strategically works at creating a cooperative learning environment amongst the students, parents, mentors, and online teachers. The focus of the program is on self-paced learning but the study participants suggested that communication and information technologies could be used to support additional opportunities for study groups, collaborative learning, group problem solving, and discussion of assignments.

In addition, many of the students and mentors emphasized how important it is to create a sense of community at the learning centers (e.g., displaying student work on the walls, creating a student council, creating a lunch and leisure space). A recommendation has been made to have senior mentors travel to new sites to help the new mentors establish their learning centers.

2.4.3 Principle 3: Good Practice Uses Active Learning Techniques

The range of technologies that the SCcyber E-Learning Community uses to encourage active learning is extensive. In the past, apprentice-like learning has been supported by many traditional technologies: libraries, laboratories, art and architectural studios, athletic fields. Newer digital technologies can now enrich and expand these opportunities – especially for those students located in rural and remote parts of Alberta and the Northwest Territories. For example:

- Supporting apprentice-like activities in fields that themselves require the use of technology as a tool, such as statistical research and computer-based music, or use of the Internet to gather information not available in the local library.
- Simulating scientific techniques such as helping chemistry students develop and practice research skills in “dry” simulated laboratories.
- Helping students develop insight. For example, students can be asked to design a radio antenna. Simulation software displays not only their design but the ordinarily invisible electromagnetic waves the antenna would emit. Students change their designs and instantly see resulting changes in the waves. The aim of this exercise is not to design antennae but to build deeper understanding of electromagnetism.

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Many of the students enrolled in this program also have their own mobile devices and a recommendation has been made to have them use these devices to document and record their learning in their local communities. For example, they could use their phones to take pictures and record videos that could then be used in the creation of digital stories for course assignments (*Center for Digital Storytelling* - http://www.storycenter.org/).

2.4.4 Principle 4: Good Practice Gives Prompt Feedback

The combination of a learning center mentor and online teacher for each course ensures that all students enrolled in the SCcyber E-Learning Community receive timely and regular feedback about their academic studies. Students receive a report card every Monday morning and they can make adjustments to their work level for course completion on a weekly basis. Computers also have a growing role in recording and analyzing personal and professional performances. Teachers can use technology to provide critical observations for an apprentice; for example, video to help a novice teacher, actor, or athlete critique his or her own performance. Teachers (or other students) can react to a writer's draft using the "hidden text" option available in word processors: Turned on, the "hidden" comments spring up; turned off, the comments recede and the writer's prized work is again free of "red ink."

In addition, as Alberta Education moves toward portfolio assessment strategies, computers can provide rich storage and easy access to student products and performances. Computers can keep track of early efforts, so teachers and students can see the extent to which later efforts demonstrate gains in knowledge, competence, or other valued outcomes. Performances that are time-consuming and expensive to record and evaluate — such as leadership skills, group process management, or multicultural interactions — can be elicited and stored, not only for ongoing critique but also as a record of growing capacity.

2.4.5 Principle 5: Good Practice Emphasizes Time on Task

The SCcyber E-Learning Community program allows students to work at their own pace in a safe environment with constant monitoring of their progress. The mentors and online teachers interviewed indicate that some students have problems completing their assignments in a timely fashion and thus, have to hastily complete a large portion of them at the very end of the semester. Strategies have been put in place to enforce regularly-distributed deadlines that encourage students to spend time on tasks and help them avoid procrastination. These deadlines also provide a context for regular weekly contact with the mentors and online teachers.

2.4.6 Principle 6: Good Practice Communicates High Expectations

This program does an excellent job of communicating high expectations and publicly praising students through the *Wall of Success* (student course completion certificates) at each learning center. Communicating high expectations for student performance is essential. An additional way for teachers to do this is to give challenging assignments. For example, assigning tasks that require students to apply theories to real-world situations rather than remember facts or concepts. This case-based approach involves real-world problems with authentic data gathered from real-world situations.

Another way to communicate high expectations is to provide examples or models for students to follow, along with comments explaining why the examples are good. Teachers can provide examples of student work from a previous semester as models for current students and include comments to illustrate how the examples met the required expectations. In addition, the online teacher can provide examples of the types of interactions she or he expects in the discussion forum. One example would be to provide an exemplary posting while also providing an example of what *not* to do, highlighting trends from the past that she or he would like students to avoid.

2.4.7 Principle 7: Good Practice Respects Diverse Talents and Ways of Learning

Finally, the SCcyber E-Learning Community clearly demonstrates how communication and information technologies can be used to support different methods of learning through powerful visuals and well-organized text; through direct, vicarious, and virtual experiences; and through tasks requiring analysis, synthesis, and evaluation, with applications to real-life situations. These digital tools are also being used to encourage self-reflection and self-assessment. In addition, technologies are being used in this program to help students learn in ways they find most effective and broaden their repertoires for learning. The technologies, with the mentor and online teacher's support, are supplying the structure for students who need it while leaving assignments more open-ended for students who don't. Fast, bright students can move quickly through materials they master easily and go on to more difficult tasks; slower students can take more time and get more feedback and direct help from the online teachers and mentors.

3. CONCLUSION

If students learn to make education a priority they are *going to succeed in life.*
(SCcyber Mentor Interview)

The study participants indicated that the blended approach of the SCcyber E-Learning Community program through the deliberate and intentional integration of local learning centers and mentors with online teachers, who provide synchronous tutorials through the use of a web-based learning management system and conferencing tool, was the key to academic success. They also emphasized how this blended approach helped First Nations students overcome major learning challenges such as remote locations, lack of access to digital technologies, high speed internet access, and quality teachers.

Finally, every SCcyber E-Learning Community student who participated in this study commented on the "passion and commitment" that the mentors, online teachers, and administrators involved in this program had for student success. They all emphasized that the SCcyber E-Learning Community was "making a difference for their lives". This enthusiasm for learning is definitely infectious and it is strongly recommended that more government departments, educational institutions, and corporations partner with this program in order to expand the positive impact on the lives of First Nations students in Canada.

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A STORYTELLING LEARNING MODEL FOR LEGAL EDUCATION

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ABSTRACT

The purpose of this paper is to describe a learning model based on *Storytelling* and its application in the context of legal education helping build challenging training resources that explain, to common citizens with little or no background about legal topics, concepts related to *Legal Mediation* in general and in specific areas like e-commerce and civil liability. The defined model has been contextualized with respect to relevant literature and implemented through the development of two software components that have been integrated in an existing e-learning environment. Such an e-learning environment is itself a module of a greater experimental system for *on-Line Legal Mediation* named eJRM.

KEYWORDS

Storytelling, Narrative Based Learning, Adaptive Learning, Legal Education, Legal Mediation.

1. INTRODUCTION

In March 2011 the Italian Government introduced mandatory pre-trial mediation of civil and commercial cases. After a ten-month stop due to a provision by the Italian Constitutional Court, the mandatory mediation came in force again in September 2013 with a new regulation. The Italian mediation model is capable of sensibly speed-up the settlement of disputes but, on the other end, it needs efficient and effective tools to support the explosion of mediations. Citizens also need to be sensitized to the benefits of mediation and must be trained on how mediation works and how to access it.

The project eJRM "*electronic Justice Relationship Management*", supported by the Italian Ministry of University and Research, brings together researchers and practitioners in the fields of law and computer science with the aim of defining, implementing and experimenting innovative methods for managing on-line mediations. The project foresees the development of a complete environment for on-line mediation with innovative features like the possibility, for a citizen, to formalize a case in natural language and let the system provide relevant information for autonomous case resolution such as connected laws, relevant jurisprudence, training modules, links to lawyers with useful competencies, etc. (Arosio et al., 2013).

eJRM also covers the definition and development of engaging training modules, targeted to citizen with little or no background on legal topics, aimed at explaining concepts related to legal mediation in general and in specific areas like e-commerce and civil liability. In line with a tradition of *Narrative Pedagogy* applied to legal education, we decided to adopt, in this case, a *Storytelling* paradigm. The purpose of this paper is to describe the developed model and the first results obtained in its implementation.

Starting from the well-known *Visual Story Portrait* (Stanley and Dillingham, 2009), we defined a story model composed of several situations where each one is made of subsequent events aiming respectively at interesting the learner, providing the required information, supporting reflection and assessing the acquired knowledge. We also integrated a *dynamic branching* mechanism that allows the re-articulation of the story on the basis of assessed training results to support the recovery of found knowledge gaps. The model has been implemented and integrated within an existing training environment. A sample story about mediation in the e-commerce field has been also defined for a first validation of the system and of the underlying model.

The paper is organized as follows: section 2 contextualizes the research described in this paper in the framework of research on narrative pedagogy and storytelling applied to legal matter; section 3 describes the defined model; section 4 presents the developed prototype; section 5 describes the experimental story defined for system validation.

2. RELATED WORK

The goal of legal education is the teaching and learning of legal and case law doctrine. In teaching practices documented in literature a clear dichotomy emerges between a more theoretical approach to knowledge transfer and a more practical approach aimed at developing skills and knowledge in action. The first, more common in Europe (where law schools are based on traditional methods which make use of resources such as lectures, essays and manuals), focuses on the discussion of abstract concepts and on the explanation of rules often far from concrete experience.

Quite different instead is the approach adopted by Anglo-American countries, where the teaching approach applied is based on practice, and on assignment of specific tasks to groups of students, pointing out resources analysis, and resolution of cases. Most of such schools resort to specific teaching methods like *Casebooks* based on true or fictional stories; *Legal Clinics* i.e. real *hands-on legal experiences* where students are called to offer pro bono legal services to real clients under the guidance of experienced teachers; *Moot Courts* i.e. simulation of a real appeal and competition with others, whose value is amplified by the use of information and communication technologies (Lettieri et al., 2011).

Narrative Pedagogy has an increasing importance in this context. Effectively utilized in several disciplinary contexts and domains, it guarantees, even within the legal framework, a high degree of learner's involvement and of skills development (Blissenden, 2007). Jurists of Anglo-American countries were the first to emphasize the importance of narrative pedagogy and the interrelationship between law and literature. Cardozo in deed published the essay "*Law and Literature*" already in 1925, introducing the possibility that narrative offers to accept, through the literary representation, the context within which legal experience takes place: *law in action* as opposed to *law in books.*

However, it is from the 1970s that the researchers began to focus not more on literary texts analysis, but on the training and education potential that the use of narration can have in the legal field. Between the 1980s and 1990s, several professors from important law schools and also legal scholars, tried to emphasize and promote the introduction of *Storytelling* as an alternative teaching method or as an addition to traditional techniques used to teach legal topics. This second phase was launched by studies like "*The Legal Imagination: Studies in the nature of the Legal Thought and Expression*" (White, 1985).

It is precisely in the 1980s and 1990s that the academic world reassessed the use of narrative in teaching (Bruner, 1984) and law schools introduced storytelling in their classrooms. In this way, the understanding of concepts that are often too abstract was facilitated through realistic o real stories. Furthermore, students were involved in role-playing games that, through different views, allowed them to empathize with the characters in the story, creating emotional and empathetic immersion.

In the period 2007-2009, the literature presented a view of the applied strategy of storytelling in the legal environment and "*to weave the law in the stories*" seemed to become the best way to preserve concepts and think about possible applications (Steslow and Gardner, 2011). Five techniques to integrate storytelling with traditional legal education were defined: *Metaphorical Stories* (i.e. stories told to explain complex concepts), *War Stories* (i.e. stories told to explain a legal rule or doctrine after the students labour through analysis of rule and its application), *Case Stories* (i.e. stories describing legal cases), *Storytelling through literature* (i.e. lifelike characters and stories from literature taken as a model), *Sharing stories* (i.e. individuals that integrate and build together their own stories expanding them routes and viewpoint).

In recent years, thanks to digital technologies, the *Digital Storytelling* captured the attention of experts and researchers and leaded to evaluating the potentiality related to its adoption. For example, *CivilObiezion!* (Steslow and Gardner, 2011) is a series of computer gaming trial simulations in which students play the role of lawyers. The players are invited to evaluate questions posed to a witness in the course of a hearing and to decide whether it is possible to oppose according to the Federal Rules of Evidence. The student must choose when to oppose and select an explanation for the objection made. Acceptance or rejection of the objection are decided by computer that plays the role of judge.

TLE (Transactional Learning Environment), developed in 2000 by Glasgow Graduate School of Law (GGSL) and UK Centre for Legal Education (Maharg, 2007), is a virtual simulation environment used in a professional legal practice training course. TLE is built around an on-line virtual town containing utilities, businesses, agencies, government organizations etc. which provide the backdrop for students to progress simulated legal transactions.

Fishbowl Online Role-Play (Douglas and Johnson, 2010) is an educational game based on problem solving for the development of legal skills. The game provides students with opportunities to practice legal skills by taking different roles that allow them to practice interviews to witnesses, legal advice and moments of judicial negotiation and enjoy instructional scaffolding moments that promote the construction of knowledge in action. The narrative game allows the development of specific skills in the negotiation and mediation field as well as those required to conduct an interrogation.

3. THE LEARNING MODEL

This section describes the *Storytelling model* we have defined in the context of the eJRM project. The model was purposed to build challenging training resources to explain, to common citizens with little or no background about legal matter, concepts related to *Legal Mediation* in general and in specific areas like e-commerce and civil liability. The training resource had to transfer notions about procedures to follow, actors involved, normative references about mediation and advantages of such a method of disputes resolution with respect to a legal trial.

To develop our model, the *Visual Story Portrait* (VSP) was investigated. It is a very much in use story map characterized by some essential elements as shown in figure 1: *Problem*, *transformations* of main character (whom the student is normally identified with) and *story closure*. To assess the power (the *storyability*) of situations, the story is conceptualized in terms of *transformations formations*, transformation layers of several types: physical/kinesthetic, inner strength, emotional, moral, intellectual, psychological, social and spiritual (Ohler, 2006).

The proposed model considers the *intellectual transformation* of VSP as changes in terms of *learning objectives* extracted from Bloom's taxonomy (Bloom et al., 1956). The learners are encouraged to use the knowledge and cognitive skills to go through different teaching situations associated with various phases of a classical VSP (Mangione et al., 2013). The correspondence between situations of VSP and learning objectives of Bloom (Krathwohl, 2002) guides the transformation of the *character* and the structure of situations.

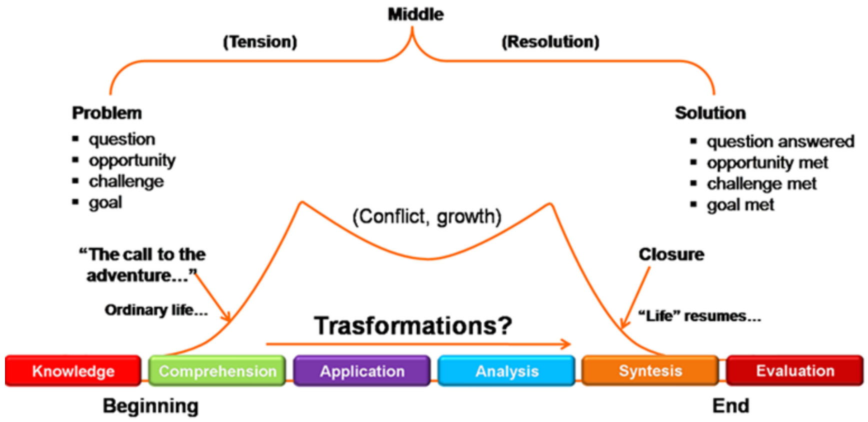

Figure 1. Mapping between VSP and learning objectives.

To ensure the achievement of assigned learning objectives, each situation presents itself as the composition of educational events whose structure facilitates organization, selection and integration of information (Gaeta et al., 2014): the *Advancer Event* designed to activate student's prior knowledge and to ensure his involvement in the initial situation; the *Learning Event* that supports the objective to maximize student's topic understanding and is based on a heavily driven approach; the *Reflective Event* designed to support the learner in the reflection process on concepts learned and helping he consolidate the knowledge acquired; the *Assessment Event* able to assess whether the type of cognitive transformation hoped for him has occurred.

By recognizing the knowledge gained by the user in different teaching situations, it is possible to define a series of treatments able to support the student in overcoming the presented shortcomings. *Assessment Events* are in fact the driver of a *dynamic branching* mechanism that allows a re-articulation of the story to recovery found knowledge gaps.

Actually, the defined model supports different "*corrective*" paths that meet specific educational approaches or principles. The alternative routes call the student to take up a new perspective in the story. Coherently with an *interactionist perspective* one accepts the idea of how individuals are able to take certain "views" (e.g., Helper, Hero, Victim, Antagonist, Essay, etc.) during the interaction with the learning resource which, selected randomly, allows learners to experience situations and events with greater responsibility and empathy (Porteous et al., 2010).

Figure 2 shows the flow of events within a modelled situation, based on two teaching iterations. The assessment event that occurs at the end of a situation, allows to obtain a measure of understanding of key concepts through a formative evaluation able to represent a specific goal of knowledge (first iteration). Once you have a score (second iteration) the narrative branches out and suggests to the student different alignment and recovery paths, basing on specific rules defined by the teacher and related to knowledge levels detected by formative tests (Mangione et al., 2011).

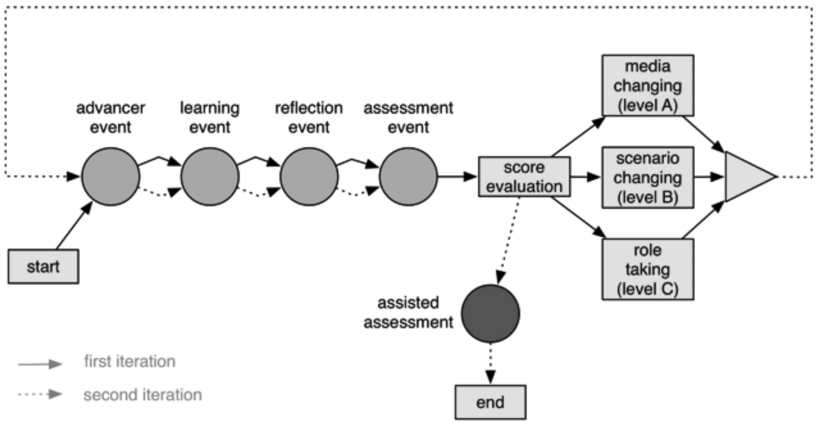

Figure 2. The defined Storytelling teaching flow.

4. THE DEVELOPED PROTOTYPE

In order to build and experiment a *Storytelling Learning Resource* based on the defined model, two software components have been defined and integrated within an existing e-learning environment. Such a learning environment, named *IWT* (*Intelligent Web Teacher*), allows the definition and execution of personalized e-learning experiences tailored to learners' cognitive state and learning preferences (Capuano et al., 2008; Capuano et al., 2011). In particular, defined software components have been obtained as a customization, in the legal domain, of results coming from a previous research initiative oriented to *risk management* (Capuano et al., 2013).

The first component developed is the *Storytelling Editor*. It allows the creation of multimedia resources, the design of story elements, the creation of testing activities and the management of different flows inside the story. It is conceived as a desktop application allowing to select several editing layouts and to support content editing functions. It enables the authors to make creative contents by integrating multimedia objects such as textbox, images, video and audio as well as to associate interactive behaviours to each object. A table of rules allows to check scores obtained by the learner within each *Assessment Event* and, if the score reach a given threshold, the story flow proceeds to the next situation; otherwise the situation is restarted with different parameters (change of media, change of scenario, change of role) according to the process shown in figure 2.

Figure 3 shows the main interface of the editor. The left pane lists the sequence of situation events while the selected event is displayed in the content pane on the right for editing. The toolbar on top of the window includes editing functions and allows to insert, in the current event, several kinds of multimedia objects. A recording toolbar is also provided on the right to capture live audio and video.

Figure 3. Screenshot of the Storytelling Editor.

The second component is the *Storytelling Player*: a Web application based on *Microsoft Silverlight* that can execute the story according to a designed flow. By interacting with scenes during the story, the learner returns a feedback to the player, while the underlying story engine, basing on them, can reason on the right continuation of the story. Figure 4 shows a screenshot of the storytelling player integrated within the learning environment. On the left pane there is the sequence of situation events while on the right pane the current event is displayed. The learner interacts within the main pane and the flow of events changes accordingly with respect to defined rules.

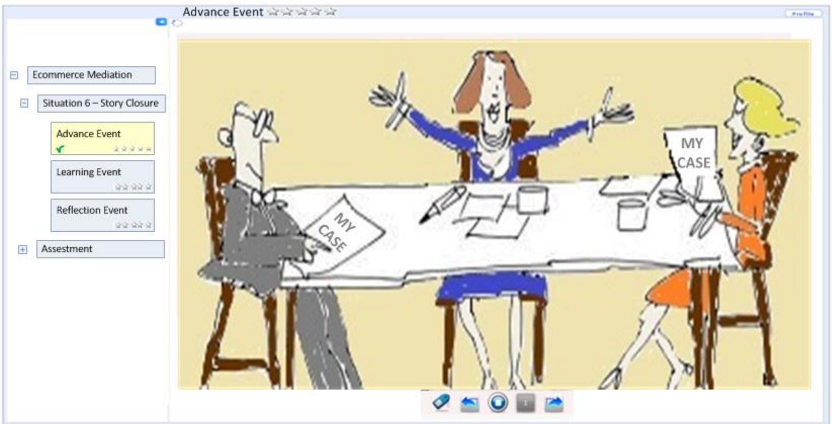

Figure 4. Screenshot of the Storytelling Player.

5. AN EXPERIMENTAL STORY

In the context of eJRM, several stories based on the model described in section 3 are currently under development. We present here a first experimental story, covering the topic of mediation in the e-commerce field that we have defined to validate the prototype as well as the underlying model. The didactic objective is articulated into three sub-Objectives: understanding the concept of mediation and situations; understanding the life cycle of mediation and key roles for its correct management; opportunities and possible consequences of mediation. The story flow is graphically depicted in figure 5 while a screenshot of the story within the Storytelling Player is shown in figure 4.

Every situation of the learning resource answers a specific didactic transformation path based on Bloom’s taxonomy. The first situation (*Introduction*), presents an *Advancer Event*, where the protagonist, Paola, following numerous commercials of the e-commerce site Orelejo.it broadcast on TV, decided to make her first online purchase, buying a watch with an automatic mechanism. In the *Learning Event*, it is possible to learn key concepts such as methods of concluding contracts online and applicable law discipline, e-payment systems, and personal data protection. The *Reflection Event* clarifies the conclusion of the online contract and finally an *Assessment Event* proposes questions and multiple choice test to understand risks and advantages of online shopping.

The second situation (*Call of Adventure*), in the *Advancer Event*, proposes a scene where Paola receives the clock and, after checked for its proper operation, wears it, and immediately starts using it. Something goes wrong so, only two months after the purchase, the automatic mechanism is blocked. Paola is disappointed and tries to solve the problem by turning the crown for manual charging many times and strongly, but the watch does not work anymore. Paola, not knowing what to do, returns to the website where the purchase was made and reads about the possibility to withdraw from the contract as well as information on product’s warranty. The *Learning Event* focuses on concepts of consumer protection, conditions, timing and withdrawal rule exercising procedures, and sale’s guarantees. A *Reflection Event* on the importance of consumer protection follows as well as an *Assessment Event* on how to fill the request for product replacement and cases in which you can take advantage of the replacement procedure.

In the third situation (*Problem*), the *Advancer Event*, Paola learns all the needed information that will help her understand that she can make use of a warranty covering her watch purchase. Paola, therefore, communicates the problem to the vendor and requests to have it replaced. After a considerable period of time, the vendor replies communicating to Paola that the company does not intend to replace the watch because, after having analysed the problem, they found the failure to be caused by an incorrect operation made by Paola. She, in fact, in an attempt to unlock the watch, would have forced the watch crown, causing a mechanism fault.

In the seller’s opinion, Paola should have immediately asked for a watch replacement, as soon as the problem had occurred, without making any arbitrary attempts. The seller, however, is willing to repair the clock at Paola’s expense. Paola does not agree with this solution and insists on her right to replacement. In the *Learning Event*, times and conditions of guarantee are explained as well as the consumer options, including replacement and repair of goods; a price reduction or termination of contract. After a *Reflection Event* on the discipline of guarantee, understanding of the explained concepts is assessed through an *Assessment Event*.

The fourth situation (*Middle*), in the *Advancer Event*, sees Paola contacting a lawyer, who clarifies her that, according to the Legislative Decree no. 28/2010, as recently amended, even if e-commerce is an area not covered by mandatory mediation, there is the option to do so anyhow, trying to avoid arbitration, as well as issues related to it. Paola searches for additional information on the Internet and discovers the existence of eJRM, a system that guides citizens in legal mediation. By this website, Paola does a self-assessment, she shortly describes her case, the system then classifies the case and suggests her to undertake the process of mediation. Through the site, Paola also understands how the mediation is performed and finds similar cases resolved through mediation. The *Learning Event* presents resources that help learn more about the current discipline regulating mediation for civil and commercial disputes, together with the concept of voluntary and mandatory mediation, and key figures in the process of mediation. After a *Reflection Event* on key concepts, the *Assessment Event* requires the student to identify and sort pros and cons of mediation compared to the legal action.

The fifth situation (*Solution*), in the *Advance Event*, introduces the online mediation process and identifies the *expert profile* for similar cases and the preparation of the first meeting. Methods of preparation and presentation of on-line mediation request are detailed during the learning event, and after a *Reflection Event* about managing mediation meetings, a simulation-based *Assessment Event* requires the user to identify the best way to manage a mediation meeting.

In the sixth situation, (*Closing*), the *Advancer Event* shows a virtual room meeting, where the mediator is unable to find a solution between the parties who in the end will go to a trial. The *Learning Event* emphasizes the importance of the mediation process, and after a *Reflection Event*, the user is asked to go through an *Assessment Event* to understand and identify ways of managing an event in order to reach an agreement. In this latter event, in case the learner does not reach a satisfactory score, the system suggests a micro adaptive recovery path where the user is given an alternative scene where through various steps he can achieve a successful mediation. A new facilitated *Assessment Event*, will then test the successful knowledge acquisition.

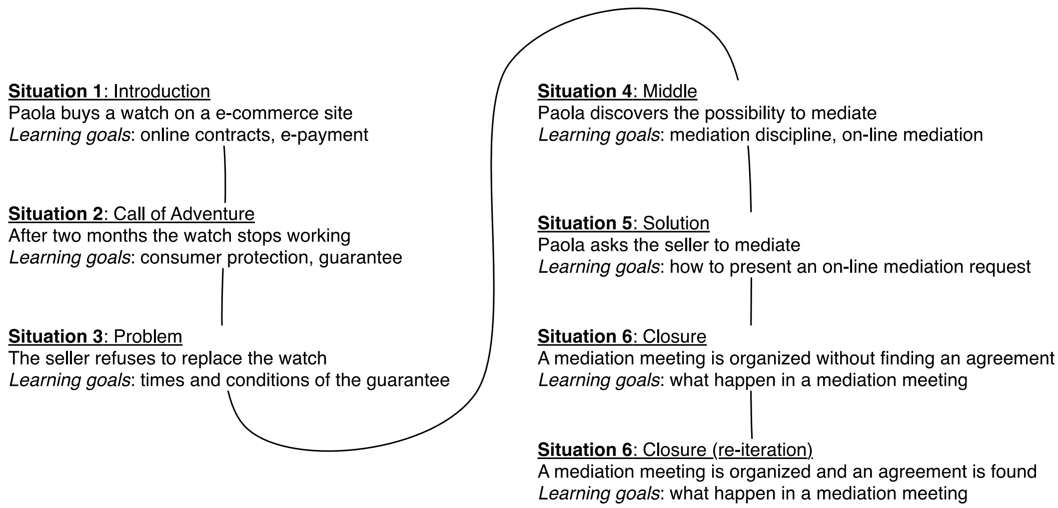

Figure 5. The teaching flow of the experimental story.

6. CONCLUSION

We described in this paper a new learning model, based on narrative pedagogy and storytelling, that integrates dynamic branching facilities allowing re-articulation of the story according to assessed training results. The model has been instantiated in the legal domain to build engaging learning resources about online mediation, targeted to users with limited background on legal topics. A prototype and a sample story have also been defined and developed to provide a first empirical validation of the model. The prototype was shown to a group of teachers expert of legal education and some *trial scenarios* have been simulated.

The results obtained up to now are encouraging and confirm that the storytelling model is capable of building valuable learning resources in the field of legal education. The defined model is able to represent a complex storyboard covering the topic of mediation in e-commerce while the developed prototype is capable of editing and playing multimedia components connected to each story event and situation as well as to model the underlying teaching flow.

The obtained learning resource is a fully interactive didactic element oriented to a real learner centred educational approach and able to provide guidance and to make the reflection easier. The *transmedia* nature of the obtained learning resources allows the creation of an *augmented narrative* that is capable of supporting learners participation and enhancement of concepts and skills.

The work described in this paper is still on-going in the framework of the eJRM project. Additional stories are currently in course of definition together with a complete experimentation and validation plan with real users, involving an Italian mediation entity and a selection of real customers. The validation will follow the *expert-based* approach combined with an *empirical* one. In either cases we will apply an analysis purposed to the verification of both learning results as well as the learner's involvement level.

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ACCEPTANCE AND SUCCESS FACTORS FOR M-LEARNING OF ERP SYSTEMS CURRICULA

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ABSTRACT

The effective training of users is a key factor of the success of Enterprise Resource Planning (ERP) system projects. This need for ERP system training is exacerbated by a demand for quality ERP consultants which is evident in Europe and in African countries, particularly in South Africa where science and technology education has been identified as a national priority. However, the high costs of traveling in developing countries within Africa can make it difficult to offer traditional face to face training by vendors. Mobile learning or m-learning has shown a significant rise in use by companies and researchers developing learning platforms. M-learning can be used to aid in the training of ERP users who are on the go as well as those who do not have direct access to desktop PCs in their work environment. Whilst several studies propose the use of m-learning systems, research related to the implementation and evaluations of m-learning systems which focus on ERP system education are limited. In this paper success factors for m-learning of ERP systems are identified. An understanding of these factors can improve the design of an ERP m-learning system, thereby facilitating an improvement in ERP and more broadly speaking, technology education. This paper reports on field studies where the Technology Acceptance Model (TAM) was used to evaluate the acceptance, usefulness and perceived ease of two systems, the OpenSAP e-learning application and the SAP Learn Now m-learning application. The study found that the m-learning system was accepted by the learners and was rated positively for perceived ease of use (PEOU) and perceived usefulness (PU). The study results also showed that the TAM model could be successfully used to evaluate e-learning and m-learning systems.

KEYWORDS

m-learning; ERP system education; e-learning.

1. INTRODUCTION

There has been a global increase in the number of small to medium size organisations making use of Enterprise Resource Planning (ERP) systems (Zhang, Gao, & Ge, 2013). ERP systems are a suite of business modules or applications that integrate the information and processes of the various business units within an organisation, such as finance, marketing and production. The integration of these units streamlines the flow of information which can bring benefits such as process improvements and reduction of inventory costs into the value chain (Beheshti, 2006). However these benefits cannot be achieved if the implementation of an ERP system is not successful. The total cost of ERP implementation failure is high and is rising rapidly (Momoh, Roy, & Shehab, 2010). Galy and Sauceda (2014) argue that the training of users of an ERP system is the corner-stone of the implementation. Several other studies have also cited ERP training as a key factor in ERP system implementation success (Bologa & Lupu, 2014; Dalveren, 2014; Dezdar, 2012). Other factors affecting ERP system implementation success are the demand for ERP skills and knowledge and access to graduates with industry-relevant ERP education (Bologa & Lupu, 2014; Scholtz, Calitz, & Cilliers, 2011). A demand for ERP skills has resulted in the introduction of ERP system courses in higher education degree programmes (Dalveren, 2014). It is therefore important to have well-structured education programmes at universities as well as industry training programmes for users and other stakeholders in ERP system implementations (Ram, Wu, & Tagg, 2014). In this paper we refer to ERP learners as those either in education programmes in universities or ERP users in industry training programmes.

It is evident that there is a need to address research regarding the design of ERP training and education programmes in order to find the most effective and efficient forms of delivery and reduce the time and cost involved whilst still maintaining the required quality. ERP training programmes can be presented through different forms varying from the traditional face to face courses to long distance learning platforms such as electronic learning (e-learning) and mobile learning (m-learning). Modern organisations have become more inclined to e-learning programmes due to the benefits of differing work schedules of employees and differences in geographical locations between vendors and the organisations implementing the ERP system (Pastor & Casanovas, 2002). E-learning is the use of technology to aid in learning at any place and anytime. M-learning, refers to the use of mobile technologies to support learning (Attewell & Savill-smith, 2003). The 2013 Africa E-Learning Report has identified mobile technologies as an important contributor to learning technologies in Africa in the last five years (Isaacs, Hollow, Akoh & Harper-Merrett, 2013).

The research field of m-learning has attracted interest from researchers as well as from companies developing and implementing learning systems (Uzunboylu, Cavus, & Ercag, 2009). While m-learning has attracted the interest of many researchers and organisations looking to implement a more flexible long distance learning environment, very little research has been done in using m-learning systems within the ERP industry. For this reason this paper proposes an m-learning model of success factors for ERP e-learning and m-learning education and training programmes. This paper is structured as follows: The related literature in the areas of e-learning and m-learning are discussed in Section 2. The research methodology used is discussed in Section 3 and the results are analysed and discussed in section 4. Finally the recommendations and conclusions are addressed in Section 5.

2. E-LEARNING AND M-LEARNING SUCCESS FACTORS AND ERP EDUCATION

2.1 E-Learning in the ERP Industry

Several definitions of e-learning have been proposed. According to Sharma and Kitchens (2005) e-learning includes learning with web-based training facilities such as virtual universities and classrooms which allow for digital collaboration and technology assisted distance learning. Siqueira, Braz and Melo (2007) define e-learning as the use of Internet related technology in education or training. E-learning has an advantage over traditional learning in that apart from it having the ability to break geographical barriers it also offers the potential of a more flexible, tailor-made learning environment which can adjust according to both to the learners' knowledge and skills and also to their preferred learning style (Sambrook, 2003).

Although e-learning has gained popularity it is important to be aware of factors affecting the success of e-learning projects (Table 1). One of these factors is the quality of content material, which can impact the success of an e-learning project (Siqueira et al., 2007). Nedungadi and Raman (2012) further suggest that the appropriate management of the content is important to ensure that e-learning is efficient. This management involves the development and maintenance (updates) of relevant information and content, which is time consuming and expensive. In order to address this issue the learning process must be as quick and as cost effective as possible whilst still achieving the learning goals. This is attained through "rapid e-learning" which reduces the duration of e-learning projects (Unneberg, 2007). By enabling those producing the e-learning content, establishing a well organised assessment and approval process and ensuring the training is consistent across the organisation this can be achieved. Hawking and Mccarthy (2006) propose an e-learning model that integrates synchronous and asynchronous learning approaches in order to assist the delivery of offshore ERP education. Asynchronous e-learning does not involve the presence of a teacher; rather learning content is located on a remote server which learners can access over the Internet. However, synchronous e-learning requires e-learning to be conducted with the learner and the teacher being present at the learning event at the same time. This model has been adopted by most ERP vendors in that they have learning community sites where various learners can access information as well as interact with instructors or experts in particular knowledge areas who provide assistance as well as virtual classes (Hawking & Mccarthy, 2006). E-learning offerings should include training, delivery of information almost immediately and consultancy from experts (McGill, Klobas, & Renzi, 2014) .

Table 1. Factors for improving the success of e-learning projects.

Factor	System	Author
Fast access to course material	Higher Education System	McGill, Klobas, and Renzi (2014)
Combination of synchronous and asynchronous e-learning applied	ERP system	Hawking and Mccarthy (2006)
Quality of content	Data Warehousing System	Siqueira et al. (2007)
Content modelling	Data Warehousing System	Siqueira et al.(2007) Nedungadi and Raman (2012)
Enabling of those producing e-learning content	Marketing System	Unneberg (2007)
Consultancy from experts	Higher Education System	McGill, Klobasand Renzi (2014) Hawking and Mccarthy (2006)
Online certifications Provision of instructor videos Interactive learning assignments Assessments (theory and practical)	ERP system	Dalveren (2014) Hawking and Mccarthy (2006)

Several ERP vendors such as SAP, SYPRO, SAGE and Microsoft have introduced e-learning platforms to meet the modern demands of the customers for an e-learning platform (Dalveren, 2014; Mishra & Mishra, 2011). These solutions offer learners access to an ERP e-learning platform whereby they have unlimited access to online training materials, online certification as well as training and learning plans. SAP's innovative e-learning platform, openSAP, enables learners, SAP professionals, developers, entrepreneurs and consultants the opportunity to learn about SAP and its innovations (SAP, 2013). It also gives the learners an opportunity to interact with other learners and SAP experts on subject matters. The openSAP e-learning system consists of various courses taught on ERP and SAP and consists of a number of units offered at different times throughout the year. However e-learning may not be ideal for all situations even though it is well implemented. The 2013 e-learning Africa Review reported finances and hardware costs amongst the constraints of e-learning. Additional bandwidth and electricity costs of maintaining desktop computers were also cited (Isaacs, et al., 2013).

2.2 M- Learning and ERP Education

The 2013 e-learning Africa Review identifies mobile technologies as the leading driving technologies in education in Africa (*eLearning Africa 2013 : In Review*, 2013) The report identifies the low cost of mobile devices as compared to desktop PCs and bandwidth amongst the reasons for mobile devices being the preferred technologies. Connectivity on mobile devices is significantly cheaper than on PCs and this may be more appealing to users in developing countries and those who may not have PCs at their homes (Nordin, Embi, & Yunus, 2010; Uzunboylu et al., 2009). M-learning has therefore been deemed as the new paradigm in education. According to Nedungadi and Raman (2012) the progression of distance learning and training can be characterised as the move from distance learning to e-learning to m-learning. M-learning involves the use of handheld mobile devices to facilitate and enhance the learning process (Nedungadi & Raman, 2012). M-learning can also be defined as the use of wireless phones or personal digital assistants to deliver digitised content (Sharma & Kitchens, 2005). Furthermore, m-learning refers to learning conducted in multiple locations, across multiple times with content accessible from various devices, for example smartphones and tablets (Oberer & Erkollar, 2013). M-learning provides collaborative interaction and learning opportunities for persons and groups that are geographically dispersed (Uzunboylu et al., 2009).

Several factors for m-learning project success have been identified (Table 2). The m-learning framework assumes that the users are on the move most of the time, with the learning taking place outside of a learning facility such as a classroom (Nordin et al., 2010). It allows professionals on-the-go to connect to training material anytime and anywhere (Sharma & Kitchens, 2005). Nedungadi and Raman (2012) suggest that m-learning should provide a flexible learning environment which can adapt content presentation format to suit the device that is being used. The delivery of information on a mobile platform needs to be conscious of the context of use of its users.

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Table 2. Factors for improving the success of m-learning projects.

Factor	System	Author
Content is instantly accessible with various devices	Higher Education i.e. Marketing Course	Oberer and Erkollar (2013) Sharma and Kitchens (2005)
Information delivery must consider mobile environment and context of use	Environmental Awareness	Uzunboylu et al. (2009)
Adaptive approaches to m-learning	Research tool	Nedungadi and Raman (2012)
Learning should be learner-centered and allow for knowledge assessment	-	Nordin et al. (2010)
Adoption of a community-centered approach (well established social learning networks)	-	Nordin et al. (2010) Suki and Suki (2007)
	ERP system	Bologa and Lupu (2014)
Ability to download and view material and content offline	-	Sharma and Kitchens (2005)
	ERP system	Dalveren (2014)
Hands-on simulation of activities provided to users as they would on actual system	Environmental Awareness	Uzunboylu et al. (2009)
	ERP system	SAP (2013)

For learning to be effective Nordin et al. (2010) suggest that the learning process should be learner, knowledge, assessment and community centred. A community-centred approach can also be enhanced by social media communities (Suki & Suki, 2007). This approach is also supported by Bologa & Lupu (2014) who propose that well-established social learning networks can reduce the learning time of ERP systems.

ERP m-learning applications are offered by most the larger ERP vendors. For example, SAP Education has developed an m-learning application, SAP Learn Now, which enables SAP users on the go, the ability to access the training information they need in order to maintain a competitive edge (SAP, 2013). The application runs on the Android and iOS operating systems and has the following features:

- Online access to content and course material which can be downloaded and viewed offline;
- Learners can interact with the hands-on SAP Learn Now simulation.
- Users can receive class tests, instructor videos and have interactive learning assignments; and
- The application enables users to highlight relevant sections, take notes and post questions on the SAP learning community which can be answered by subject matter experts.

2.3 The Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) has been accepted by a number of researchers in an attempt to explain why individuals choose to adopt or not adopt a particular technology when performing a task. TAM is built on the theory of reasoned action (TRA) which proposes that a person's behavioural intention initiates his or her performance to carry out a specified activity (Joo & Sang, 2013). TAM is based on two variables that influence the adoption: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). Several studies (Ngai, Poon, & Chan, 2007;Liu, Liao, & Pratt, 2009) on e-learning have used TAM to predict the acceptance of e-learning systems. These two variables can therefore be used to evaluate e-learning and m-learning systems (Figure 1). According to Joo and Sang (2013) PEOU refers to the degree to which an individual believes that using a particular system would be effortless. There are three common items which can be used as metrics for PEOU, namely: 1) I found the system easy to use; 2) Learning to use the system was easy for me; and 3) It was easy to become skilful at the system. PU is defined as the degree to which a person believes that using the particular technology would improve his or her job performance. Five items can be used to describe PU, namely:

- The system will be of use and benefit to me;
- The system can improve my performance (with ERP);
- The system can help me accomplish my tasks more efficiently;
- The system is useful for my ERP studies; and
- The system can help me be more productive.

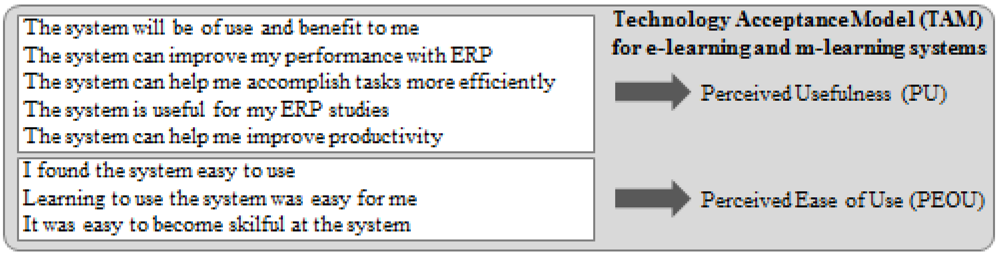

Figure 1. TAM metrics for e-learning and m-learning systems for ERP training and education programmes.

3. RESEARCH METHODOLOGY

The primary aim of this paper is to investigate the acceptance of e-learning and m-learning technologies specifically designed for ERP training and education programmes. The scope of the study will be limited to learners in higher education institutions in a developing country like South Africa. The research problem to be investigated is that whilst several ERP vendors are offering these new paradigms in learning, the acceptance of these technologies in developing countries is not known. Africa has been shown to have slightly different challenges as compared with other first world countries, since issues such as bandwidth can impact the success of e-learning and m-learning programmes. An improved understanding of the challenges involved with e-learning and m-learning for ERP systems is required in order to address the lack of quality ERP training programmes in both education and industry in Africa. In this way the demand for ERP skills and knowledge can also be met. The main research question of this paper is *"What are the success factors and acceptance of e-learning and m-learning technologies for ERP courses in higher education in developing countries?"*. The main purpose of this study is therefore to establish the level of acceptance of e-learning and m-learning for teaching an introduction to ERP systems to novice ERP learners. In order to address the main research question, two secondary research objectives need to be realised, namely:

- RO1: Determine the PEOU and PU of the openSAP e-learning system; and
- RO2: Determine the PEOU and PU of the SAP Learn Now m-learning system.

The research strategies used were a literature review and two field studies in order to further investigate the research problem and determine the acceptance of SAP's e-learning and m-learning systems. The two field studies were undertaken in and ERP systems course at the Nelson Mandela Metropolitan University (NMMU) in South Africa. In the first field study learners evaluated the PEOU of SAP's openSAP e-learning system and the second field study the SAP Learn Now m-learning system was evaluated. The field studies were conducted in two practical sessions of the ERP course module. The practicals are aimed at supporting the weekly face to face lectures conducted by the lecturer. In these practical sessions learners get hands-on experience of the ERP systems. Prior to this study all learning content for this course related to the practical sessions was delivered in a traditional format where learners are provided with a document specifying a step-by-step tasks list to follow in the ERP system and then answer some questions at the end. In the first field study the learners were required to view the benefits offered by SAP HANA Business Suite for Sales, Service and Marketing. The learners were then required to complete an online assessment of the course material in order to evaluate their understanding of the course material. In the second field study learners made use of the information on the Management Accounting module using a mobile application (Table 3).

Table 3. Summary of Field Studies.

Field Study	**Learning System**	**Outcomes/Tasks**
1	OpenSAP e-learning	• Review Sales, Services and Marketing Material • Complete assessment
2	SAP Learn Now m-learning	• Review Performing Posting to Management Accounting • Complete tasks on the hands-on simulation of the posting activity • Complete assessment based on material reviewed

A paper-based questionnaire was compiled based on other studies (Ngai, Poon, & Chan, 2007;Liu, Liao, & Pratt, 2009) done on TAM for e-learning. The questionnaire was distributed to learners for completion after they had successfully completed all the tasks in the practical session. Since the questionnaire items have been used in previous studies, both the content and face validity of this study was established. Furthermore the questionnaire was statistically checked by an expert for reliability and validity. The questionnaire consisted of closed-ended questions with a 5-point Likert scale where learners had to rate the PEOU and PU items from 1 to 5, where 1 represents *Strongly disagree* and 5 represents *Strongly agree.* The following statistical ranges were applied: negative [1 to 2.6), neutral [2.6 to 3.4] and positive (3.4 to 5]. In addition to the Likert scale questions, open ended questions were used in order for learners to express their opinions on the two systems being evaluated. The qualitative data was thematically analysed where themes were determined (Thomas, 2006).

4. RESULTS AND DISCUSSION

In the sections to follow the results captured from the questionnaires will be discussed in greater detail.

4.1 Participant Profile

The number of learners that were registered for the ERP module was 25 with the majority (64%) being male and the remainder were female. All of the learners are Information Systems (IS) majors and are therefore expert computer users but are novice ERP users since none of them had any prior experience with any ERP system, the SAP system or with either learning platform. Most of the learners were between the ages of 18 and 25, with only two learners being over the age of 25. The sample size for the field studies was 23 as opposed to the 25 learners registered for the module. This is due to the fact that two learners did not attend the practical session for the openSAP practical when the questionnaires were administered. An additional participant was removed since it was an outlier, resulting in a final sample size (n) of 22.

4.2 TAM Results

The PEOU was analysed for the two systems (Table 4). After analysis of the results it can be noticed that the overall mean rating for PEOU for the SAP Learn Now m-learning system (μ = 3.9) was only slightly higher than that of the openSAP rating (μ = 3.6) and both of the scores were ***positive***. From this result it can be deduced that the learners found the m-learning system easier to use than that of the e-learning system. From this information it can be deduced that the learners perceived the usefulness of the m-learning system (μ = 4.0) to be the same as that of the e-learning system (μ = 4.0). Further the low standard deviation values of both systems reveal that the difference in opinions of the system was around the mean and therefore opinions did not vary that much.

Table 4. Technology Acceptance (PEOU and PU) Results.

	PEOU		**PU**	
System	**OpenSAP**	**SAP Learn Now**	**OpenSAP**	**SAP LearnNow**
n	22	22	22	22
Mean	3.6	3.9	4	4
StdDev	0.7	1	0.7	1
Min	2	2.3	2.6	2.4
Max	5	5	5	5

Further analysis was conducted in order to gain more insight on the specific items which consists of the PEOU and the variation to the mean values which were recorded for the two systems (Figure 2). The SAP Learn Now m-learning system was rated higher than the openSAP e-learning system for all three metrics of PEOU. The highest rated item (μ = 4.1) was *"Learning to use the e-learning/m-learning system was easy for me"* and was for the SAP Learn Now m-learning system. Five of the six scores were in the positive range.

The only metric not in the positive range was, *"It was easy to become skilful at the system"* (μ = 3.3), which was for the openSAP e-learning system. One aspect which needs to be investigated in further studies is the impact of the content on the ratings for the m-learning system. In order to get a more detailed perspective on the five individual items relating to PU further analysis was done (Figure 3). All items for both systems were in the positive range for PU. The ratings were very similar for all five items for both systems. The highest rated item was "*Can improve my performance with ERP"* (μ = 4.1). The lowest rated item was for "*Helps me to accomplish tasks more efficiently*" (μ = 3.8).

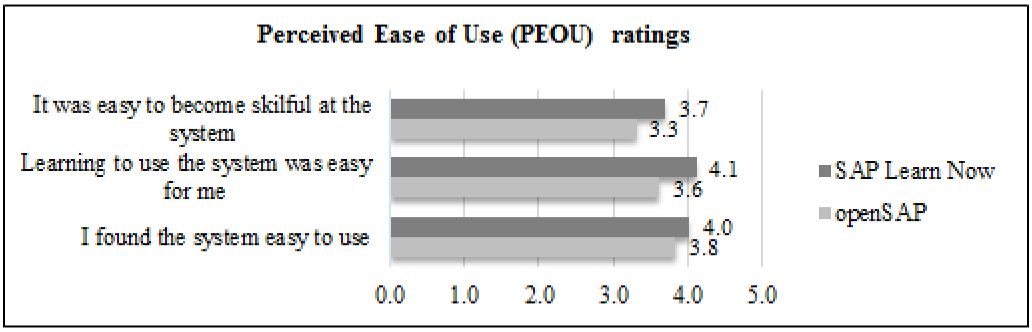

Figure 2. Perceived Ease of Use (PEOU) ratings (n = 22).

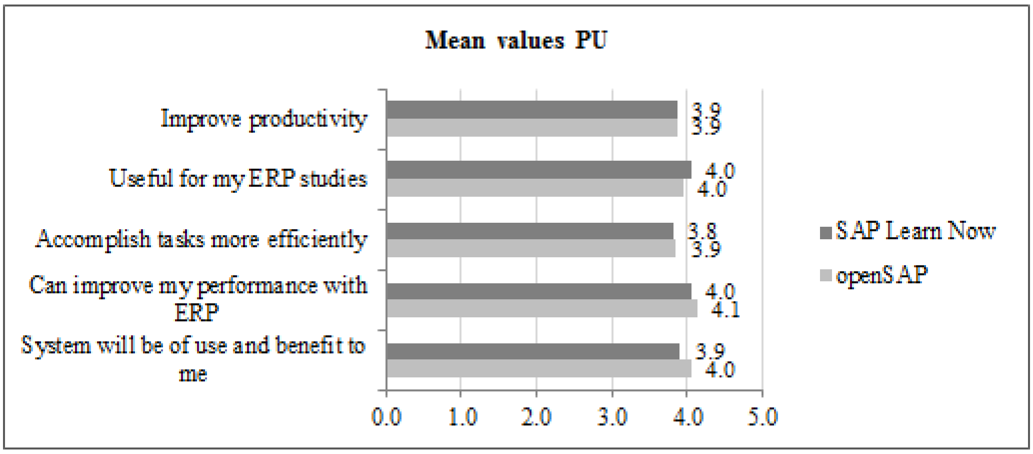

Figure 3. Mean values PU.

4.3 Qualitative Results

Through the use of open-ended questions qualitative feedback was obtained from the learners by asking them to comment on features of the learning systems which they liked or didn't like. A frequency count (*f*) was calculated for each theme identified in the thematic analysis and categorised into positive (Table 5) and negative (Table 6) features. Only the themes with the top two frequency counts for each system are listed in the table. The most two frequently identified features for OpenSAP were the use of videos (*f* = 9) and the quality and breadth of content (*f* = 9). One learner stated that *"It is easier to learn from videos than from text"*. Another learner highlighted the real life examples used during the video lectures as a positive feature. This supports the results of studies (Nedungadi & Raman, 2012; Siqueira et al., 2007) citing content quality and learning flexibility and adaptability as critical success factors of m-learning projects. During the SAP Learn Now session the use of videos was also identified frequently (*f* = 12) as a positive feature. The theme with the second highest frequency count was the hands on simulation (*f* = 9).

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Table 5. Top positive features.

Themes (openSAP e-learning)	Frequency Count *(f)*	Sample comments
Video lectures	9	*I found it easier to learn from a video than having to read through text and slides*
Flexibility and content	9	*Practical examples*
Themes (SAP Learn Now m-learning)	**Frequency Count *(f)***	**Sample comments**
Video tutorials	12	*Explanation of the content via the videos*
Hands on simulations	9	*Guided simulations; The touchscreen interface made learning easier*

The analysis of open-ended comments revealed that the most frequent negative feature of the openSAP e-learning system was the long duration of the video lectures (f = 8). This was followed by the amount of information that had to be consumed, that is information overload (f = 6). After the second session, which involved the SAP Learn Now m-learning system the fat finger problem and the size of the icons was the most frequently (f = 10) identified theme. This confirms the study of Uzunboylu et al. (2009) stating that designers of m-learning systems need to consider the environment and context of use. Other issues identified were related to content quality, for example information being too textual or too theoretical (f = 9).

Table 6. Negative features.

Themes (openSAP e-learning)	Frequency Count *(f)*	Sample comments
Duration of videos	8	*Videos too long; Some videos are too long(easily lose concentration)*
Information overload	6	*"Too much theory to read"*
Themes (SAP Learn Now m-learning)	**Frequency Count *(f)***	**Sample comments**
Fat finger and icons too small	10	Icons too small to click
Content related issues	9	It is quite a lot of information to take in

5. CONCLUSIONS AND RECOMMENDATIONS

The results of the two field studies showed that both e-learning and m-learning systems for ERP education programmes can be successfully used to assist learners with improving their productivity and learning. In addition the systems are perceived by learners as easy to use. However these systems should be context aware just as they are in other learning environments. The m-learning system could be used to help those users who do not have the time to have a full experience with particular modules of ERP but wish to have a quick and easy understanding of ERP. Hence m-learning can be used to help those who need an introduction to ERP concepts and to get a simulated experience of hands-on tasks in an ERP system. The m-learning system should present content that is easy to understand. From the study the use of media content such as videos and audio tutorials could make the learning experience more efficient to the user. However the quality of content is an important issue for both e-learning and m-learning systems, and the fat finger problem needs to be taken into consideration when preparing the content to enable interactive experience of m-learning systems to be optimal. The study described in this paper was a preliminary study undertaken with a small sample size of ERP learners at one university. This study forms part of a larger study which involves the development of an m-learning system for ERP education and training purposes. In conclusion, the results obtained from the study indicate a positive acceptance of e-learning and m-learning by ERP learners. The study focused on the factors used in the TAM model and it was not always clear what the impact of content was on this acceptance. Future research is needed that investigates the impact of these factors on the acceptance of m-learning systems.

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SELF-REGULATION COMPETENCE IN MUSIC EDUCATION

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ABSTRACT

This work starts from a systematic review about music education and self-regulation during learning processes. Then the paper identifies those meta-cognitive strategies that music students should adopt during their instrumental practice. The goal is applying such concepts in order to rethink the structure of a didactic e-book for instrumental music education. Thanks to the adoption of the IEEE 1599 standard, the paper outlines a model of active e-book able to improve learners' performances through proper cognitive and multi-modal scaffolds. In the last section the design principles for an implementation will be proposed.

KEYWORDS

Self-regulation, music education, e-book, IEEE 1599 format.

1. INTRODUCTION

Music education for the young, particularly during *early childhood* (between the ages 3 and 8), requires a specific review of course curricula. An integration of multi-modal experiences based on activities such as moving, creating, playing, reflecting (Young, 2003) is required to train a *symbolically fluent child* (Jorgensen, 2002; Barrett, 2009).

The learning environment should be able to represent activity-oriented musical experiences, where students, properly sustained by scaffold elements, are involved in a process of music construction/deconstruction. For example, according to Tomlinson (Tomlinson, 2013), expanding or scaffolding children's early musical experiences and investigations, their engagement in the world of sound, their trans-modal redesign of known literature and song repertoire to communicate new meanings helps children establish strong, confident, vibrant, and creative identities in learning, communication, and performance.

Recent research results emphasized the importance of seeing and hearing children's perspectives, in order to embed children's voices within curricular choices (Griffin, 2009). The path to the music knowledge for young people requires a redefinition to allow them to influence and actively build the course of their studies, namely to negotiate their own pathways by remaking texts. An active interaction in education should engage learning processes for children through complex, authentic communication (Kress, 2004).

Children negotiate their own identities and pathways by remaking interactive texts and representations, catching in this way the essence of the alterations, transformations, musical arrangements and practices (Kress, 2013).

New digital technologies allow to imagine new ways to design and implement educational text, as well as new interaction possibilities. Traditional publications should be reviewed in order to make them usable from different perspectives and along different pathways. In particular, a guided content customization should be provided. Nowadays, the exploration-driven learning environments are particularly relevant for music theory and musical instrument teaching. These frameworks emphasize key ideas such as an interactive and progressive investigation, and the development of an intuitive and creative way of thinking, as reported in (Jorgensen, 2002).

These supports, if properly conceived and redefined, could endorse self-regulatory cognitive and metacognitive strategies. Unfortunately, e-books today have a linear structure with a single path through content, and the lack of choice reduces the possibility to control the learning experience. For the new generation, the innovative e-book has to be flexible, adaptive and dynamic in the order and way in which content is studied.

2. SELF-REGULATION AND MUSIC LEARNING

Education technology, i.e. the research field that investigates how to teach and learn through media, denotes the self-regulation capability as a crucial element to be considered when defining a learning environment (Chang, 2005). As stated in (Järvelä and Järvenoja, 2011) and ([Zimmerman, 2008), self-regulation is fundamental for a successful learning process since it helps students to create their own “method” and strengthen their study skills (Wolters et al., 2011), to apply the best strategies in order to reach their educational goals, to control their performance, and to evaluate their academic progress (de Bruin et al., 2011).

Learning, particularly when related to *conceptually-rich domains* (Azevedo, 2005; McMahon, 2002; Lin, 2001), requires environments which support activities of goal self-regulation, controllable and revisable also in a participatory way (Schunk, 2008). Recent works, such as (Schunk and Zimmerman, 2007), (Graham and Harris) and (Kistner et al., 2010), demonstrated that self-regulated students obtain better results as regards both motor and conceptual performances. Staring at teaching and learning from the self-regulation perspective has great potential in music education, and in instrumental didactics in particular.

Practising a musical instrument presents many challenges. For instance, students are required to practice over a long period of time, to focus on their goal, to face the threats typical of a competitive learning environment, to gather feedbacks in order to improve their performance, to overcome insecurity, to develop a psychological and behavioural toolkit against pressure and problems (Martin, 2008).

Music education experiences a high drop-out rate caused by students’ sense of failure. Works such as (McPherson and Renwick, 2001) and (Pitts and Davidson, 2000) show that young music students are not methodical in their learning process. Like any other theoretical or practical discipline, music learning requires a good self-regulation attitude. Most indications come from a longitudinal research that investigated the evolution of 157 children practising a musical instrument between the ages 7 and 20 (McPherson and Renwick, 2011). Research results highlight the importance of self-regulation theory as a tool to support music knowledge and skill acquisition.

In order to gain ability to play a music instrument, the young student has to learn and apply a number of behaviours aiming at improving his/her own performances, such as: managing and planning exercise activity, promptly reacting to his/her performance or to external feedbacks (e.g. when practising in an ensemble),modifying and adapting strategies, adequately setting the environment, asking for help when needed, in order to access useful resources for learning.

Music mastering occurs when *ad hoc* scaffolds are provided to the learner, helping him/her to adopt self-regulated mechanisms to monitor and control performances (McPherson and Zimmerman, 2011).

With respect to other research areas about learning, only now the one related to instrumental practice is beginning to consider and apply the *self-enhancing cycle*, a key concept of the self-regulation learning theory. About self-regulation techniques young music students can adopt, the model by Zimmerman and Campillo (Zimmerman and Campillo, 2003) has been recently applied to the self-regulated problem-solving process. Three cyclical macro-phases are identified (McPherson and Renwick, 2011), as shown in figure 1. A detailed analysis of self-regulation cycle is fundamental to identify the proper scaffolds for active music e-books, as discussed in Section V.

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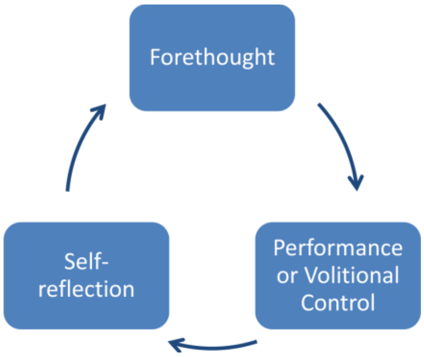

Figure 1. Cyclical phases of self-regulation.

2.1 Forethought

This phase is based on *task analysis* (goal setting and strategic planning) and *management of self-motivation beliefs* (self-efficacy, outcome expectation, intrinsic motivation) (McPherson, 2005). By autonomously defining medium- and long-term goals students can fix their own performance standards and become more motivated. Self-confident students are more effective in their learning efforts and do not give up when they have to face difficulties. Young musicians have to apply strategic learning behaviours (strategic planning) by identifying the most appropriate methods to accomplish a given task, without losing sight of the defined goals. An example of strategic planning for a musician is to stop performing warm up material from the printed score, and start playing the memorized text. Other strategies include hand annotations written on the score, or well-known techniques of *sight reading* (McPherson and Renwick, 2001).

The idea of self-efficacy is fundamental for a musician (Bandura et al., 1999), and it implies the self-recognition of being a good instrumentalist. This opinion interacts with the outcome expectations (Graabraek Nielsen, 2008), thus affecting the continuation of musical studies. Self-efficacy drives students to evaluate their performance not only on the basis of external rewards but also for the intrinsic motivation of personal satisfaction (Zimmerman, 2002).

2.2 Performance or Volitional Control

We can recognize two processes that students can apply to improve their performance: *self-control* (self-instruction, imagery, attention focusing) and *self-observation* (self-recording and self-experimentation). Self-control processes help musicians to concentrate on their musical performance and to optimize efforts. For instance, they can adopt *self-tasks* to learn a difficult section during instrumental practice. This kind of self-instruction let students monitor their concentration during learning activities (Vygotsky, 1962). Other examples are: *inner self-speech*, also known as *positive self-talk* (e.g. "I can do this!"), that increases the focus on performance and alleviates performance anxiety; the creation of *mental blueprints* about specific goals; breaking up the whole piece into smaller sections, easier to be studied (Miksza, 2007).

Self-observation highlights progresses - or their lack – in performance skills and instrumental techniques. In (Lehmann and Ericsson, 1997) the process has been decomposed into 3 kinds of representation: an *aural representation* of the target performance (i.e. how the piece should be played), a *motor representation* of the physical actions required, and finally the *representation of current performance*, constantly monitored and compared to the performance of reference the musician has in mind. Feedbacks act as cues prompts by suggesting to young students how to improve their performance. A clarifying example is switching from the interpretation of graphical symbols for crescendo and diminuendo to an *inward feel* about music expression.

2.3 Self-reflection

The third phase of the self-regulated learning cycle is based on *self-evaluation*, *causal attribution*, *self-satisfaction/affect* and *adaptivity* (Zimmerman and Campillo, 2003). Self-evaluation is one of the initial processes of self-reflection, and it implies a comparison between personal performance on one side and performance of peers on the other. The latter is considered either a standard to satisfy or a goal to achieve. Self-regulated musicians typically attribute their success to causes that can be improved only through a greater effort. Adaptive inferences will lead to reflect on the best learning strategy, while defensive inferences will tend to limit the personal commitment and will lead to the abandonment of the activity. A high self-satisfaction level will push students towards new goals and challenges.

3. TOWARDS ACTIVE E-BOOK FOR SELF-REGULATED

The idea of making a school subject more engaging through computer-based technologies is not new at all. An example is the adoption of interactive blackboards in primary and secondary education in order to add multimedia and interactive contents to “traditional” ones. For instance, (Sunners et al., 1994) describes a framework that integrates the blackboard model with a graphical user interface, and (Van Zeir et al., 1998) provides an extensive overview of the data models and the knowledge sources that form the back-bone of an interactive Computer Aided Process Planning (CAPP) kernel. In the field of music education, this approach is particularly relevant, since the subject is strictly related to multimedia and multi-modal interfaces. In fact, e-books for music education have been already designed and released. Unfortunately, their typical approach provides a linear pathway through contents and allows a low degree of interaction: in other words, they are usually digital copies of traditional paper texts. Needless to say, digital technologies can introduce some aspects of novelty peculiar to music:

- Hyper-links can easily provide further information about an instrument, an author, a music genre, etc.;
- Scores can have a performance associated with, so that the learner can listen to a pre-recorded performance by either a professional player or an automated system;
- Music notation can be presented in alternate formats, designed for visually impaired students or people affected by learning disabilities.

However, music e-books available on the marketplace are far from the definition of “active book” mentioned in Section I. The *study mode* proposed by an active book is different from the *reading mode*, where the learner is able to freely read any part of a text, and solve any task or interactive part without any restriction. Rather, the model is characterized by the fact that the progress of reading (in this case studying) is handled by the textbook itself (Binas et al., 2012). In this approach, there are many concurrent study paths related to the goals and levels of detail of a given subject. Any chapter, activity, exercise proposed to the learner is related to a previous path made of actions that can be seen as prerequisites.

In *study mode*, different paths are offered to access contents by skill degree, personal interest, and goals to achieve. Contents are structured to provide guidance to learners, keeping the didactic framework supervised and designed to achieve the best results.

Digital active books should let students adjust their cognitive as well as meta-cognitive behaviours (Aleven et al., 2010; Azevedo et al., 2011; Winne, 2011) thanks to appropriate scaffolds (e.g. *feedbacks* and *prompts*). As stated in (Aleven and Koedinger, 2002) and (Graesser et al., 2000), scaffolds are functional to the development of specific self-regulation skills in the music field. For this reason, in Section V the subject will be discussed in depth.

In scientific literature many different theories and visions are present about scaffolding. This heterogeneity resulted in a number of adaptive approaches and assistive technology solutions, often united by the concept of fixed and adaptive scaffolds (Azevedo et al., 2004). Researchers have stressed how adaptive scaffolding in hypermedia environments can assist students in developing more sophisticated mental models, increasing declarative knowledge as well as the frequency of some self-regulated learning strategies (Azevedo and Hadwin, 2005). The mentioned studies have inspired the design and development of innovative learning systems employing the adaptive component in didactic self-regulation.

Further studies (Kramarski and Hirsch, 2003) have provided empirical evidence that an adaptive scaffolding - based on *feedbacks* and *prompts* -when applied to scientific subjects supports the execution of regulation strategies. The importance of *cueing* and *prompting* has been confirmed by the work of (Azevedo et al., 2011), thus paving the way for new studies on adaptive scaffolding as a key element in the education of self-regulated learners.

Nowadays, the scientific community is paying a great attention to the effectiveness of different kinds of scaffold on students' self-regulation processes (Lajoie, 2005; Hadwin and Winne, 2001; Baylor, 2002; Puntambekar et al., 2003). Research results are used to revise the design of adaptive hypermedia learning environments.

4. TECHNOLOGIES FOR AN ACTIVE MUSIC E-BOOK

HTML5 is currently the latest release of HyperText Markup Language (HTML), specially designed to deliver rich content without the need for additional plugins. It can deliver a wide range of media contents, ranging from animation to graphics, from music to videos, etc. It can also be used to build complicated and rich web applications. HTML5 is cross-platform, in fact it has been designed to work on personal computers, tablets, smartphones, e-book readers and even smart TVs. Thanks to its features, HTML5 is revolutionizing not only the Web but also many other fields. With the release of the EPUB 3 specification (Garrish, 2011), HTML5 is officially a part of the EPUB standard. Consequently publishers are able to take full advantage of its feature set to add rich media and interactivity to their e-book content.

Some relevant examples are described in (Kleinfeld, 2011) and (Choi et al., 2014). The integration of HTML5 into e-book readers allows a number of advanced and innovative applications, such as the support of audio/video, the use of geolocation to customize a work of fiction, the creation of colouring books, etc. Nevertheless, some features oriented to music education and instrumental practice require an appropriate format, able to represent music contents by maintaining compatibility with HTML technologies. This format could be IEEE 1599 (Baggi and Haus, 2009), an international standard aiming at a comprehensive description of music contents that has been approved by the IEEE Computer Society in 2008. IEEE 1599 adopts Extensible Markup Language (XML) in order to describe a music piece in all its aspects. XML is a simple, but very flexible text format which is playing an increasingly important role in the exchange and publishing of a wide variety of data on the Web and elsewhere. Since XML is one of the standards recognized by the World Wide Web Consortium (W3C), the choice of integrating IEEE 1599 into an e-book is coherent, as demonstrated in Section V.

With respect to other music formats, the innovative contribution of this standard is providing a comprehensive description of music and music-related materials within a unique framework, ranging from symbolic score to catalogue metadata, from score images to performance audio tracks. Comprehensiveness is realized through a multi-layer environment where data are arranged within six layers, each corresponding to a different information type: general, logic, structural, notational, computer-driven performance, and audio.

Music events are univocally identified through a common data structure known as the spine, and then instanced in the mentioned layers.

Thanks to this concept, IEEE 1599 supports two synchronization modes: i) *Inter-layer synchronization*, which takes place among many descriptions of the same event in different layers, and ii) *Intra-layer synchronization*, which occurs among multiple instances of the same event within a single layer. An in-depth description of the key aspects of the standard is provided in (Ludovico, 2013). For further details, please refer to the official IEEE repository. Finally, it is worth citing the EMIPIU portal,[1] where an HTML5 viewer for IEEE 1599 documents is publicly available.

5. DESIGN PRINCIPLES FOR AN ACTIVE MUSIC E-BOOK

This section aims at reviewing the key features of the active e-book exposed in Section III in order to apply them to the self-regulated learning of music described in Section II through the technologies mentioned in Section IV. Let us go back to the definition of the three macro-phases typical of self-regulation cycle, namely forethought, performance or volitional control, and self-reflection (see Figure 1). For each of them, we can identify a number of scaffolds and consequently design a possible implementation in an active e-book.

[1] http://emipiu.di.unimi.it

As regards forethought, first we propose *computer-assisted sight reading*. This feature implies an automatic score follow ing algorithm with customizable tempo.[2] Tempo can be set either to improve performance or to add new obstacles. The IEEE 1599 format supports this feature, since both symbolic and graphical information are encoded in a single environment, specifically in the logic and notational layer. In this way, it is possible both to propose a specific printed version of the piece, page by page, and to reconstruct notation starting from its logical description, e.g. on a unique linearized staff system. In score editing software, these approaches are often called *score view* and *scroll view* respectively. Both graphical representations can be automatically scrolled at a given rate that the student can customize.

Another scaffold regarding forethought implies asking *meta-cognitive questions* to the students in order to improve their comprehension of the difficulties to be faced during performance. Answering such questions allows relating students' problems with their previous knowledge, as well as to redirect them to *ad-hoc* learning paths, potentially crossing different semantic axes. If the e-book page presented not only a score to be played, but also a number of final questions about its musical and extra-musical meaning, its key features (melody, rhythm, genre, etc.) and main performance obstacles, the e-book would become adaptive and active in suggesting a proper path to improve learning. For instance, if a student is experiencing difficulties with a jazz piece because of its swung notes, the interface can automatically propose a link to a page containing a historical performance: from the comparison between the printed score and the audio/video track, the concept of swing in jazz music can be intuitively acquired. From a technical point of view, this feature is implemented just taking full advantage of the hypertext possibilities. Please note that IEEE 1599 supports synchronization between score and audio/video contents, even with differently temporized performances.

The second phase introduces a new set of scaffolds. As mentioned in Section II, *jumping* is one of the most adopted and successful techniques to practice. A piece can be subdivided into smaller parts on the base of music sections, performance difficulties, etc. The intra-layer and inter-layer synchronizations provided by IEEE 1599 support two kinds of jump. As regards the first one, after selecting a given score version and one of the corresponding audio/video tracks, the student can enjoy them not only in a linear way, but also jumping from a point to another, and without losing neither the score following nor the synchronization effect. This requires implementing a number of sensitive areas and controls in the interface. However, please note that the mapping of music events (time position, space coordinates, mutual synchronization, etc.) resides inside the IEEE 1599 document, and the interface simply has to implement devices to make them explicit. In this way, the learner can easily create jumps or loops on specific score sections. Besides, another kind of jumps is supported: IEEE 1599 describes within a single document many concurrent digital objects (all related to the same piece), as regards both graphical scores and audio/video performances. Consequently, during a session a student can compare different performers or different notations in real time, simply switching from one to another. Once again, score following and synchronization are preserved.

Other scaffolds to be implemented are: *noting* and *think-aloud processes*, explicitly invoked by the system as a learning tool; *peer seeking*, intended here as help requests to other students*; search for new sources*, in order to get further information about a given music domain or to improve previous knowledge. Needless to say, also these scaffolds can be easily implemented in an active e-book, even if they could require network connectivity.

Finally, as regards self-reflection we have identified another set of scaffolds fit for an active music e-book. Once again, *peer seeking* can be employed to improve the learning process, but in this case it implies a comparison between personal performance on one side and performance of peers on the other. Another possibility offered by this scaffold is cooperative learning, namely the translation of traditional classroom activities into academic and social learning experiences. In this case, peer seeking does not mean searching for a yardstick to measure personal performances against other students, but searching for other musicians of equal or similar skill to study and play with them. Web technologies, such as HTML, XML, and IEEE 1599 can support both mentioned approaches. Possible consequences are *gamification* and reward mechanisms, two ways described in scientific literature to encourage self- regulated learning. Please note that, with an Internet connection available, this kind of music e-book could even push students towards distributed music performance.

[2] Tempo is the speed or pace of a given piece in terms of beats per minute (BPM).

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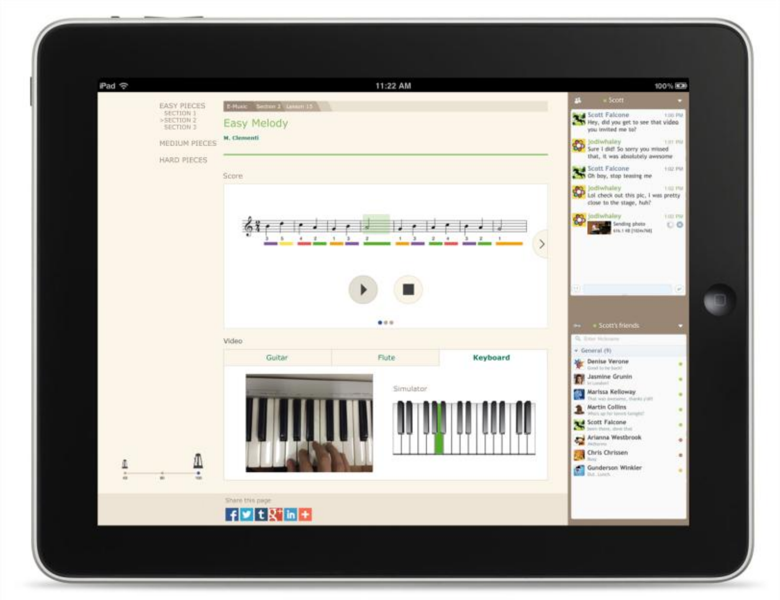

Figure 2. Implementation proposal for an active music e-book.

Probing and *checking* are two other scaffolds referable to self-reflection. The former implies that students conduct systematic analysis on their conceptual map, using both causal reasoning and computer aid to locate potential errors. An example is watching videos performed and commented by professional musicians, who can stimulate self-reflection. Thanks to IEEE 1599, these videos could be synchronized with all other music contents, and comments and hints could be enabled/disabled just like subtitles in movies. As regards *checking*, quizzes and automatically generated feedbacks on performance could help evaluating conceptual maps.

An instance of the proposed model can be implemented by using Web technologies such as HTML5, Javascript and PHP. Figure 2 shows a possible interface for an active music e-book presenting some of the mentioned self-regulated processes.

The music piece to perform is shown in multiple ways: through a standard score, through a color coding of pitches, through the keys to be pressed on different instruments (in this case, a keyboard, a guitar and a flute). Additional material is available, in the form of video performances and explanation texts (not shown in Figure 2). Standard controls allow to play, pause and stop the pre-recorded performance, and the audio track changes according to the currently selected instrument. Besides, the musician can choose a tempo to feel confident about.

6. CONCLUSION

Empirical evidences show that new media can help to innovate the paths of musical learning. Starting with the most recent studies on music education, an analysis was conducted on music students' self-regulation capabilities, highlighting their importance in a learning experience.

The design of traditional e-books in general - and music e-books in particular - has been rethought according to the macro-phases the self-enhancing cycle is made of: forethought, performance/volition control, and self-reflection.

The transition from a reading mode to a study mode made some scaffolds emerge. These scaffolds aim at training self-regulated learners who will be able to improve their performance and maintain high motivation in their music studies.

From a technological point of view, the implementation of scaffolds in a multi-modal, adaptive and dynamic interface is possible, thanks to the integration of HTML5 with IEEE 1599. The latter is an XML-based format aiming at a comprehensive description of music materials in an integrated and fully synchronized environment.

The educational approach presented in this work is driving the design of a working prototype. As shown in Figure 2, an early interface for an active music e-book has been already implemented. An early experimentation phase will take place next year, in the context of music courses for Italian middle school. Such a product follows the guidelines of the project “Scuola digitale - Editoria Digitale Scolastica” released by the Italian Ministry of Education, Universities and Research. If successful, this experience will be repeated at European level thanks to the cooperation with an international publisher.

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TIME-DECAYED USER PROFILE FOR SECOND LANGUAGE VOCABULARY LEARNING SYSTEM

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ABSTRACT

Vocabulary learning is the foundation of second language learning. Many E-learning systems have been developed to help learners to learn vocabulary efficiently. Most of these systems employ Ebbinghaus Forgetting Curve to make the review schedule for learners. However, learners are different in learning ability and the review schedule based on Ebbinghaus Forgetting Curve may be not fit for every learner. To solve the problem, this paper proposes the time-decayed user profile (TUP) to store the personalized Forgetting Curves for each learner. First, TUP is defined and then two algorithms, TUP Training Data Generation algorithm and TUP updating algorithm, are designed to train TUP. The experimental results show that the proposed time-decayed user profile can model the personalized learning characteristics of learners accurately.

KEYWORDS

Vocabulary learning, Ebbinghaus Forgetting Curve, User profile, Personalization, E-learning.

1. INTRODUCTION

Vocabulary learning is the foundation of second language learning (Horwitz, 1998; Laufer, et al. 2001; Read, 2007). So many E-learning systems have been developed to help learners to learn vocabulary efficiently. In most of these systems, Ebbinghaus Forgetting Curve is employed to make the review schedules for learners (Read, 2001).

German psychologist, H.Ebbinghaus, found that the forgetting started immediately after the learning and the process of forgetting is not uniform. At the beginning, the speed of forgetting is high, and then the speed of forgetting will reduce. Retention and forgetting are the function of time and the experimental results are described as Ebbinghaus Forgetting Curve (Wixted, 1997), as shown in Figure 1. In Figure 1, the abscissa axis denotes the elapsed time since learning, the ordinate axis denotes the retention of acquired knowledge, and the curve denotes the law of retention after learning. The forgetting curve graph shows that humans tend to halve their memory of newly learned knowledge in a matter of days or weeks unless they consciously review the learned materials.

Ebbinghaus Forgetting Curve is built on many learners' learning process, which is a general law for most of humans and doesn't consider the individual characters of each learner. However, learners are different in learning ability because each one has different memory habits, memory modes, and memory characteristics, which makes their forgetting curves different (Webb, 2005; Schmitt, 2008). Therefore, the review schedule based on Ebbinghaus Forgetting Curve made by e-learning system may be not fit for every learner, which will reduce the efficiency of learning.

To solve the above problem, this paper proposes a personalized user profile, named as time-decayed user profile (TUP), for vocabulary E-learning systems, which has the following characteristics:

(1) Personalization. The individual forgetting curve for each learner will be generated, based on his learning process, to personalize the learning ability of different learners.

(2) Rank vocabulary based on difficulty. The forgetting curve is also different when a learner learns words of different difficulty ranks. Generally, the difficult words are much more likely to be forgotten than easy words.

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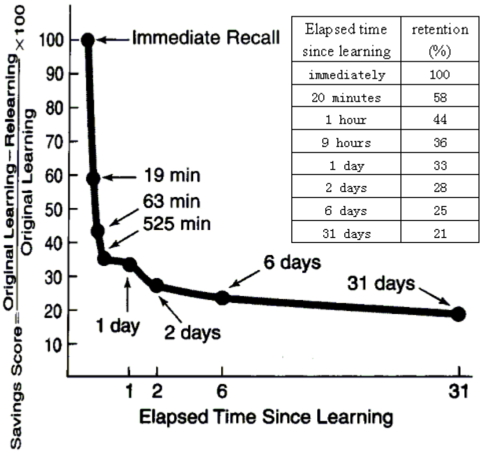

Figure 1. Ebbinghaus Forgetting Curve (Wixted, 1997)

(3) Dynamically update. The user profile will be updated dynamically in order to catch the learning ability of a learner in different periods and status.

The rest of the paper is organized as follows. Section 2 defines the proposed time-decayed user profile. Section 3 discusses how to generate the personalized time-decayed user profile for each learner. Some experiments are shown in Section 4 to validate the proposed user profile. Finally, summarizes are made in section 5.

2. TIME-DECAYED USER PROFILE

The user profile in E-learning system should record the individual characters of learners. In the learning process, the retention will decay as time goes on, which is focused on by the proposed user profile. Therefore, we name the proposed user profile as Time-decayed User Profile (TUP)

Generally, the difficult words are much more likely to be forgotten than easy words. The user profile should record the abilities of a learner in learning vocabulary of different levels. Therefore how to rank the vocabulary for TUP should be discussed firstly.

2.1 Rank Vocabulary based on Difficulty

The target vocabulary for learning should be ranked into different difficulty levels. Then we can generate the learning tasks or build the forgetting curve for each difficulty level. Furthermore, the learning history of each word, such as the learning times, the time of recent learning, and so on, is used to generate the forgetting curve, which should be attached to each word in the vocabulary. The vocabulary model satisfying the above requirements is defined as following.

Definition 1: Let V be the vocabulary and the **vocabulary model with difficulty ranks** for V, denoted by R, is defined as

$$R = \{R_1, R_2, ..R_i, ..., R_n, (R_1 \cap R_2 \cap ... \cap R_n = \varnothing), (R_1 + R_2 + ... + R_n = V)\}, \qquad (1)$$

where n is the number of difficulty ranks in V.

There exist many vocabulary difficulty ranks in fact. For example, in China the College English Test grades the vocabulary into six difficulty levels from CET1 to CET6. If V is the CET vocabulary, then n may be set to 6.

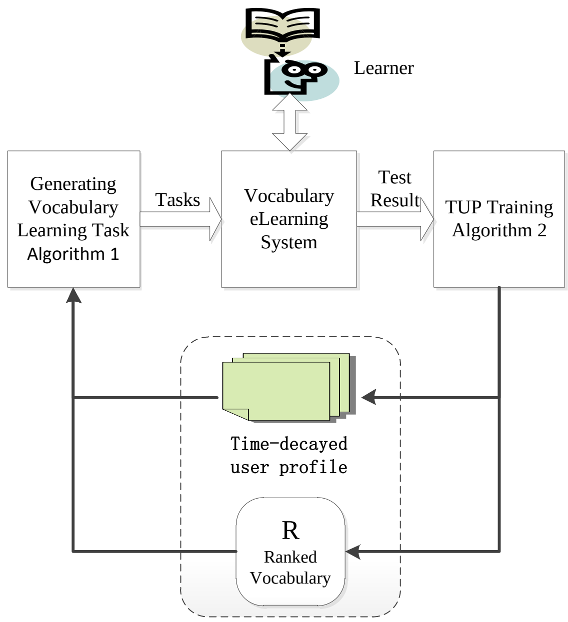

Figure 2. TUP Training Process

In R each R_i is a set of words and each word, denoted by w, is defined as

$$w = (r, lt, et), \tag{2}$$

where r is the rank that the word belongs to, lt is the learning times that the user had already done, et is the elapsed time since the latest learning on the word.

2.2 Time-Decayed User Profile

To personalize the characteristics of a learner in vocabulary learning process, user profile should record the personalized forgetting curve for each difficulty rank of vocabulary. The user profile satisfying the above requirements is defined as following.

Definition 2: The **time-decayed user profile**, denoted by *TUP*, is defined as

$$TUP = \{R, fc_1, fc_2, ..., fc_i, ..., fc_n\}, \tag{3}$$

where R is the vocabulary model with difficulty ranks as defined in (1) , R records the learning status of each word as defined in (2). fc_i records the forgetting curve of the vocabulary of the i^{th} rank, which is defined as

$$fc = \{(et, ret) \mid 0 \le et \le 31, 0 \le ret \le 100\}, \tag{4}$$

where et is the elapsed time since learning, ret is retention at the time et, which is calculated by

$$ret = \frac{original\ learning - relearning}{original\ learning} \times 100. \tag{5}$$

In Equation (5), *original learning* is the number of words in vocabulary learning task, *relearning* refers to the number of words that are forgotten and need to be reviewed, and the *ret* is the final score of retention at the time *et*.

According to Ebbinghaus Forgetting Curve, when the elapsed time since learning is bigger than a month, the retention words will be remembered for a long time. Therefore it is enough to set the upper bound of et as 31 days. et can also be a decimal to record the elapsed time less than a whole day, for example, $et = 0.5$ means the elapsed time is 12 hours.

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For a new learner, the values of fc can be initialized according to Ebbinghaus Forgetting Curve. To a specific elapsed time et, the corresponding ret can be initialized as

$$ret = e^{-et/r}, \tag{6}$$

where r is the difficulty rank of vocabulary. Another way is to initialize the forgetting curve based on the average of other learners' forgetting curves.

3. TIME-DECAYED USER PROFILE TRAINING

The training of TUP is the process to acquire the characteristics of a learner in vocabulary learning process. The acquisition is a dynamic process and the atom unit of acquisition is based on each elapsed time on each difficult rank. The general process of training the user profile is shown in Figure 2, which includes the following three steps.

3.1 Generate Vocabulary Learning Task

Vocabulary learning tasks are groups of words to test the mastery level of a learner. According to the definition of TUP, the learning task should be able to test the mastery of words belonging to different difficulty rank at different elapsed time. The learning task is defined as

$$T = \begin{bmatrix} T_{1,1} & \dots & T_{1,31} \\ \dots & T_{i,j} & \dots \\ T_{n,1} & \dots & T_{n,31} \end{bmatrix}, \tag{7}$$

where each $T_{i,j}$ is an atom learning task to test the mastery level of words belonging to difficulty rank r_i at the elapsed time j.

The process of generating vocabulary learning task is described in Algorithm 1.

Algorithm 1: TUP Training Data Generation
Description: *Generate the vocabulary learning tasks for a learner to collect training data for Algorithm 2 to train the time-decayed user profile for the learner.*
Input: *R , the vocabulary with difficult ranks*
m, the number of words in each subtask.
Output: *Learning Task, T*

```
1.  For   r = 1 to n
2.    For   et = 1 to 31
3.       While  k < m
4.             Select a word w from R randomly
5.             If (R.w.r = r and  R.w.et = et and w ∉ T_ij)
6.                    T_ij=T_ij ∪ R.w
7.             Endif
8.       Endwhile
9.       If T_ij .length<m Then
10.            Select (m- T_ij .length) words from R_r -T_ij
11.      Endi f
12.   Endfor
13. Endfor
```

3.2 Get the Feedback from E-learning System

Vocabulary E-learning system interacts with learners, performs the vocabulary testing tasks, tests the mastery level of each testing subtask in (7), and generates test results for the user profile updating in the next step.

Because the design of E-learning system is not the main work of this paper, here we just give the definition of test results, which is denoted as

$$TR = \begin{bmatrix} tr_{1,1} & \dots & tr_{1,31} \\ \dots & tr_{i,j} & \dots \\ tr_{n,1} & \dots & tr_{n,31} \end{bmatrix}, \tag{8}$$

where each $tr_{i,j}$ is the result of learning task $T_{i,j}$ and the value of $tr_{i,j}$ is calculated by (5).

3.3 Update the User Profile

Based on the test results of E-learning system, the forgetting curves of each difficulty rank can be generated and used to update the user profile, which is shown in algorithm 2.

In algorithm 2, ∞ in test results means that there is no result for the test subtask, the values of fc is initialized according to (6).

Algorithm 2: TUP Updating Algorithm
Description: *Generate the new forgetting curves to update the TUP according to the test results from E-learning system.*
Input: *TUP*
Test Results, TR
Output: *TUP (Updated)*

```
For   r = 1 to n
  For   et = 1 to 31
      If  (tr_{r,et} = ∞) Then
          ret = e^{-j/r}
      Else
          ret = tr_{r,et}
          If ret>FC.fcr.ret|_{et-1} Then
              ret = FC.fcr.ret|_{et-1}
          Endif
      Endif
      FC.fc_r = FC.fc_r ∪ (et,ret)
  Endfor
Endfor
```

4. EXPERIMENTS

Three experiments are shown in this section to validate the effectiveness of the proposed user profile.

Data Set: In these experiments, we use College English vocabulary as the data set. College English is a second language course in Chinese university, which is ranked from level 1 to 6. The vocabulary is also divided into 6 ranks. So the difficult rank of the vocabulary in the experiments is 6.

Experiment Participants: We select 60 none-English major students from different departments in a university. Among these students, 20 students are freshmen whose English level is level 1~2, another 20 students are sophomores whose English level is level 3~4, the last 20 students are juniors whose English level is 5~6. Also students are selected according to their scores in English course to ensure each group consists of students with different levels: good level, middle level, and low level.

All 60 students are divided into two groups randomly: one is experimental group, the other is control group. Each group has 30 students.

4.1 Experiment on evaluating the Accuracy of TUP

Experimental Goal:

This experiment is designed to validate the accuracy of TUP.

The accuracy of TUP refers to the degree that the forgetting curves fit the actual situations of the learners. We first generate a learning/test task for each learner according to the forgetting curves in his TUP. The learning/test task consists of the words are just forgotten according to the forgetting curves. If the test result shows that the learner really forgets these words, and then the forgetting curve is accurate, otherwise it is not. The total accuracy of a forgetting curve is the average of each time on the curves.

Experimental Process:

(1) Make a study plan for duration of 31 days, the duration of learning time in each day is 30 minutes.
(2) Select a student from the experimental group to participate in the learning process according to the study plan. During the learning process, the user profile of the student is trained. At last, the user profile has forgetting curves with the length of 31 days.
(3) Generate test tasks for the student according to the forgetting curves in his user profile.
(4) The student does the test and the score of each test is recorded to calculate the accuracy.
(5) Repeat the steps from (2) to (4) for each student in the experimental group and consequently we get 30 results.
(6) Calculate the average accuracy of the forgetting curve of each difficult rank based on the above 30 results
(7) Calculate the total average accuracy of all the average values in step (6).

Experimental Results:

The experimental results are shown in Figure 3. In the figure each line is the accuracy of a forgetting curve belonging to a difficult rank. For example, R1 refers to the accuracy of the 1st rank of the vocabulary (The words of College English level 1). Each point on the line is the average of the accuracy of the results of 30 students. The total average of the accuracy is 0.852.

4.2 Experiment on comparing the Accuracy between TUP and UP

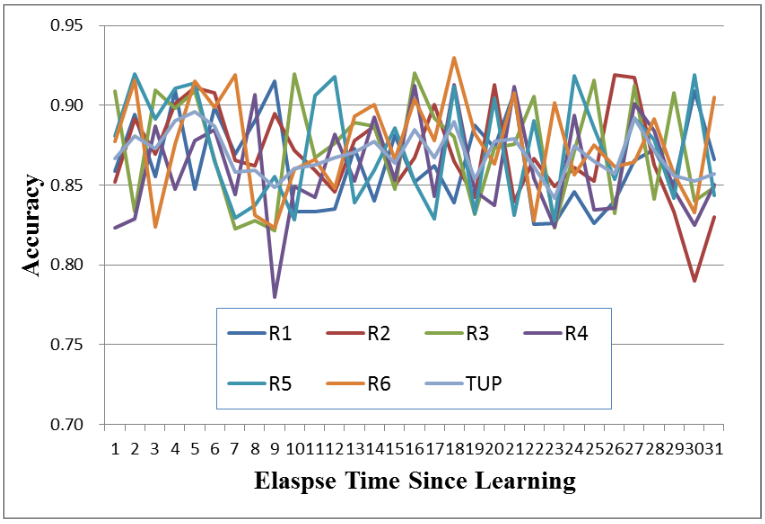

Figure 3. The Accuracy of TUP

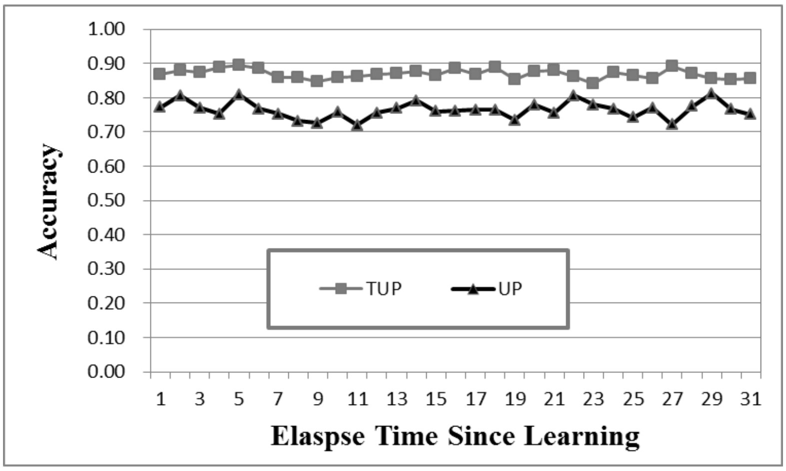

Figure 4. The accuracy comparison between TUP and UP (Ebbinghaus Forgetting Curve)

Experimental Goal:

The goal of this experiment is to compare the accuracy of the proposed TUP with the UP that uses Ebbinghaus Forgetting Curve.

Experimental Process:

The process of the experiment is the same as the first experiment. The participants of the experiment are the students of control group.

Experimental Results:

The experimental results are shown by the line UP in Figure 4, which is the average of all students of control group. The average result of Experiment 1 is also shown by the line TUP in Figure 4 for comparing with UP.

The results show that TUP (the time-decayed user profile) does better than UP(the user profile using Ebbinghaus Forgetting Curve), which also means that TUP can be used to make the review plan in vocabulary e-learning system to improve the SLVL efficiently.

4.3 Experiment on the Effectiveness in improving Vocabulary Learning

Experimental Goal:

The goal of this experiment is to compare the effectiveness between TUP and UP in improving vocabulary learning.

Experimental Process:

(1) Make a study plan for duration of 31 days and the duration of learning time in each day is 30 minutes.
(2) All the students of the experimental group do the learning with the help of TUP. At the same time, all the students of the control group do the learning with the help of UP (the same as Experiment 2)
(3) After the plan is completed, each student will be tested with the purpose of how they have mastered these respectively words.
(4) Calculate the average of students from different grades (freshmen, sophomore, and junior) in each group (the experimental group and the control group) respectively.

Experimental Results:

The result shown in Figure 5 declares that the TUP is more effective in improving vocabulary learning compared with UP.

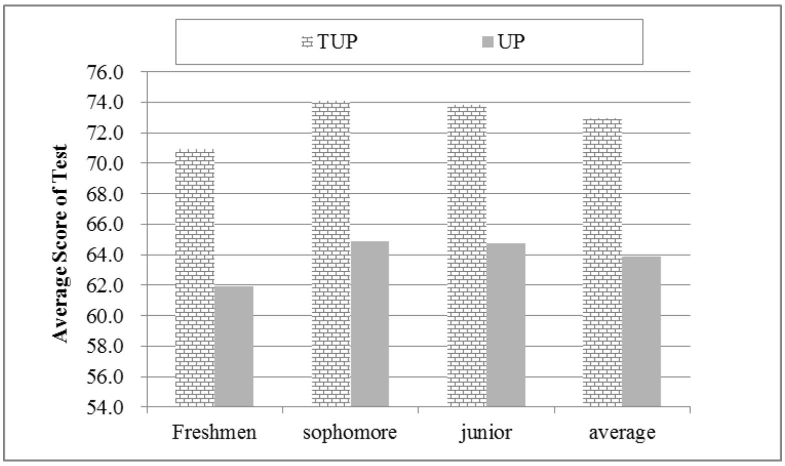

Figure 5. The effectiveness comparison between TUP and UP in improving vocabulary learning

5. CONCLUSION

Vocabulary learning is the foundation of second language learning, and a rich vocabulary makes the skill of listening, speaking, writing and oral easier to perform. Many E-learning systems have been developed to help leaners to learn vocabulary efficiently. In most of these systems, Ebbinghaus Forgetting Curve is employed to make the review schedule for learners. However, learners have difference in learning ability, so the review schedule based on Ebbinghaus Forgetting Curve may not be fit for every learner. To solve the problem, this paper proposed the time-decayed user profile (TUP) to store the personalized Forgetting Curves for each learner. First TUP is defined and then two algorithms, TUP Training Data Generation algorithm and TUP updating algorithm, are proposed to train TUP. The experimental results show that the proposed time-decayed user profile can model the personalized learning characteristics of learners accurately.

The future work of this paper includes the following:

(1) Develop an e-learning system with user-friendly interface to support larger experiments.

(2) Validate the proposed user profile in larger experiments which means more participants and longer experimental period.

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E-LEARNING TRENDS AND HYPES IN ACADEMIC TEACHING. METHODOLOGY AND FINDINGS OF A TREND STUDY

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ABSTRACT

What comes next in the field of academic e-learning? Which e-learning trends will dominate the discourse at universities? Answering such questions is the basis for the adaptation of service strategies and IT-infrastructures within institutions of Higher Education. The present paper therefore introduces methodology and findings of a trend study in the field of e-teaching. The overall interest of the study was the analysis of life stages and future potentials of e-learning innovations. A content analysis has been conducted based on 427 scientific articles of leading German-speaking e-learning conferences. Thus, e-learning trends and hypes in academic teaching have been identified and characterised. The following paper focusses on two things: on the one hand, existing academic concepts of trend research in the field of e-learning will be discussed, and on the other hand, the above-mentioned study will be introduced.[i]

KEYWORDS

Trends, E-Learning, academic teaching, Higher Education, content analysis

1. INTRODUCTION

E-learning is a concept that focusses on the use of digital technologies in education. E-learning innovations are define as technological or methodological e-learning forms which are perceived as new by potential users (Fischer, 2013)

The integration of e-learning innovations is the current challenge for organisations in Higher Education in order to support learning, teaching, and administrative processes. Due to changed student needs, increased competition between organisations, different political and economic conditions, as well as new educational and technological approaches in Higher Education, institutions need to implement e-learning to generate additional educational and economic values (Seufert, 2008). But which e-learning formats can change academic teaching? Which formats dominate the current scientific discussions? Which approaches are close to a breakthrough? Which e-learning innovations have been or will be successful in Higher Education? Information about future challenges in the field of academic e-learning are needed for providing fitting conditions to teachers, like trainings, services, incentives or technologies. Therefor the present paper focusses on these questions.

In the following, academic studies and reports will be introduced in order to discuss future developments in the field of academic e-learning. In the next step, we will describe a theoretical approach to analyse and evaluate the life cycle of e-learning trends based on the degree of public discussions. Based on this, insights will be provided into a study which helped to identify and evaluate potential e-learning-trends in academic teaching in German institutions of Higher Education.

2. INSTRUMENTS FOR TREND EVALUATION

In order to identify and characterise technical innovations which will have impacts on academic teaching, the Horizon Report will be introduced in the following chapter. The Horizon Report, which is published annually, identifies and characterises technological trends that are expected to have a great importance for the various levels of education in the following years (http://www.nmc.org), with a focus on academic teaching and learning. With the Horizon Report experts in education and technology research evaluate the short (<1 year), medium (2-3 years), and long-term (4-5 years) perspectives and effects of six technical innovations in the field of Higher Education (Bechmann, 2012).

In the recent Horizon Report (2014), Flipped Classroom, Learning Analytics, 3D Printing, Games & Gamification, Quantified Self, and Virtual Assistants (see figure 1) were identified as trends in e-learning. However, a detailed review of the last Horizon Reports demonstrates the difficulties of forecasting. For example, in 2005 and 2006, as well as in 2011, 2012, and 2013, educational games were considered as a medium-term trend (two to three years). But for all that, the dissemination of game-based e-learning formats in academic teaching has not happened so far. As a short-term trend in 2009, 2010, 2011, and 2012, mobile applications (Mobile Apps) were considered. Also here the reality in institutions of Higher Education reveals another picture. However, other e-learning formats appear unexpectedly and diffuse rapidly in the field of academic teaching. A good example for this is Massive Open Online Courses (MOOCs). For the first time MOOCs were recorded in the Horizon Report in 2013 and immediately reached number one of all e-learning trends. In fact, many MOOCs exist in Higher Education and the number of publications and scientific events about them is growing rapidly (McAuley, 2013).

Time-to-Adoption Horizon	2014	2013	2012	2011	2010	2009	2008	2007
<1 year	Flipped Classroom	Massively Open Online Courses	Mobile Apps	Mobiles	Mobile Computing	Mobiles	Grassroots Video	User-Created Content
	Learning Analytics	Tablet Computing	Tablet Computing	Electronic Books	Open Content	Cloud Computing	Collaboration Webs	Social Networking
2-3 years	3D Printing	Games and Gamification	Game-Based Learning	Game-Based-Learning	Electronic Books	Geo-Everything	Mobile Broadband	Mobile Phones
	Games and Gamification	Learning Analytics	Learning Analytics	Augmented Reality	Simple Augmented Reality	The Personal Web	Data Mashups	Virtual Worlds
4-5 years	Quantified Self	3D Printing	Gesture-Based Computing	Gesture-Based Computing	Gesture-Based Learning	Sementic-Aware Applications	Collective Intelligence	The New Scholarship
	Virtual Assistant	Wearable Technology	Internet of Things	Learning Analytics	Visual Data Analysis	Smart Objects	Social Operating System	Multiplayer Education Gaming

Figure 1. Trends in e-learning based on the Horizon Reports (2007 to 2013)

As the Horizon Report shows, the life cycle of e-learning innovations is not linear. Often new e-learning approaches appear suddenly on the agenda and dominate the scientific discussion at universities for a limited time. But they then disappear abruptly from the agenda as fast as they appeared. That is why forecasting is difficult. For the identification of trends and the assessment of future potentials, scientific instruments and methods are needed. One of these instruments is the Innovation Hype Cycle by Gartner Group (See in: http://www.gartner.com/technology/home.jsp).

The Hype Cycle is an analytic instrument developed and used by the IT research and advisory firm Gartner to represent the maturity, adoption, and social application of emerging technologies (see figure 2).

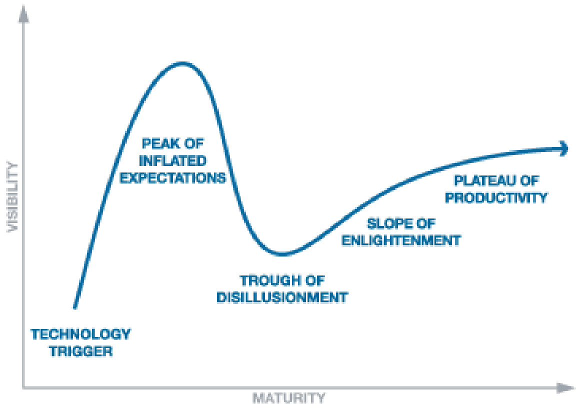

Figure 2. Gartner Hype Cycle (Gartner, 2014)

The Innovation Hype Cycle establishes a connection between the productive use of technologies and the public communication about it. This makes it possible to derive future potential of individual innovations by analyzing previous or current discourses. According the Innovation Hype Cycle the life cycle of technologies contains five phases. In the first phase (Technology Trigger), a technology breakthrough kicks off things. Based on early proof-of-concept stories, the interest of the public grows. In the second phase, early publicity produces a number of success stories. Growing public interest is then followed by the Peak of Inflated Expectations. In the next step (Trough of Disillusionment) public interest wanes because of failed experiments and implementations as well as the emergence of negative effects of the technology. The public interest grows again within the next phase. More examples of how organisations or users can benefit from the technology come to the fore, therefore the technology enters the Slope of Enlightenment. In the last phase, mainstream adoption starts and the Plateau of Productivity is reached. The technology's market applicability and relevance are clear and paying off. As the above description of the Innovation Hype Cycle shows, public attention or discussion is relevant for the evaluation of technology life stages.

3. EMPIRICAL STUDY

Related to the general aim of this paper, an empirical study is now presented. The overall interest of the study was the analysis of life stages and future potentials of e-learning innovations. In order to make trends in e-learning in recent years at German universities visible, an investigation was carried out in 2014. The study should answer the following questions: Which e-learning formats dominate the current scientific discussions? Which approaches are close to a breakthrough? Which innovations of e-learning have been or will be successful in academic teaching?

To answer these questions, a trend study based on a content analysis was performed (Langer, 2000). It was assumed that the intensity of discussion about e-learning innovations is related to their life stage – within the innovation process – and the degree of usage in academic teaching. This idea is based on the Innovation Hype Cycle, which has been described above. Therefore we analysed the content/topics of scientific contributions of two leading German-speaking e-learning conferences and publications: Gesellschaft für Medien in der Wissenschaft (GMW, http://www.gmw-online.de) and E-Learning-Fachtagungen der Gesellschaft für Informatik e. V. (DeLFI, http://fg-elearning.gi.de/fachgruppe-e-learning/delfi-tagung). 427 scientific papers of both conferences resulted in the period from 2007 to 2013. Both conferences address scientists of German universities which apply e-learning in academic teaching. While the GMW has a strong focus on didactic innovations, e-learning applications tend to be discussed more from a technical perspective at the DeLFI. In combination both conferences demonstrate the technical and didactical potentials of e-learning innovations.

The trend study is based methodically on the approach of qualitative content analysis (Mayring, 2008). First of all, the topics of the articles were identified, by looking for keywords, and then combined into categories. In this way a system of categories was derived inductively which covers the main topics of both conferences. All conference contributions of the GMW (n=234) and DeLFI (n=193) were sorted into the category system. For practical reasons, only the abstracts of the respective contributions (n = 427) were used. The following categories of e-learning innovations were distinguished within the study:

- Social Software (keywords: wiki, blogs, social networks, social bookmarking, peer learning etc.),
- E-Assessment (keywords: online exams, online assessments, tests, evaluation etc.),
- E-Portfolio (keywords: virtual artefacts, learning blogs etc.),
- Mobile Learning (keywords: mobile applications, smartphones, tablets, mobile devices etc.),
- Audio/Video (keywords: podcasts, videocasts, learning videos, lecture recordings etc.),
- Virtual Worlds (keywords: virtual environments, 3-D, virtual laboratory, simulations etc.),
- Learning Management (keywords: course management, campus management, IT-systems etc.),
- Virtual Classroom (keywords: online meetings, webinars, video conferences etc.),
- Open Content (keywords: open learning resources, copyrights, content repositories etc.),
- MOOCs (Massive Open Online Courses).

The basic assumption of the study was that conclusions about the development potential of e-learning innovations in the German Higher Education can be drawn from the analysis of the scientific contributions

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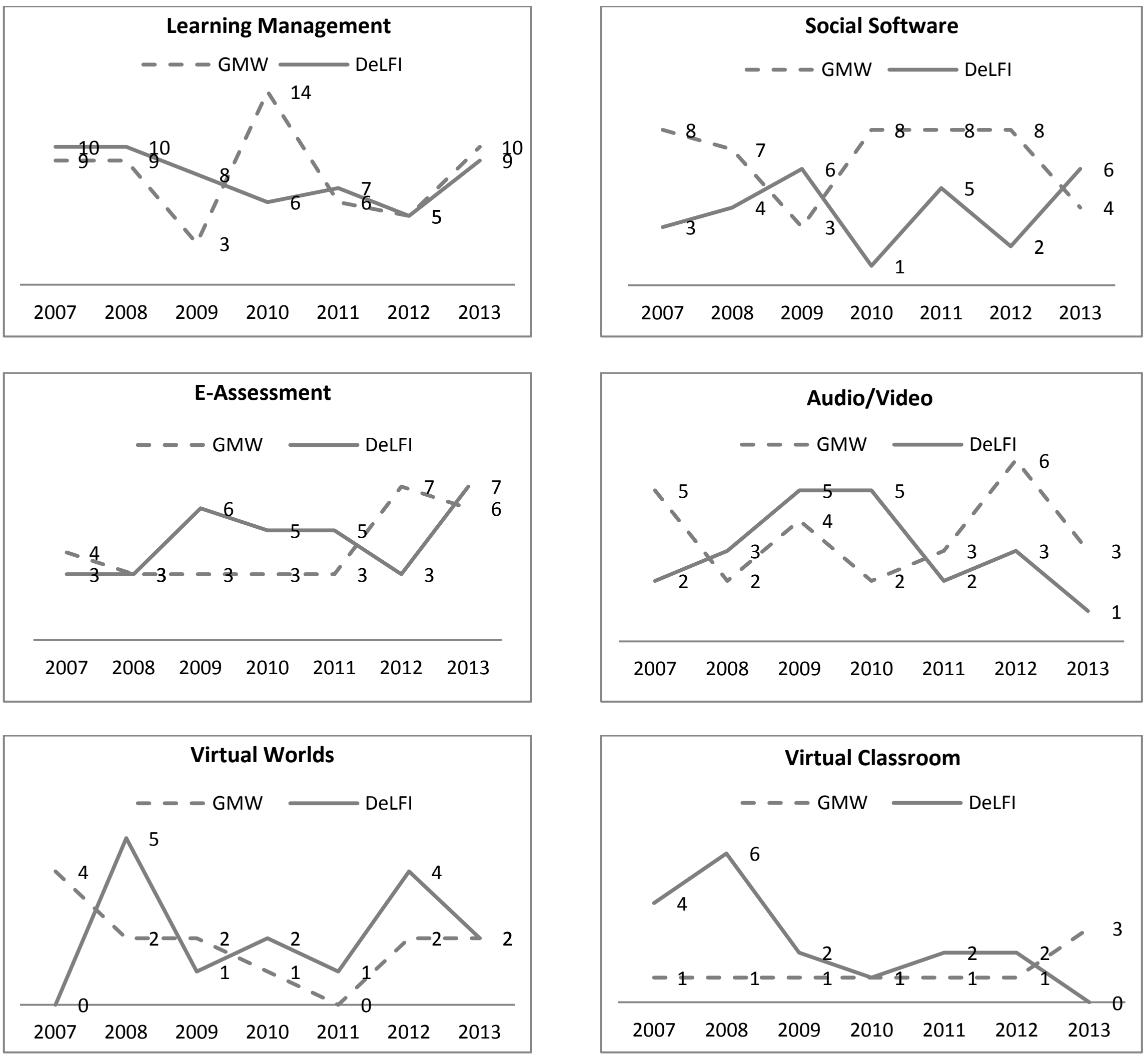
within the two selected e-learning conferences. As the Innovation Hype Cycle suggests, the degree of discussion delivers hints of the life stage of innovation. On that basis, it is assumed that frequently discussed innovations in these scientific conferences should have a high potential for academic teaching.

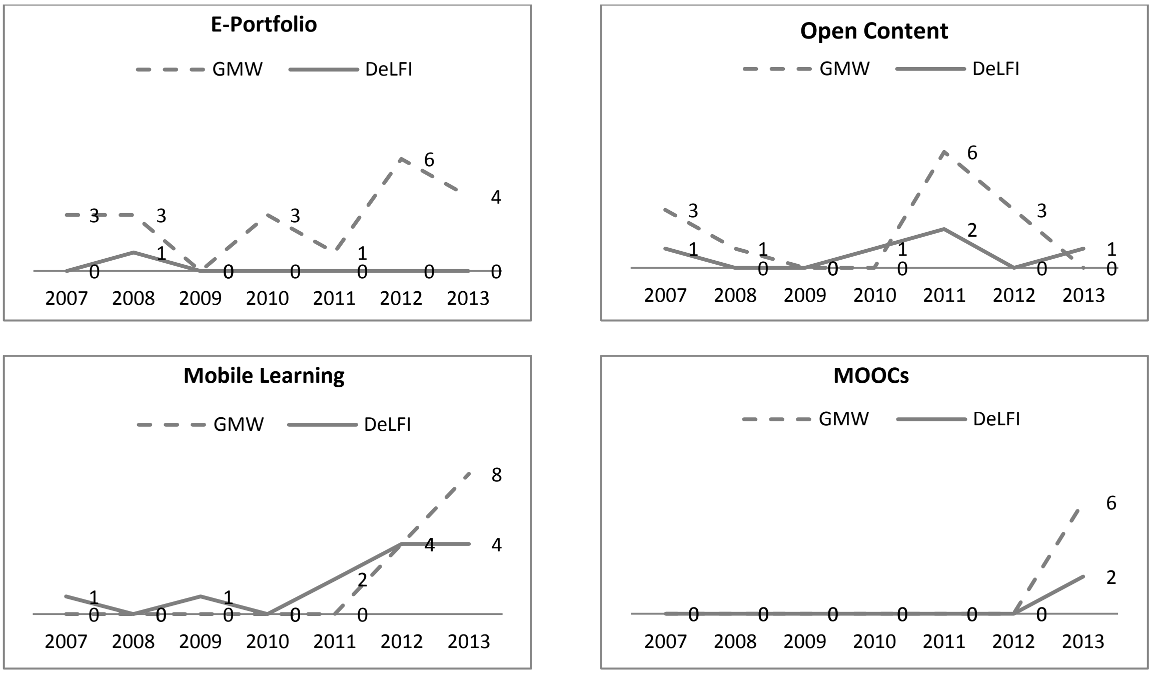
4. FINDINGS

The findings of the investigation are presented below. The figures in table 1 show how many papers of GMW and DeLFI conferences report about the respective e-learning innovations. The following assumptions can be derived from the results:

- The detailed analysis of the frequency distribution over the seven years shows trends in the investigation period. The increase of frequency goes along with an increase of importance for academic teaching.
- From the distribution of the frequencies within the two conferences, conclusions about the didactical or technical potentials of innovations can be drawn because both conferences are different in terms of their objective. The GMW is more oriented towards didactical issues, whereas the DeLFI targets increasingly technical topics.

Table 1. Findings of the study (numbers of articles per year)





In the following, the interpretation of the findings will be presented. To achieve the prognostic targets of a trend study, striking findings of the study will be formulated in the form of assumptions. We will not leave the field of the data, but also personal experiences from our daily work with teachers as well as own observations in the field of e-learning in German speaking universities will included in the assumptions. In addition, a constant comparison with the predictions of the horizon report has been done. But first, the classification of the life stages of all selected innovations based on the Garter Hype Cycles were made (see figure).

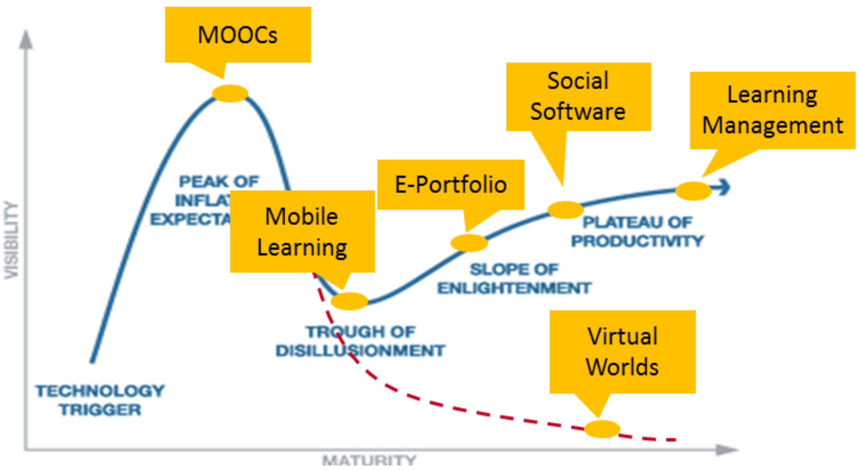


Figure 3. Life stages of selected e-learning innovations

Learning Management is the backbone of e-learning in Higher Education. Numerous articles about learning management have been presented continuously at both conferences. The decreasing degree of the scientific discussion should not be interpreted as a loss of importance, but rather for the productive usage of technologies for learning management in daily routines of academic teaching.

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Considering the discussion about **Social Software**, it is striking that it is addressed much more often within the didactic-pedagogical-oriented GMW – in quantitative terms – (46) than within the DeLFI (27), since the DeLFI has a stronger focus on technical topics. It can be concluded that Social Software – and the associated learning activities like communication, co-operation, and prosumption – is currently considered primarily as a didactic innovation.

In 2007, **Virtual Worlds** were identified as a medium-term e-learning trend in the Horizon Report, with an expected breakthrough time of 2-3 years. The euphoria was triggered by the public interest related to the application Second Life. But for all that, the scientific discussion of virtual worlds decreases continuously. This is confirmed by current Google statistics (Google trends), which capture and analyse general trends related to internet search queries (see figure 3). Virtual Worlds were hypes. They could not prevail at universities and will probably disappear from the e-learning agenda in the medium-term.

Figure 4. Internet search queries in Google, analysed by www.google.de/trends (Keyword: "Virtuelle Welten")

E-Portfolios have become established firmly in the academic discourse about e-learning. However, it is more surprising, therefore, that e-portfolios have not been included in the internationally oriented Horizon Report. It cannot be determined whether e-portfolios are merely a phenomenon in the German-speaking area of Higher Education or not. In any case, the investigation showed that e-portfolios were significantly more in focus at the GMW conferences (20). Therefore they are probably more a didactical and organisational innovation in academic teaching than a technical challenge.

From 2009 to 2012, **Mobile Learning** was number one of all e-learning trends in the Horizon Report. But what about the professional debate in the German Higher Education area? So far, mobile trends in e-learning have been rarely discussed at the investigated conferences. Until 2010 there were only two articles about this topic (in both conferences). However, mobile learning has moved into the focus of the GMW and the DeLFI during the past three years (12 papers in 2013) and now it seems to be established in the scientific discourse within German-speaking universities.

MOOCs have unexpectedly become number one among all e-learning trends in the Horizon Report 2013. Throughout the period since 2007, there had been no indications suggesting this development. Neither the acronym MOOC nor the ideas behind it (open online teaching for large groups of learners) were identified as trends in the Horizon Reports. In 2013, the first articles about MOOCs were published in the GMW (6) and Delphi (2) proceedings. The fact that MOOCs belong to the e-learning trends with the largest development potential in academic teaching is shown by the practices of many universities. Numerous MOOCs have been developed in the past few months and the public debate about MOOCs is growing. The European Knowledge Centre for Open Education currently lists nearly 500 MOOCs of European universities (http://openeducationeuropa.eu/de/european_scoreboard_moocs). However, it is too early to assess the true potential of MOOCs. We believe that MOOCs are currently on the top of the hype (peak of inflated expectations), therefore it can be assumed that the scientific discussion will decrease in the following years.

5. LIMITATIONS

The presented findings are the result of an exploratory study. With this in mind, the described research design can lead to distortions or errors, which can have impacts on the validity of the findings.

- Only abstracts of the contributions have been investigated. It is conceivable that in the complete articles topics have been addressed which are not referenced to in the abstract or that abstracts are enriched by modern (trend) terms to attract the attention of potential readers. In both cases, the assignment of the content into the categories has been incomplete or incorrect.

- For many e-learning innovations, there are no fixed technical terms in the scientific debate. The assignment of concepts to pre-defined categories is therefore difficult. Errors in the category allocation due to unclear terminology cannot be excluded.
- We analysed the frequency of reports concerning e-learning innovations. The correlation between the frequency of reporting and the future potential of innovative e-learning applications has not been established empirically, but follows plausibility considerations (Rogers, 2003; Gartner, 2014).
- Organisers of the investigated conferences often define the (main) topics. This influenced the spectrum of represented topics over all, as well as the focus of individual contributions.
- The above-presented study was conducted at German-speaking conferences and therefore reflects the situation in Germany, Switzerland, and Austria. The structure and culture of Higher Education in all three countries is comparable. As the usage of digital media highly correlates with national characteristics of the higher educational system, the findings cannot be generalised. The situation of e-teaching might be very different in English or French-speaking areas.

6. RÉSUMÉ

These above-mentioned limitations could affect the scientific quality of the results. The data and findings therefore should not be over-interpreted. Despite all the potential limitations, the data provide on the one hand a differentiated picture of the current debate focus of e-learning innovations in Higher Education. Some trends have become visible. On the other hand, the study describes a methodical approach to characterising the life cycle of innovations by analysing scientific material.

Finally, we would like introduce possible method-based extensions of the presented study for future research:

- The study could be extended to international conferences.
- The prospects of individual innovations (e.g. MOOCs) could additionally be investigated by qualitative research methods (e.g. in the form of expert interviews).
- The public discourse about e-learning in academic teaching could be investigated by using discourse analysis, to thereby bring out the role of individual actors and public institutions.

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[i] Parts of the study has been presented also at EDEN 2014 (http://www.eden-online.org/2014_zagreb.html)

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PROOF OF ECONOMIC VIABILITY OF BLENDED LEARNING BUSINESS MODELS

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ABSTRACT

The discussion on economically sustainable business models with respect to information technology is lacking in many aspects of proven approaches. In the following contribution the economic viability is valued based on a procedural model for design and evaluation of e-learning business models in the form of a case study. As a case study object a blended learning continuing education course is used. It is provided by a small technology-based education service provider, a typical representative of small and medium-sized companies (SMEs) in the german education market. The focus of the results discussion is the entrepreneurial attractiveness of such business models and recommendations for further studies

KEYWORDS

Continuing education; business model; profitability analysis; blended learning; visualization of financial implications

1. INTRODUCTION

With the commencement of commercial use of the Internet there is an ongoing search for suitable business models and approaches according to their well-founded derivation. This is the theme of " business model " discussed quite controversial even in business computer science (e.g. Hess, 2012, p. 2). A fitting for this post definition of the business model concept, which emphasizes the tool character, provide Weiner, Renner and Kett (2010). Thus, a business model (elements and their relationships to each other) should contain in its conception the perspective of the customer/market, the service provision as well as economic relations with taken into account (Weiner, Renner & Kett, 2010, p.23). An overview of the state of the business model research can be found ibid. (2010, pp. 49), simultaneously the same is practiced at the current situation review: "business model research happens to be very strong on paper." (Weiner, Renner & Kett, p. 106). Case studies are an adequate research method as it is presented in this paper for the step in the direction of applied research. An interesting case study for business objects for business model analysis is that of technology-based training providers. An industry that is in publications on business model research very rarely in focus. For example, the activities of the E-Learning/Blended learning in highly cited science-based classification of business model types, according to Laudon and Trever (2011) are not explicitly classified. It is to be noted that in Germany the market of continuing education, as measured by the gross domestic product (approximately € 27 billion in 2003), long ago acquired a greater significance than the market of agricultural, forestry and fisheries (Dt. Bildungsserver, 2011 and DESTATIS, 2004).

The heterogeneous supply structure in the continuing education sector is dominated by small and medium sized enterprises (SMEs), with the majority of vendors micro enterprises (up to 25 employees) as stated by Dietrich and Schade (2008), of the estimated 12 to 15 thousand providers in Germany (e.g. DIE, 2008 and Lünendonk, 2008). Just this small private training providers are facing enormous challenges with change processes described below in the teaching-learning culture and the educational technologies.

The ubiquitous slogan of Lifelong Learning indicates that learning has become an ongoing task. This development on the one hand reflected in the demand for continuing education resist, exemplified by the following figures: "Distance learning or distance studying is for more and more people in Germany the method of their choice, if they continue their education in addition to work and family. [. . .] About 387,000 people thus occupied last year, a state- approved correspondence course or a distance learning course at a remote high school. These are 2.0 percent more than last year. Since 2005, the “number of participation” figures are even increased by 25 percent." (Forum-Distance-Learning, 2010, p. 1). On the other hand, in the wake of increasing demand for part-time training opportunities, the demands grow on the design of appropriate teaching-learning scenarios. A long time are the so called “new media” no new media anymore, the use of the Internet and multimedia elements is steadily increasing in the context of continuing education courses in Germany, from 2,821 in 2011 to 5,664 in 2013 (Dt. Bildungsserver, 2011a). To summarize it, this is the way get to the point: "E-learning - or more generally, the use of new media in education - is not only the continuation of the usual formation of new funds, but will lead to restructuring, which are difficult to predict today. The educational institutions will have to set up that they become permanent “construction areas”." (Sesink, 2006, quoted in Appelt, 2010, p. 151).

The reaction and the implementation of the answers to the challenges outlined in the continuing education market should ever prove to be feasible in the economic wattle for SME educational institutions with their own self- understanding and financial funding (Kraft, 2010, p. 419). This means, that the (re)-modeling of entrepreneurial activity has to be measured by economic criteria. A possible process model is explained in the following section and in section 4 the results of its application in the analysis of the economic aspects are presented.

2. THE ECONOMIC EVALAUTION OF BLENDED LEARNING BUSINESS MODELS

As a promising approach with practical benefits, the process model for the design and evaluation of blended learning business models developed by Brocke, Buddendick, Gaiser and Haug (2007) is used as a template for the evaluation of the case study. This process model should help to subject the design of business models and the results of such design to continuous economic evaluation (in an iterative cycle). The core consideration of profit maximisation should be achieved by the triad of a market, activity and capital model (Brocke et al., 2007, p 10). Figure 1 outlines the process model: the three sub-models are evaluated using quantitative and/or qualitative methods. The focus of the assessment in this article is on the capital model.

The market model is used to describe the structure of the e-learning market as well as the different stakeholders and their roles (Grob, vom Brocke & Bensberg, 2004), with the purpose of creating an innovative product (product portfolio) which gains market acceptance to the extent that it allows long-term business success. This includes customer segmentation, the delineation of strategic business fields, an assessment of market attractiveness, and an industry structure and competitor analysis which enables providers to classify themselves as quality or cost leaders, or as niche providers (Brocke et al., 2007). A quantitative assessment is undertaken by means of a deposit page that includes estimates of opportunities and threats.

In the activity model (e-learning) activities (see figure 1) are described which a (training) provider carries out in the course of their business activity (Grob et al., 2004). The reconciliation of their core competencies with the planned e-learning business model is the basis for qualitative assessment of the activity model (Brocke et al., 2007). The calculation or forecast of the withdrawal page (resource consumption) is the core step towards quantitative assessment of the activity model (for example by means of event-driven process chains or process cost accounting (e.g. according to Gutbrod & Fischer, 2004). In the capital model, the organisational or legal form and the financing are defined for the e-learning business model. The legal framework is considered, the capital requirements are determined and the available or planned lending and investment options in the capital market are investigated. Qualitative assessment of the capital model for the planning period is carried out in a scenario analysis. Methods of investment appraisal, e.g. Visualization of Financial Implications – VoFi, are used for quantitative evaluation.

The payments over several periods associated with the e-learning business model are compressed to target values and evaluated, and can be used to compare different business model alternatives as required.

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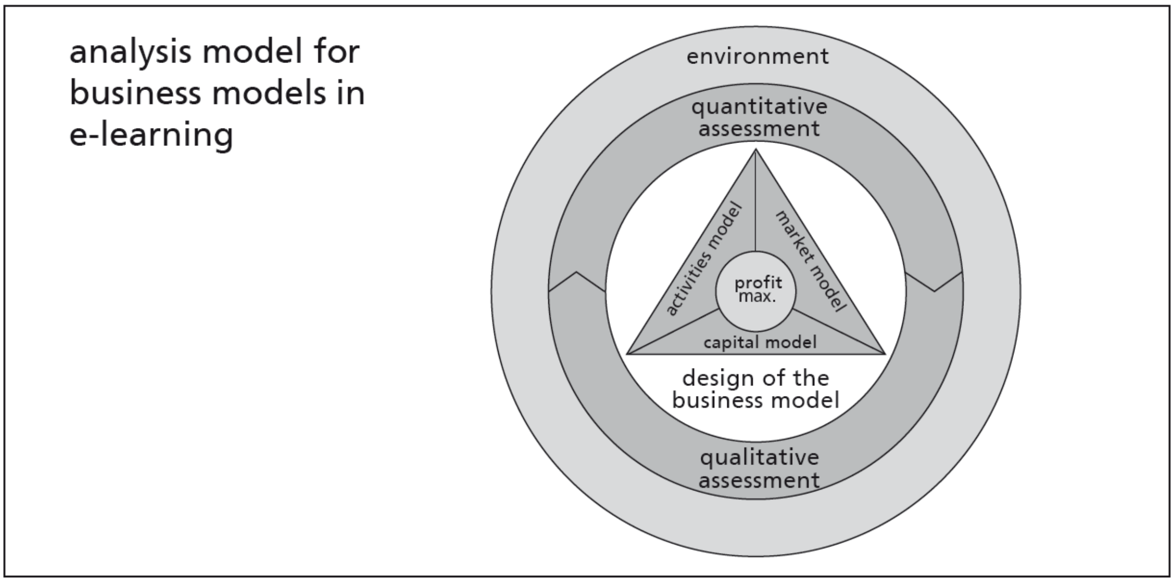

Figure 1. analysis model based on v. Brocke et al. (2007, p. 10)

The additional comments focus on the capital model. They are operationalised for practical application and are used to carry out a quantitative evaluation (profitability assessment) of the subject of the case study.

3. TECHNOLOGY-ORIENTED TRAINING SERVICE PROVIDER – A CASE STUDY APPROACH

The subject of the case study is a typical participant in the training market. Scientific Learning Systems (SLS, www.sls-saar.de) is an SME and niche provider. Its business objective provides for a three-year training course leading to a qualification as a state-certified radiology assistant (MTRA). The SLS itself is a spin-off of the Saarland University Clinics. The goal was to create a modern, customised computer-based training scenario. The blended learning approach was selected for the training course. To meet the requirements and the professional and living conditions of those interested in the training, the MTRA blended learning course combines attendance periods (every six to eight weeks for two to three days) sequentially with self-learning phases, which are supported by multimedia elements and Internet-based communication tools.

In this way, the drawbacks of traditional distance learning courses and pure e-learning scenarios should be compensated, and there should be clear advantages over the attendance-based training from which the course was developed. The development of blended learning training began in 2002. In 2003 the first year started with 20 participants (the number of participants is limited to 25 per year). A learning management system (LMS) was developed for the blended learning scenario. The learning scripts are distributed on this LMS. These scripts are enriched with visualization elements such as interactive graphics, animation and simulations. Numerous instructional videos were produced for a variety of subjects, such as recording technology, and linked into the course texts. A particular focus of this teaching-learning scenario is on learner support during the self-learning phases. For this purpose, a so-called multimedia response system is used, involving a very short response time by the lecturers. Trainees receive elaborate (e.g. Narciss, 2006) audio-visual feedback to their questions by e-mail; for example, if they have problems while solving a physics task. This intensive exchange between students and lecturers during the self-learning phases enables an individual learning path to be developed for each learner. If components of this type are absent from a modern teaching-learning scenario, or if they are inadequately designed, the learners may become dissatisfied due to a lack of support and inadequate individual feedback or delays in providing it (Ojstersek, 2007, p 196).

Minocha, Schroeder and Schneider (2010) even propose a clear expectation of lecturers that they should assume the role of providers of feedback, particularly when e-learning components and social software are used. However, these components cause a considerable financial outlay on the part of the training provider.

Despite a sort of consolidation phase for e-learning based training options that can be currently seen, the development costs of computer-based training (CBT) and web-based training are still very high (Meister & Kamin, 2010). Likewise, learner support during the self-learning/online-phase has proven to be very costly overall (Bremer, 2004, p 51).

So far, the MTRA blended learning training course has been fully booked since it started (recommendation rate of participants is over 90 percent; Druhmann, 2013), so that the deposit page has shown the maximum volume, in terms of the market model. Nevertheless, this business model has not been imitated by other MTRA training providers (or by those offering courses for related professions such as pharmaceutical technical assistants - PTA). One reason could be lack of assessment or evidence of the cost-effectiveness of such training opportunities, and hence that of the underlying business sector. Moreover, established procedures are lacking. In the following a possible approach and the results of the case study outlined above are described.

4. PROCESS AND INSTRUMENTS OF ECONOMIC ASSESSMENT

Firstly, a cost structure was developed which is specially tailored to the MTRA blended learning training programme. This was necessary, as so far no standard cost structure has been developed on the basis of the various approaches in the literature. Cost-generating activities were initially identified on the basis of the teaching-learning processes, and the associated cost types defined – structured according to the phases of design, use and development of the MTRA blended learning training measures (see Figure 2).

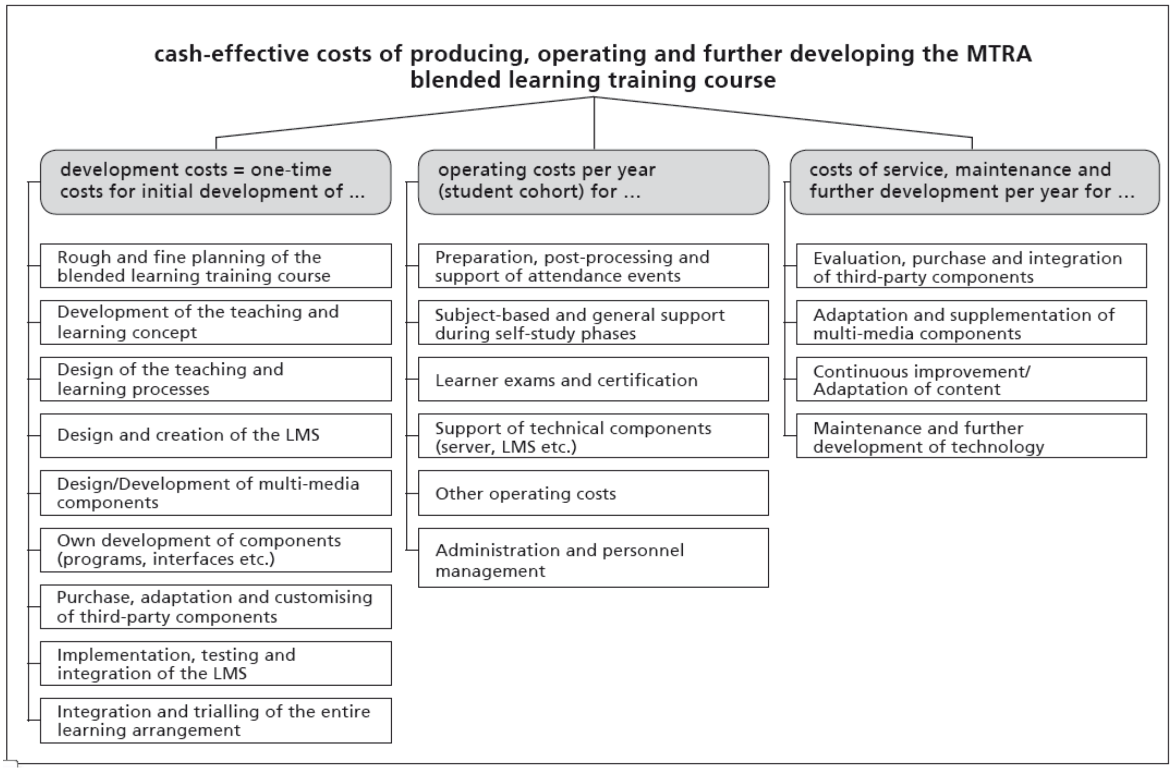

Figure 2. Pragmatic cost model for determining the payment-related expenses for production, operation and development of the MTRA training course. Cash-effective costs of a blended learning course (own compilation based on SEIBT, 2005, p 43; RUMBLE in comparison with 2001 cit. at GUTBROD & FISCHER, 2004, p 3)

The withdrawal page in the case study consists of investment and current expenses (operating costs and cost of maintenance, care and development), each containing fixed and variable costs.

The **investment costs** include the initial production costs, which are comparable to those which arise in the establishment of a conventional teaching-learning scenario. Work must be carried out on the rough and

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fine planning of the training course on a project basis (initialisation, organisation and team building, project management and time and budget controls, etc.). This includes, for example, the creation of a suitable teaching and learning concept and design of the associated processes. The one-off design costs are determined mainly by personnel costs (salaries). The costs of preparing the learning scripts were halved, as they are also used in the attendance variant.

The non-recurring technology costs include expenses for the selection, acquisition/creation, production and implementation of the self-developed LMS. Further cost considerations are the desired functionality (e.g. with or without a virtual classroom) and the degree of integration of digital media. Licence fees in the higher education environment are usually moderate, thanks to discounts from manufacturers or the use of open source software (e.g. Moodle). The purchase of appropriate hardware plays a minor role in the initial costs.

The **running costs** can be broken down into operating costs and service, maintenance and further development costs. The operating costs are reported per calendar year. Personnel costs incurred in the provision of teaching make up about 60 percent of total operating costs. They include attendance events, support during the self-learning phases, interdisciplinary coaching and examination costs. The number of students and teachers who use the LMS, the nature of the technical infrastructure and software systems, and organisational responsibilities determine the operating costs of the LMS. A maximum of 75 students and 14 lecturers have access to the self-developed LMS of the MTRA training course; a 20-percent position for a multimedia technician is added for technical support.

The proportion of organisational administration by the technical support for the LMS is not insignificant: it includes user and rights management, technical support with regards to login, browser and codec problems and misplaced passwords. The operation of the institute's own server and associated network also leads to proportional personnel and hardware costs. Other operating expenses consist primarily of a lump sum for the use of space at the University Hospital. In 2011 greater efforts were made to modernise the teaching-learning scenario (teaching and learning methods, extending the functionality of the LMS, new learning videos, embedding a virtual classroom).

The investment and running costs can be summarised as follows:

Table 1. Selected information on the cost side of the MTRA blended learning training (based on Druhmann, 2013 pp. 195)

Costs	Year	Amount
Investment costs	2002/2003	€ 248.712,-
Operating costs	2009	€ 71.147,-
Costs of service, maintenance and further development	2009	€ 11.067,-
“Modernisation investment”	2011	€ 82.172,-

For the Visualization of Financial Implications (VoFi) calculation the investment costs are pragmatically divided into proportions of two thirds for the first year and one third for the second (development) year, since implementation activities and the launch of the training course incurred higher costs in the first year.

The market model is not referred to in detail at this point (see Sections 1 and 3), because the customer target group is defined and deposits are generated in the case study solely from the course fees collected (€ 149, - / participant and month; max. 25 participants/year). The MTRA blended learning training course has operated at full capacity since its launch.

The imputed connections of the complex deposit and withdrawal structure of a training course are shown below in the capital model. The VoFi was chosen as a suitable model for investment accounting. The concept of complete financial plans differs from the “classical” methods of investment accounting mainly in the fact that all payments caused by the investment are shown explicitly. This allows a relatively accurate and transparent assessment of the relevant series of payments, a differentiation of the financing side (equity/debt, e.g. short-and long-term forward-interest rates, repayment terms, etc.) and the resulting financial consequences. In the investment time t = 0, the initial net investment is financed through the use of own capital and possibly an initial loan. During the observation period, n years, of the investment, payment surpluses (including the liquidation surplus in t = n) are set as original payments. Taking into account transfers, deposits and tax payments, interim financing arrangements (temporary financing) and reinvestments (temporary investments) need to be made which lead to annual financial balances of zero. The lending/net borrowing of each period is thus by definition zero and is derived from the gap between all incoming and outgoing payments in consideration of the initial stock of cash. The balance of assets and loans (inventory balance) shows the evolution of the target value over time. Of particular importance is the target or final wealth at the end of the useful life or at the end of the planning horizon. The result of the VoFi represents the final wealth of the investor achieved by making the investment as an absolute number. Particularly significant for the evaluation of business models in blended learning is the VoFi total return on assets, which expresses the return on investment (ROI) based on a dynamic number base.

The VoFi total return on assets shows the interest paid on capital employed over the useful life, which can be compared to a calculated basis for an investment decision using the average cost of capital. The VoFi return on total capital g_{GK} is calculated according to the equation below (figure 3):

$$g_{GK} = \sqrt[n]{\frac{EW^M + FK_0 + Z^S}{EK + FK_0}} - 1 \text{ für } EW^M + FK_0 + Z^S \geq 0$$

Figure 3. VoFi return on total capital g_{GK} (Grob, vom Brocke & Bensberg, 2004, p 8)

In order to use this equation to assess the absolute and relative benefits of the project, not only the final value of the investment alternative, but also the final value of the default alternative must be determined (e.g. using a risk-free financial asset; see Grob, 1989, pp. 73). As additional assessment information, the VoFi the pay-off period can be determined: this specifies the time it will take for the net initial investment to pay for itself, taking into account imputed interest on equity (Grob, 1989, p 92).

In order to make a meaningful calculation for the case study, the deposits and withdrawals incurred by the business model of the case study were recorded over a longer period (2002 to 2011) and adopted into the VoFi as elements of the payment sequence (all payments in arrears at the end of each year).

For the running costs (operating costs and service, maintenance and development) real data were available until 2011; for the following years an annual cost and price increase of four percent is assumed. On the revenue side a one-time ten percent increase in participant fees was calculated for 2011. The observation period for the VoFi calculation was set to 2016 (13 student cohorts); no end of the training courses, nor a sale with a fictitious, incalculable, return are assumed for this calculation. The observation period selected is long enough to ensure that the initialisation costs are not disproportionately weighted. A result, the revenue side is taken into account using the total real number of students in each cohort, considered several times, and also a sufficiently long observation of the outlay side, including a significant overhaul of the teaching-learning scenario.

The final value calculation is made in accordance with the VoFi model on the last date of the period: for any previous period a payment surplus (receipt surplus) is offset by interim financing (reinvestment). The VoFi pay-off period can be specified as an additional, time-critical figure: this indicates the period in which the net initial investment will pay for itself, taking into account an imputed interest rate of 4.4 percent on equity. The VoFi total return calculation for the case study is made for the case of 100% own financing (from existing cash funds). Thus, the VoFi total return is equal to the VoFi return on equity. The result is a VoFi own or overall profitability of 5.10 percent (see table 2). The VoFi pay-off period is outside the period under consideration. A payback of the capital invested is therefore not to be expected within 13 years.

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Table 2. Extract from the VoFi of the MTRA blended learning training course (based on Druhmann, 2013, p. 199)

VOFI of MTRA Blended Learning training course – szenario „status quo"																
	t_0	t_1 2002	t_2 2003	t_3 2004	t_4 2005	t_5 2006	t_6 2007	t_7 2008	t_8 2009	t_9 2010	t_{10} 2011	t_{11} 2012	t_{12} 2013	t_{13} 2014	t_{14} 2015	t_{15} 2016
direct payments																
investments		−82.904	−165.808													
running costs			−24.523	−81.715	−82.532	−79.649	−81.564	−80.032	−78.895	−82.214	−85.503	−88.923	−92.480	−96.179	−100.026	−103.027
cash inflow	250.000		53.640	98.340	89.400	134.100	134.100	134.100	134.100	134.100	134.100	147.510	147.510	147.510	147.510	147.510
net total		−82.904	−136.691	16.625	6.868	54.451	52.536	54.068	55.205	51.886	48.597	58.587	55.030	51.331	47.484	44.483
equity	250.000															
dept capital	0															
interest on dept capital		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
amortisation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
bridge financing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
interest on bridge financing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
reinvestment tn_1		−167.096	−34.582	−52.072	−57.638	−110.648	−160.418	−210.476	−260.419	−305.794	−346.746	−396.665	−441.778	−482.065	−517.497	0
interest on reinvestment		0	−4.177	−865	−1.302	−1.441	−2.766	−4.010	−5.262	−6.510	−7.645	−8.669	−9.917	−11.044	−12.052	−12.937
repayment		0	0	0	0	0	0	0	0	0	0	0	0	0	0	517.497
final value EW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**549.043**
residual debt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
annuity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EW(t)	250.000	167.096	38.760	52.937	58.940	112.089	163.184	214.486	265.681	312.305	354.391	405.333	451.695	493.109	529.549	549.043
opportunity	250.000	261.000	272.484	284.473	296.990	310.058	323.700	337.943	352.813	368.336	384.543	401.463	419.127	437.569	456.822	476.922
delta EW(t)	0	−93.904	−233.724	−231.537	−238.050	−197.969	−160.516	−123.457	−87.132	−56.032	−30.152	3.870	32.567	55.540	72.727	72.121
VOFI-Pay-off-Period		nein	nein	nein	nein	nein	nein	nein	nein	nein	nein	ja	ja	ja	ja	ja
Long-term interest debit balance	6,5%	6,5%	6,5%	6,5%	6,5%	6,5%	6,5%	6,5%	6,5%	6,5%	6,5%	6,5%	6,5%	6,5%	6,5%	6,5%
Short-term interest debit balance	8,5%	8,5%	8,5%	8,5%	8,5%	8,5%	8,5%	8,5%	8,5%	8,5%	8,5%	8,5%	8,5%	8,5%	8,5%	8,5%
Long-term interest credit balance	4,4%	4,4%	4,4%	4,4%	4,4%	4,4%	4,4%	4,4%	4,4%	4,4%	4,4%	4,4%	4,4%	4,4%	4,4%	4,4%
Short-term interest redit balance	2,5%	2,5%	2,5%	2,5%	2,5%	2,5%	2,5%	2,5%	2,5%	2,5%	2,5%	2,5%	2,5%	2,5%	2,5%	2,5%
VOFI-return on total capital	**6,2%**															

The imputed nominal and credit interest rates were defined as follows:

- Long-term interest on debit balance: 6.5 % (range of promotional loans for SMEs: 2.45–9.1 %; www.genobank.de),
- Long-term interest on credit balance: 4.4 % (average return on 10-year government bonds 2003–2011; www.bundesbank.de),
- Short-term interest on debit balance: 8.5 % (assumption, as dependent inter alia on creditworthiness, credit rating, existing liabilities etc.);
- Short-term interest on credit balance: 2.5 % (average money market interest rate 2003–2011; www.bundesbank.de)

The calculated VoFi return is positive and can thus seem advantageous for the project, in terms of financial criteria. However, the absolute figure of 5.1 percent should be compared to the returns from alternative investment opportunities. Thus, the absolute size of the return is slightly above the average yield on 10-year government bonds (4.4 percent), which considering the difference to this very low-risk investment alternative represents a very small premium when the risk and profit for the training provider are taken into account. The VoFi Pay-off-Period of over thirteen years, calculated using the opportunity interest rate, also seems uninviting from a business perspective. Direct comparison with other schools or providers of MTRA training with national accreditation is not available, as none of the other MTRA training service providers nationwide have so far implemented a blended learning concept. An extension of the “peer group” for a comparison of returns also affords no meaningful comparisons, due to the fact that the relevant financial data have not been published. In addition, an analysis would need the same framework conditions for the comparative case studies as for the case study in this article. For example, the withdrawal page would have to be created using the same cost structure, and the same accounting procedure would have to be used to calculate the measured values (e.g. VoFi).

5. CONCLUSION AND OUTLOOK

Training service provision is an industry that has been faced with profound and necessary changes in its activities for several years. Due to "modern" teaching-learning scenarios, marked by time- and location-independent learning and a high degree of multimedia and ICT use, providers are confronted by significant challenges to their business models, despite a growing market. In particular, economic viability is essential for training providers, so that the result for this case study (in the form of equity or total return) is all the more disappointing. Due to the full student numbers for the MTRA training course (so far), the search for economic optimisation can concentrate on the activity model. An area for analysis is the use of multimedia and blended learning elements, because this is responsible for the majority of the initialisation costs in the training scenario (about two thirds). Individual attention during the self-learning phases accounts for 25-30 percent of the total ongoing costs during the provision of training: these are mainly personnel costs for teachers. Thus changes in the training scenario need to be justified from an economic, but also from an educational perspective. For this purpose it will be necessary to carry out more interdisciplinary education-economic cost-benefit analyses within larger samples. This is because the assessment of the economic viability of this blended learning business model was performed using a customised cost model and an as yet infrequently used investment calculation method (VoFi). Both instruments could be used in further studies.

On the one hand this could increase the frequency of use of the application itself, so that the number of results achieved in the same way would be increased, which in turn would allow comparisons between business models. On the other hand, the cost model and the complete financial plan could be further tested and developed regarding their suitability for economic assessment. In addition, the approach used for this work could be combined with current approaches to cost-benefit analysis in further education (e.g. Schlicht, 2012; Zangemeister, 2000), in order to systematically and comprehensively determine the cost-effectiveness of teaching and learning with digital media.

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DOES SATELLITE TELEVISION PROGRAM SATISFY ETHIOPIAN SECONDARY SCHOOL STUDENTS?

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ABSTRACT

The Ethiopian development plans have dealt with education sector as a key strategic pillar. There have been a lot of educational efforts. Especially to cope with lack of qualified teachers, lack of good teaching models, and remote rural regions separated from educational benefits, Ethiopian Ministry of Education has made efforts in utilizing educational media such as satellite TV program for improving quality of secondary education for last decades of years. However, there was lack of national investigation in the aspect of systemic evaluation, for measuring the effectiveness of satellite TV program. This study aims to investigate the actual practice and effectiveness of satellite TV program in Ethiopian secondary schools. To achieve the goal, one questionnaire was developed based on CIPP model. Two secondary schools are selected and 228 students (Grade 9-12) participated in the survey. Data collected from them were utilized for descriptives & frequencies analysis, chi-square test, and multiple regression analysis. The results indicated that Ethiopian students utilizing satellite TV program scored highly in the evaluation areas of context, input, process, and product of the program. It was also found that learning demand, learning content, and class management were factors affecting the satisfaction in satellite TV program. These findings suggested that satellite TV program could play an important role in improving the quality of in Ethiopian secondary education. As a conclusion, several educational and administrative strategies to improve the TV program were recommended.

KEYWORDS

Educational ICT, Satellite TV Program, Secondary Education, Ethiopia.

1. INTRODUCTION

Located in the Horn of Africa, Ethiopia has made a lot of efforts for the better national economy, especially poverty eradication. The main national development plans are as followings (MoFED, 2013); Agricultural-Development-Led Industrialization (ADLI)(2002), Sustainable Development and Poverty Reduction Program (SDPRP) (2002/03-2004/05), Plan for Accelerated and Sustained Development to End (PASDEP) (2005/06-2009/10), Growth and Transformation Plan (GTP) (2010/11-2014/15). Through the PASDEP, Ethiopian economic growth reached average 11 percent per annum and mobile telecom network capacity increased 0.5M users (2005/06) to 25M users (2009/10). The number of telecom customer grew from 0.56M users (2004/05) to 6.5M users (2009/10). CDMA wireless network covered 90 percent of Ethiopia and 10,000km fiber optic cable and National Network Operation Center was established. And GTP aims to eradicate poverty and to reach the level of a middle-income economy as of 2020-2023. These plans are aligned with Millennium Development Goals (MDGs).

The Ethiopian development plans have dealt with education sector as a key strategic pillar. For example, GTP has goals to achieve in general education area; Scaling up educational quality by building communities' sense of ownership of educational quality by initiating integrated community mobilization, at all levels, using every media, digitalized (plasma based) secondary education, more Alternative Basic Education Centers. For supporting those plans in the educational sector, several national educational plans have been implemented; Education & Training Policy (ETP) (1994), General Education Quality Improvement Package (GEQIP) Ⅰ&Ⅱ, Education Sector Development Program (ESDP) Ⅰ(1997/98-2001/02), Ⅱ(2002/03-2004/05), Ⅲ(2005/06-2009/10), Ⅳ(2010/11-2014/15).

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Due to these educational plans, the system of Ethiopian education which consists of preschool, primary education, secondary education, TVET, and higher education, has sharply developed. Especially a lot of educational indicators of general education (primary & secondary education) have been on the increase. Net Enrollment Ratio (NER) of primary education (Grade 1 to 8) rapidly increased from 24.9% in 1996/07 to 85.9% in 2012/13 (Grade 1-4: 95.5%; Grade 5-8: 47.3%). ESDP Ⅳ plans to achieve 100% of NER until 2015. But there is relative distribution of each region to the national NER (Educational Statistics Annual Abstract, 2013). Afar has the lowest achievement (41.5%) compared with other regions (Gambella: 98%, Addis Ababa: 69.4%). In case of secondary education, NER (2012/13) falls sharply (Grade 9-10: 19.4%, Grade 11-12: 5.3%). This may be due to delayed graduation from primary school, examination barrier and financial barrier. And enrollment of children with special educational needs (blind, physically & intellectually disabled, deaf, etc.) was 6,551. Five year (2008/09-2012/13) trend of Pupil-Teacher Ratio (PTR) for grades 9-12 shows that PTR has been continually reduced from 41 to 28.7. But still there is regional difference in PTR (Somali : 47.4%; Benishangul Gumuz: 19.9%).

In contrast with primary education, the percentage of qualified teachers is higher in secondary education. Nationally, of all the secondary teachers, 91.5% are qualified for their level of secondary teaching. There is, however, considerable variation by region in the percentage of qualified teachers (Tigray: 96.2%; Afar: 20.8%).

Even though there have been a lot of educational efforts, many problems still have happened in the Ethiopian educational sector. Especially to cope with lack of qualified teachers, lack of good teaching models, and remote rural regions separated from educational benefits, Ethiopian Ministry of Education has made efforts in utilizing educational media such as satellite TV program for improving quality of secondary education.

However, up to now, there was lack of national investigation and more systemic evaluation, for measuring the effectiveness of satellite TV program. Accordingly, this study aims to investigate the actual practice and effectiveness of satellite TV program in Ethiopian secondary schools. Research problems are as follows:

What is the present status of satellite television program in Ethiopia?

What are the factors which are influential in students' satisfaction in satellite TV program?

2. CHALLENGES OF EXISTING SATELLITE TELEVISION PROGRAM AND NEW OPPORTUNITY

Ethiopian government launched satellite TV program as part of the national SchoolNet Initiative in 2004, which is a nationwide network of Ethiopia's secondary schools. Today, Center for Education ICT (CEICT), ICT-leading organization for general education under Ministry of Education (MOE), broadcasts 2978 television programs of 10 subjects (English, mathematics, chemistry, biology, physics, geography, civics, economics, technical drawing, general business) for grade 9-12. This program is broadcasted via satellite and secondary students in class watch the programs in plasma television for 20 minutes or so out of the 40 minutes class ([Figure 1]).

As of 2014, there are about 2000 secondary schools including preparatory schools (Grade 11 & 12), of which 1278 schools are well equipped to receive the television broadcast from the center, however only 69 % (893 secondary schools) among 1278 secondary schools are utilizing properly the satellite TV program. Even though satellite TV program has contributed in improving the quality of the secondary education in Ethiopia, there are several main constraints in the program. First, the basic problem is a lack of electricity power. There are many cases where each school is not equipped with generators for frequent blackouts. Second, there is a lack of maintenance and accessories for the Plasma TVs and VSAT apparatus installed in the schools. Third, there is still a lack of proper collaboration among CEICT, Ethio Telecom, regional educational bureaus and schools. And the critical problem is that the TV program is delivered one way, not considering the teacher-student and student-student interaction. In addition, there is a limitation in satisfying a variety of special education needs such as cognitive & physical disability, although the program provides the service of sign language for students with hearing disability.

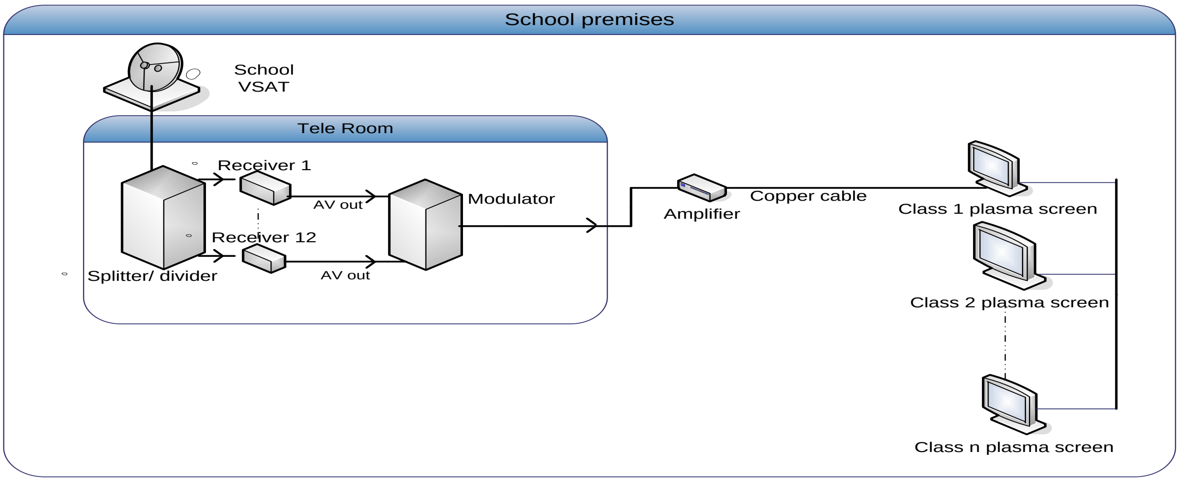

Figure 1. Structure of Operating Satellite TV Program for Ethiopian Secondary Education

Ethiopian educational ministry continues to take efforts for overcoming these shortcomings in secondary education ([Figure 2]).

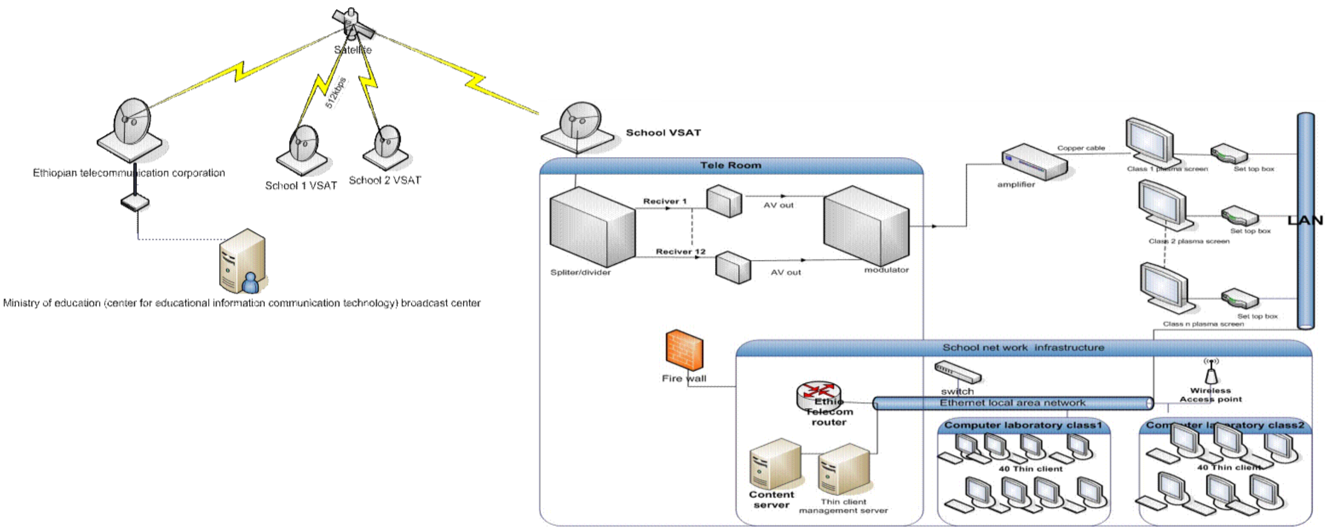

Figure 2. Future Structure of Satellite TV Program in Ethiopian Secondary Education

As one strategy, the ministry has launched an initiative to build a Local Area Network (LAN) in the first phase for 120 secondary schools. Each school computer laboratory will be equipped with a minimum of 80 thin client computers throughout the country. The ministry already carried out the pilot test for its effectiveness. Nowadays the ministry is designing another e-learning project under the General Education Quality Improvement ProgramⅡ (GEQUIP Ⅱ), which is supported by World Bank. As a part of the efforts to enhance the quality of general education, especially individual, self-directed, and self-paced learning environments through ICT, the MOE and CEICT has designed a program targeting 300 secondary schools nationwide. This program hopes to enhance the existing in-class video learning service, establish a computer laboratory-based learning experience managed through a private cloud service, and expand the reach of online-based out-of-class learning using mobile devices. An extension to this program will include the participation of twelve secondary schools in innovative programs to explore the use of mobile-based technologies for strengthening the quality of general education in emerging regions.

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3. METHOD

3.1 Participants

This study aims to investigate the actual practice and effectiveness of satellite TV program in Ethiopian secondary schools. To achieve the goal, two secondary schools including preparatory schools are selected. A school is located at the urban area in Addis Ababa City and B school is located at rural area in Oromia state. 228 students (Grade 9-12) from two regions participated in the survey.

Table 1. Participants' Information

		Number (%)
Location	Urban	114 (50)
	Rural	114 (50)
Gender	Male	122 (53.5)
	Female	106 (46.5)
Grade	Grade 9	40 (21.1)
	Grade10	71 (31.1)
	Grade11	75 (32.9)
	Grade12	34 (14.9)
Total		228 (100)

3.2 Instrumentation

To investigate the actual practice and effectiveness of satellite TV program in Ethiopia, a questionnaire was developed. It was based on the CIPP (Context, Input, Process, Product) model, which was designed by Stufflebeam (1985). Based on Figure 3 below, 23 items are developed (See Appendix). They are validated through reviewing of 3 program experts from Center for Educational ICT (CEICT), Ministry of Education and 10 students from a secondary school.

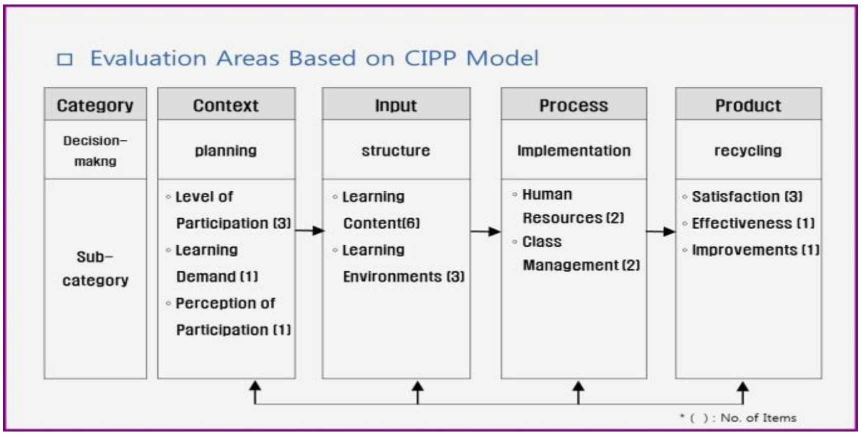

Figure 3. Structure questionnaire for student

3.3 Procedures

Reading official documents for literature reviews, personal interviews with related officials from CEICT, and searching for internet sites of Ministry of Education and Ministry of Communication Information Technology, Ethiopia were carried out. Based on these and CIPP model, a questionnaire was developed and validated.

Data gathered from secondary school students were analyzed by SPSS. Descriptives & frequencies analysis, chi-square test, and multiple regression analysis were performed for answering to the research questions

4. RESULTS

The scores from some items (a 5-point Likert-type) of the survey for evaluating the effectiveness of satellite TV program ranged from 3.11 to 4.12, indicating that most of the students agreed that the satellite TV program was satisfactory (Table 2). And students responded to other questions as follows; 41.7% of students selected "the program is helpful for understanding the class" as the most important motive participating in the satellite TV program. And as a reason why the program is interrupted during their class, they chose 'plasma TV trouble' (40.4%), lack of electricity (28.1%), and others (23.6%) in order They also responded that the program was helpful in the aspect of 'more understandable in learning'(30.3%), improving English skills (23.2%), rich learning materials (10.5%), and more attention to the class (10.1%) in order. For a strategy of improving the program, they responded 'more interesting lesson (30.7%)', 'better stability of program transmission (13.4%), better quality of screen design (11.8%), and more faster maintenance service of plasma TV (11.8%) in order. And 38.2% of respondents answered that they never watched satellite TV program in their class per week. 34.1% of students chose 'no attention of teacher' to the question 'why they did not watch the program even though it was broadcasted'.

Table 2. Mean and Standard Deviation (SD) for Main Variables Related with Satisfaction of Satellite TV Program

Area	Sub-Area	N	Mean	SD
Learning Demand	Learner's level	216	3.96	1.114
Learning Content	Interests	226	4.00	1.170
	Customized learning	226	3.57	1.404
	Appropriateness	221	4.06	1.208
	Compensation of face-to-face class	219	3.61	1.313
	Understanding	219	3.55	1.282
	Usefulness	224	3.87	1.349
Learning Environments	Safety	224	3.61	1.490
	Interaction with TV program	219	3.52	1.342
Human Resources	Perception of teacher	221	4.03	1.232
	Knowledge of teacher	224	4.12	1.157
Class Management	Interaction with TV teacher	221	3.57	1.339
	Affirmative class environment	220	3.11	1.384
Satisfaction	General satisfaction of TV program	222	3.54	1.268
	Learning contents	156	3.91	1.132
	TV teacher	157	3.94	1.102

A chi-square test was performed to determine whether the levels of satisfaction (general satisfaction, learning contents, TV teacher) were equal irrespective of location (urban and rural), gender (male and female), and grade (Grade 9-12). Only levels of general satisfaction of satellite TV program were not equal at the variables of location (χ^2=16.270, df=4, p=.003) (Table 3) and gender(χ^2=15.146, df=4, p=.004) (Table 4).

Table 3. Chi-square test of location and general satisfaction of satellite TV program

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	Total
Urban	11 (9.7%)	12 (10.6%)	30 (26.5%)	42 (37.2%)	18 (15.9%)	113 (100%)
Rural	12 (11%)	12 (11%)	12 (11%)	34 (31.2%)	39 (35.8%)	109 (100%)
Sub-total	23 (10.4%)	24 (10.8%)	42 (18.9%)	76 (34.2%)	57 (25.7%)	222 (100%)

χ^2=16.270, df=4, p=.003

Table 4. Chi-square test of gender and general satisfaction of satellite TV program

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree	Total
Male	12 (10%)	9 (7.57%)	24 (20%)	33 (27.5%)	42 (35%)	120 (100%)
Female	11 (10.8%)	15 (14.7%)	18 (17.6%)	43 (42.2%)	15 (14.7%)	102 (100%)
Sub-total	23 (10.4%)	24 (10.8%)	42 (18.9%)	76 (34.2%)	57 (25.7%)	222 (100%)

χ^2=15.146, df=4, p=.004

Multiple regression was conducted to determine the accuracy of the independent variables (learning demand, learning content, learning environments, human resources, class management) predicting the dependent variable (satisfaction). Regression results in Table 5 indicate that the overall model of the five independent variables significantly predicts satisfaction of satellite TV program. A summary of regression coefficients is presented in Table 6 and indicates that only three variables, learning demand, learning content, and class management, significantly contributed to the model. This model accounts for 37% of the variance in satisfaction of satellite TV program.

Table 5. ANOVA Table

	SS	Df	MS	F	Sig.
Regression	45.947	5	9.189	17.026^{*}	.00
Residual	72.325	134	.540		
Total	118.272	139			

$^{*}p<.01$

Table 6. Results of Multiple Regression

Variable	Unstandardized Coefficients		Standardized Coefficients	T	P
	B	Std. Error	Beta		
(constant)	.637	.366		1.739	.08
Learning demand	.159	.064	.192	2.461*	.02
Learning content	.327	.105	.273	3.129*	.00
Learning environments	.038	.065	.043	.578	.56
Human resources	.095	.080	.096	1.193	.24
Class management	.224	.061	.282	3.675*	.00

R^2_{adj}=.37, $^{*}p<.05$

5. CONCLUSION

This study investigated the actual practice and effectiveness of satellite TV program in Ethiopian secondary schools. The results indicated that Ethiopian secondary school students utilizing satellite TV program scored highly in the evaluation areas of context, input, process, and product of the program. It was also found that learning demand, learning content (interests, customized learning, appropriateness, supporting face-to-face class, understanding, usefulness) and class management (interaction with TV teacher, affirmative class environment) were factors affecting satisfaction in satellite TV program. These findings suggest that satellite TV program can play an important role in improving the quality of Ethiopian secondary education.

As a conclusion of this study, several educational and administrative strategies are recommended as follows; First, each secondary school should be equipped with basic infrastructure such as regular electricity and generator in blackout.

Second, immediate technical service should be provided by regional technicians when plasma TV has a trouble.

Third, motivational instructional design should be considered for improving students' active participation in satellite TV program. For a strategy of improving quality of the program, 30.7% of respondents chose 'more interesting lesson.' Especially for the preparation of future satellite TV program in Ethiopian secondary education serving e-learning utilizing clouding systems, teachers in schools and program experts in Center of Educational ICT, institution leading educational ICT under the Ethiopian ministry of education, need to have the competences of instructional design.

Fourth, factors such as location (urban and rural) and gender should be considered carefully when designing, developing, and operating satellite TV program. This is why they may effect on the satisfaction of the program.

Fifth, there should be countermeasures for raising teacher's integration of the satellite TV program to the class. As mentioned above, 34.1% of students responded 'no attention of teacher' to the question 'why they did not watch the program even though it was broadcasted'. It is educator's perceived barrier to technology to be overcome (Robinson, 2007). As a strategy for this, the concept of homophily (Rogers, 1995) needs to be applied. That is, for equal colleague teacher to introduce it or to be successful at using the technology increases the possibility of adoption of integrating the technology into the class. It is important to share best practices in utilizing satellite TV program in class.

Sixth, leadership training of ICT for principals as well as teachers can be suggested. Diffusion of an innovation cannot be accomplished without teachers' and educational administrators' engagement and attention.

And many students have complained about lack of interaction of TV teacher-student, student-student and student-learning contents. Although radical change is difficult due to financial and technical reasons, alternative instructional TV such as 'one-way video with two-way audio may be chosen; According to a study (Simpson, et al., 1993), the most successful instructional TV technologies were those allowing continuous two-way audio communication between classrooms with either one-way or two-way video, which were effective both in terms of student performance and acceptance. For Ethiopian satellite TV program having a shortcoming of one way delivery, using two-way audio may be good alternative. And for improving one way delivery of learning contents, individual, self-directed, self-paced learning environments should be designed and developed.

Fortunately Ethiopian educational ministry continues to take efforts for overcoming the shortcoming in secondary education. Nowadays Ethiopian educational ministry is designing an e-learning project under the General Education Quality Improvement ProgramⅡ. As a part of the efforts to enhance the quality of secondary education, it has designed a program targeting 300 secondary schools nationwide, which hopes to enhance the existing in-class video learning service, establish a computer laboratory-based learning experience managed through a private cloud service, and expand the reach of online-based out-of-class learning using mobile devices. It will be very helpful for providing satellite TV program appropriate for learner's learning demands and level. Education utilizing ICT has the potential to overcome the issues of cost, less number of teachers, and poor quality of education as well as overcome time and distance barriers (McGorry, 2002). However, although the use of ICT in educational settings by itself may act as a catalyst for change, the change does not happen always. More instructional and administrative efforts are needed for its successful performance.

More researches are needed to discover more details of strategies for improving the effectiveness of the satellite TV program in the context of e-learning in future and to understand why secondary teachers have failed to integrate satellite TV program into the class.

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APPENDIX

Category	Area	Sub-Area	Item
Context (5)	Level of Participation (3)	Frequency of Use	How often do you watch Satellite TV programs in your class per week?
		Duration of time	How long do you watch Satellite TV programs per one class?
		Reason of No use	Why don't you watch the program?
	Learning Demand (1)	Learner's level	Is satellite TV program appropriate at learning level of learner?
	Perception on Participation(1)	Motive of Participation	What is your most important motive participating in the satellite TV program?
Input (9)	Learning Content (6)	Interests	Is learning content in satellite TV program interesting?
		Customized learning	Can you study learning contents in satellite TV program customized at your level of learning?
		Appropriateness	Does learning content in satellite TV program give rich and reliable information?
		Compensation of Face-to-Face class	Does satellite TV program compensate for face-to-face class?
		Understanding	Is learning content in satellite TV program understandable clearly?
		Usefulness	Does satellite TV program supply enough related material and cases?
	Learning Environments (3)	Safety	Is there any problem such as disconnection of transmission? Why is satellite TV program interrupted during your class?
		Interaction with TV program	Is there enough interaction with satellite TV program?
Process (4)	Human Resources (2)	Perception of teacher	Is the television teacher helpful for understanding learning contents?
		Knowledge of teacher	Does the television teacher have enough knowledge in the subject?
	Class Management (2)	Interaction with TV teacher	Can you interact with the television teacher?
		Affirmative class environment	Do you feel close relationship with the television teacher?
Product (5)	Satisfaction(3)	Overall level of satisfaction	Is satellite TV program generally satisfactory? Is learning content in satellite TV program satisfactory? Is television teacher satisfactory?
	Effectiveness(1)	Level of help	In what aspect is the program helpful?
	Improvements(1)	Overall improvements	What is your opinion of improvements?

ORGANISATION AND MANAGEMENT OF A COMPLETE BACHELOR DEGREE OFFERED ONLINE AT THE UNIVERSITY OF MILAN FOR TEN YEARS

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ABSTRACT

This paper is aimed at presenting some reflections on organisation and management of SSRI online: an e-learning initiative started at the University of Milan (Italy) in the academic year 2004/05 and offered to students over the last ten years. The initiative consisted in implementing the online version of an already existing three-year bachelor degree ("Laurea in Sicurezza dei Sistemi e delle Reti Informatiche - SSRI": a Degree on Security of Computer Systems and Networks).

KEYWORDS

E-learning, online bachelor degree, online degree organisation, online degree management

1. INTRODUCTION

SSRI online is the e-learning version of a traditional, classroom based bachelor degree on Security of Computer Systems and Networks, offered at the University of Milan, Italy since ten years. A detailed description of the project architecture leading to implementation of SSRI online can be found in (Damiani 2005) whereas a deep analysis of students' population registering to the online degree is given in (Frati 2010).

In this paper, after discussing the teaching model adopted for SSRI online, we focus our attention on the organizational model we adopted to handle SSRI online offering, and we present the business model we used to finance the overall project.

2. TEACHING MODEL OF SSRI ONLINE

2.1 Structure of Online Lectures

The design of the online degree has been supported by consultants from Isvor Knowledge System, an Italian company specialized in the production of e-learning courses. These consultants worked together with the university staff of CTU, the e-Learning Centre of the University of Milan, in defining the teaching model and the technological architecture of the project.

As described in Damiani (2005) the structure of SSRI online can be summarized as follows:

- each online course is structured in modules corresponding to the various topics. Each module is composed of didactical units, associated with the various aspects of the topic and constituted by different activities: lectures, exercises, tests;
- all teaching material is available to students on the CTU web platform, which provides also forum discussions among students and tutors;

- students progresses are monitored by tracking their activities and the results of the tests associated with each online lecture;
- online activities are coupled with face to face meetings with teachers for course introduction, midterm tests and final exam.

Content is distributed mainly by video-lectures characterised by sequences of slides or desktop capturing, both synchronized with the explanation given by the teacher's voice. It should be noted that the average duration of each video-lecture is about one fourth of the corresponding classroom lecture.

The exercises proposed vary from online multiple choices, to closed answer tests, to more complex essays requiring tutor correction, to programming, and to networking exercises that students have to develop using a virtual lab (Frati, 2010) (Anisetti, 2007).

2.2 Online Support for Students

CTU designed and implemented the Ariel.net web platform, based on the Microsoft .net technology. This choice dated 2004. At those times, the Learning Management Systems offer was not too wide and, after a benchmarking activity, it seemed easiest and more appropriate to develop a "home-made" LMS, devoted to completely support online degrees or courses. The qualifying functionalities of Ariel.net allow:

- the support of one-to-one as well as one-to-many communications, both asynchronous and synchronous. Besides traditional e-mail and forums, Ariel.net supplies also a private messaging system among students and tutors integrated into each single didactical activity (instant messaging) a virtual bulletin board reserved to tutors to post general interest messages, a virtual classroom support for synchronous meetings among students and tutors/teachers;
- self-planning of learning activities by each student, who has a suggested learning plan, but who can change this plan according to her/his own needs.
- both online streaming fruition of audio/video elements, as well as download for offline fruition;
- the support of the exercising phases of students, tracking their advance and their results;
- the ability to closely follow and support the individual learning process of each student, through a tool allowing each student to annotate her/his own instance of the online material. (Damiani, 2005: 4).

2.3 Exams

Taking into account the particular needs of working students (as the majority of SSRI students are) SSRI online has been structured around a three four-month periods calendar, allowing the student to follow a reduced number of courses in each teaching period. Most of the courses plan two midterm tests, used not only for self-evaluation purposes but also for integrating the final grade.

Reserved exams for online students have been planned at the end of each four-month period, before the starting of the next one, in order to clearly separate test times from learning times. Moreover, to help working students, tests and exams have been organized on Friday and Saturday (Damiani, 2005: 5).

3. ORGANISATIONAL MODEL OF SSRI ONLINE

3.1 Production of Online Materials

As Anderson outlines: "having comprehensive and clearly stated intended learning outcomes, as well as a curriculum and associated teaching approaches designed accordingly, makes the task of building the ideal online learning system so much easier" (Anderson, 2008:124).

Following this statement, to implement the pedagogical design, SSRI online teachers have been supported by a group of instructional designers, coordinated by CTU.

The design activity started from the identification of the learning objectives of each course, followed by a complete re-design to identify a new content structure based on modules and units. Each unit has been organised in several lectures, associated with specific activities.

This macro-design phase has been followed by a micro-design phase, aimed at identifying, for each activity, the most suited way (i.e., slide sequence and/or desktop capturing synchronized with teachers voice, blackboard-like effect recording teachers voice and handwriting, teacher's video recording) to deliver the content. Video-based screen capturing software tools like TechSmith's Camtasia Studio® have been selected to facilitate teachers work, allowing them to produce autonomously almost all video lectures without requiring meeting CTU staff.

3.2 Course Tutoring

As already mentioned, SSRI target students are full time workers who hardly cope with their "work – family – study" balance, so assuring them a reliable and continuous support during each step of their learning process has been considered a key feature to improve their chances and finally to successfully achieve a degree. According to these purposes the SSRI online tutoring staff has been organised referring to the national and international literature available in 2004 about to roles and competences of tutoring. The main references were: (Salmon 2000) who grouped the competencies for e-moderators into five categories: (a) understanding online process, (b) technical skills, (c) online communication skills, (d) content expertise, and (e) personal characteristics; (Rotta M. and Ranieri M. 2005) and (Rivoltella 2006) who distinguished three different roles for tutors: instructor, as a content expert; facilitator, charged in scaffolding students; moderator, as a manager of tutors-students and peer to peer discussions.

So two SSRI different tutoring roles have been identified:

- Course expert tutor, who acts as content facilitator (for each course, one course tutor has been selected for each group of 40/50 students);
- Process tutor, who acts as e-moderator, process facilitator, adviser/counsellor.

Duties of course expert tutors and process tutor as well as their preferred interaction media are summarized in Table 1.

Table 1. Duties and interaction media of SSRI online tutors

Tutor	***Main duties***	***Preferred interaction media***
Course expert	• Clarify course key concepts for the students. • Give students sparks for reflection, evaluating their exercises or open essays. • Answer any question useful to improve the student subject competences. • Support teachers in developing the course contents, in managing exams and face-to-face meetings with students.	• One asynchronous forum for each course, used to promote discussion about course topics and day-by-day peer tutorship. • Email messages from/to students. • Instant messaging system used by students to pose questions directly related to a given learning step.
Process tutor	• Manage a preferential channel of communication with students. • Monitor all the communication and relationship processes developing inside the learning environment. • Coordinate and support any organizational and logistic process collaborating with the secretarial staff and the management.	• One asynchronous forum for the overall community of learners. • Email messages from/to students.

3.3 Learners Community Tutoring

The whole online community (students and course tutors) is coordinated and supervised by the process tutor. As (Berge 2000) points out an online moderator has to perform several roles: facilitator, manager, filter, expert, editor, discussion leader, marketer, and helper. (Moisey 2008: 430) also underlines that "the work of the counsellor in an online learning environment has three aspects. The first is to be involved in the development of online resources that help learners to identify and address barriers to reaching their educational goals. The second is to interact with the learners when an intervention is required. The third is to work with other institutional staff to ensure that processes and procedures support and enhance learning"

Process tutor has to be aware of the online community climate and of the situation of every single student, so she daily interacts with students using both forums and emails, implementing a "push and pull" communication style. She answers to any student question and – at the same time – tries to prevent their inquiring by contacting them directly and scaffolding them in facing each difficulty. The process tutor also tries to keep students engaged in the online classroom activities and to promote as much as possible peer collaboration.

An analysis of the different topics discussed between students and the process tutor allows to understand how the areas covered by this communication process are wide: tips and tricks on course contents and exams, discussions about students study scheduling or about their study method, motivational counselling and sometimes also funny questions to relieve the pressure caused by the stressful daily routine of worker students. Eventually this interaction is intended to develop an empathic relationship with students, since a mutual trusting is essential to make the process tutor support effective.

At the same time, the process tutor pays attention also to all the other communications being developed inside the learning environment – mainly the discussions in course forums – because each interaction may give her interesting hints about the student competence improvements and about the community feelings.

Setting this team of tutors and cope with all its management dimensions – last but not least the economical one – during these first ten years has required a great deal of efforts, but the working students who represent our target found them really helpful.

Student feelings and opinions have been collected year by year through different surveys about their whole learning experience and about each single issue (teaching materials, tutoring services, learning management system and so on). Looking at the quality surveys collected in several years (Frati, 2010) it is easy to see that students always underline the importance of the constant presence and high reliability, the accuracy and fair play of tutors to better organise their time/energy efforts and to achieve their educational goals with a complete satisfaction. Aspects emphasized as the most positive are:

- teaching materials clarity and comprehensibility, precision and completeness, exercises availability and usefulness;
- teachers and tutors willingness and support;
- information availability and clarity about the teaching organization and the related exams.

4. BUSINESS MODEL OF SSRI ONLINE

In this section, we discuss the economical effort required to setup and to handle SSRI online during these first ten years, and the decision taken by the University regarding the fees required to students registering to the online version of the SSRI degree.

For the sake of simplicity, we mainly consider direct costs (i.e. money actually spent by the University) without estimating indirect costs due to staff time dedicated to SSRI online and amortization of the technological infrastructures used for this purpose. Rationale behind this choice is the fact that both staff time and infrastructures amortization are costs the University has to afford in any case, regardless the specific activities performed by the staff and the effective usage of the infrastructures. The decision to allocate personnel and resources to SSRI online can thus be considered an investment, which is part of the strategic plans of the University, more than a mere cost.

4.1 SSRI Online Implementation Costs

To setup SSRI online, we had to provide during the first three years all the video-lectures of the courses required to complete the degree: 21 mandatory courses and 6 elective courses, for a total of 183 CFUs (university credits, using the ECTS scheme where a full time student is expected to earn 60 credits per academic year).

As discussed in the previous sections, this required first to define a methodology for traditional courses restructuring, to provide guidelines for video-lectures implementation and to support involved teachers in the micro-design process of their restructured course. The private company consultants involved to supply competences not present at that time in the University operate during those first three years, for a total cost of around € 350.000 including V.A.T. It should be noted that a side effect of this operation has been the knowledge transfer from the private company to CTU, which is now perfectly trained in supporting micro-design and implementation of online courses. In case of future initiatives like SSRI online, the consultancy cost could then be completely avoided.

The second, main setup cost the University had to afford has been an extra salary for teachers involved in the video-lectures implementation, requiring a significant amount of work to be completed within strict deadlines (thus frequently performed during evenings and weekends). To quantify this extra salary, a survey of similar activities in the University of Milan as well as other Italian Universities has been conducted, leading to the conclusion that the amount of work required to teachers can be considered proportional to the number of credits of each course (i.e., to its weight): as a result, an implementation cost per credit (€ 2.000) has been defined as the extra salary unit for the implementation of each course, and a revision costs per credit (€ 200) as the extra salary unit for teaching materials revision (error corrections, self-test updating, etc.) in the first two years after course implementation. Using these cost units, the resulting, total cost for a course of e.g. 6 credits (48 lecture hours in classroom) is € 14.400 over the first three years.

4.2 SSRI Online Management Costs

As discussed in section 3, the main activities required to manage SSRI online are:

- teaching support provided by a tutor expert of each course for each group of 40-50 students;
- support to the online community of students guaranteed by the process tutor.

Costs for the first type of tutors have been estimated in terms of hours per day necessary to monitor each course forum answering common questions, to reply to single students email messages, to correct open answer essays of students that cannot be automatically handled by the platform tools. Since these activities are only partially linked to the number of credits associated to each course (i.e. to its length) two cost units have been identified: a tutorship cost per course (€ 1.500 per year) and a tutorship cost per credit (€ 250 per year). As a result, the total tutorship cost for a course of e.g. 6 credits followed by 80 students needs two tutors, each costing € 3.000 per year.

Cost of the second type of tutorship (i.e., the process tutor) is easier to compute: it is the yearly cost for the University (€ 36.000) of an administrative person almost fully dedicated to SSRI online.

4.3 SSRI Online Revenues

Since no external financial support (private or public) has been obtained by the University to offer SSRI online, the only revenues come from the enrolment fees paid by the students.

In the University of Milan, the ordinary enrolment fee a student has to pay is based on a declaration of the total income of the student family. For a bachelor degree like SSRI online, it ranges from € 768 to € 3.639 per year, with an average around € 1.450 (computed on the students enrolled in SSRI online over the first ten years). To cover the extra costs of course and process tutorship – as well as some minor structure costs related to exams organised during weekends to facilitate participation of employed students – the University decided to apply an additional yearly fee of € 1.500 (independent from the student family income) which has been reduced to € 1.200 for the first cohort of students (enrolled in academic year 2004/05) taking into consideration the “pioneering” work they did in using for the first time (and sometimes debugging) all the teaching materials.

5. EVALUATION OF SSRI ONLINE AFTER THE FIRST TEN YEARS

5.1 Characteristics of SSRI Online Students

To evaluate the effectiveness of the online proposal and in particular the overlapping (if any) between the population of students registering to SSRI online and the population of students registering to the traditional, classroom version of SSRI, we took in consideration two main aspects: the age of students and their geographical provenience (i.e., their residence address).

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As far as the age is concerned, SSRI freshmen (i.e., students registering to the first year of the degree) have been divided in three categories:

1. 18-20 years old, where the students who just finished high schools are found;
2. 21-28 years old, where students (partly already working, partly still searching for a job) interested to specialize in SSRI topics are found;
3. more than 28 years old, where working students are found, interested to raise their skills to become more attractive for their companies.

The comparison between SSRI online and traditional SSRI is given in Figure 1. It is easy to note the very limited overlap of the two populations: more than 50% of online students are older than 28 years, and less than 10% come immediately after the high schools, while almost 70% of the classroom students just finished their high schools ad less than 8% are older than 28 years.

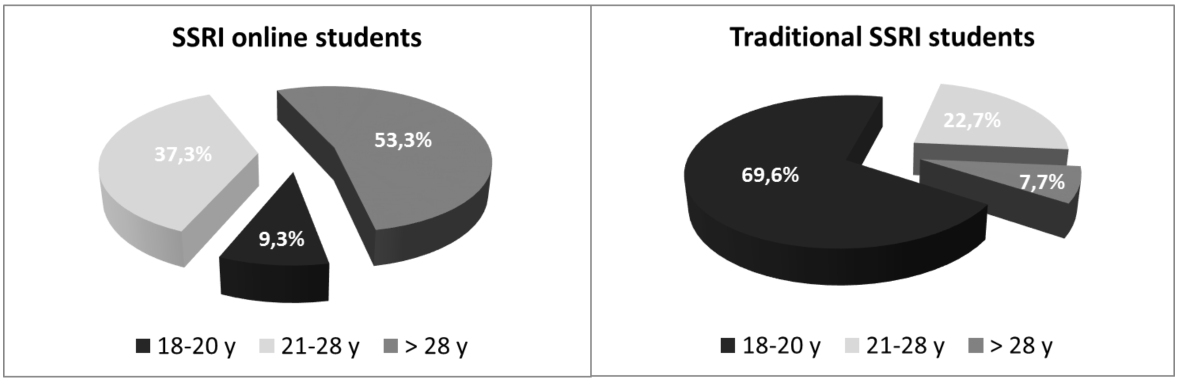

Figure 1. Age of SSRI online students vs. traditional SSRI students

As far as the provenience of students is concerned, again three categories have been identified:

1. students resident in Crema town and its surroundings (a small town 40 km. east of Milan, where classroom lectures of traditional SSRI are held);
2. students resident outside Crema and surroundings but inside Lombardia, the 24.000 km^2, almost ten million inhabitants north western Italian region where both Crema and Milan are located;
3. students resident outside Lombardia.

The comparison between SSRI online and traditional SSRI is given in Figure 2. It is easy to note again the very limited overlap of the two populations: more than 50% of online students resided abroad and selected the online version to follow the degree without moving from their home, while two thirds of the classroom students come from Crema and the surroundings area.

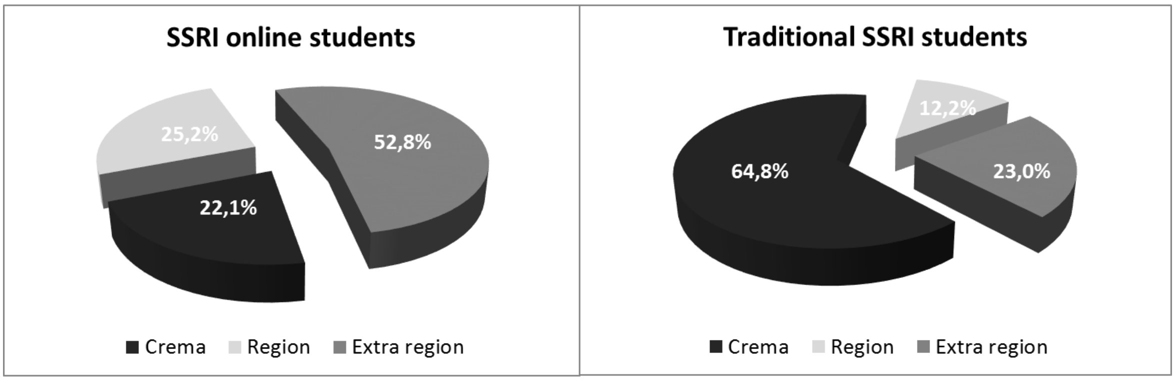

Figure 2. Home residence of SSRI online students vs. traditional SSRI students

From the above comparison, it can be concluded that the SSRI online initiative addressed a type of students different from the "usual" ones: these students would probably never have registered for the traditional classroom version of SSRI, thus the net result is a significant social service, with the improvement of skills of persons not interested to follow a normal degree, and a net increase of the number of University students.

5.2 Performances of SSRI Online Students

Online students' behaviour shows in general:

- a slower progression in their career with respect to traditional students; as seen before, most of them already have a job position, thus they have to study during weekends and evenings only;
- higher grades in exams, demonstrating the stronger motivation of online students paying a significant extra fee and possibly stealing time to their families to obtain the degree.

During the first ten years, 20% of online students obtained the degree (with respect to 33% of normal students) but with a final average degree around 100/110 (vs. 95/100 of traditional students).

5.3 SSRI Online Economical Results

A summary of the direct costs and revenues during the first ten years of SSRI online is provided in Table 2.

Setup costs (including all taxes) are summarized in the first two columns of Table 2. Note that in 2010 the Ministry of Education introduced some revisions in all Italian University degrees, requiring a further investment in SSRI online during year 2012 to update some of the already available online courses.

Full costs for course tutors are show in the third column of Table 2. The decrease of these costs in the last years are mainly due to the following reasons:

- progressive reduction of the number of students, common to all ICT degrees in Italy (and abroad) – see next section;
- reuse of previous years forums, progressively reducing tutors effort, with a consequent reduction of the cost units defined at the beginning of SSRI online life.

Full cost of the process tutorship is shown in the fourth column of Table 2, where the initial presence of more than one administrative person (even if part-time dedicated to SSRI online) reflected in larger expenses.

SSRI online total revenues are obviously strictly related to the number of enrolled students, as discussed above. As a result, sixth and seventh columns of Table 2 show an initial increase, due to the progressive activation of the three years of the degree, followed by a decrease due to the reduction of freshmen. Starting from last year (2013) a particular attention has been given to the degree promotion through social networks like Facebook, which led to double the first year population (economical results will obviously appear in spring 2014, after final payment of students fees).

It may be interesting to consider the graph reported in Figure 3, which plots the cumulative costs and revenues of SSRI online over the considered period. It is easy to note that the extra fees is almost sufficient to cover direct costs, while the sum of ordinary enrolment fees and extra fees practically double the expenses over the years. By considering that – as previously discussed – SSRI online students population has very limited overlapping with classroom SSRI population, leading to the conclusion that without the online version almost none of these students would have registered for the classroom version, we may conclude that SSRI online surely constitutes a profitable initiative even from the purely economic point of view.

6. CONCLUDING REMARKS

The paper presented an analysis of the online version of a bachelor degree in Security of Computer Systems and Networks, summarizing its design model, describing its organizational model and evaluating its business model.

Main conclusions we may draw from this analysis are the following:

- replicating online a traditional, classroom based degree needs a careful re-design of its courses to make it suitable for online students;
- tutorship (both for supporting the learning activities in each course and for helping the student community) is a key factor for ensuring student success;
- the populations of online and classroom students have very little overlapping: this means that an online degree supplies an important teaching service for students who cannot attend a traditional academic degree;
- even without specific funding, the economical result can be definitely profitable, provided that the University supplies human resources especially in terms of e-learning experts.

Table 2. Direct costs and revenues for SSRI online implementation

	COSTS					***REVENUES***		
	setup costs		***management costs***		***TOTAL COSTS***	ordinary enrolment fee	extra fee for online services	***TOTAL REVENUES***
	private company consultancy	teachers extra salaries	course tutoring	process tutoring				
2004			€ 33.016		**€ 33.016**			
2005	€ 132.000	€ 74.855	€ 106.438	€ 24.000	**€ 337.293**	€ 176.816	€ 147.600	**€ 324.416**
2006	€ 108.000	€ 284.999	€ 170.168	€ 48.000	**€ 611.166**	€ 283.397	€ 279.000	**€ 562.397**
2007	€ 108.000	€ 159.907	€ 152.180	€ 48.000	**€ 468.087**	€ 384.313	€ 334.800	**€ 719.113**
2008			€ 134.136	€ 36.000	**€ 170.136**	€ 398.366	€ 340.000	**€ 738.366**
2009			€ 106.049	€ 36.000	**€ 142.049**	€ 436.483	€ 334.500	**€ 770.983**
2010			€ 80.734	€ 36.000	**€ 116.734**	€ 402.808	€ 200.000	**€ 602.808**
2011			€ 48.006	€ 36.000	**€ 84.006**	€ 393.069	€ 102.000	**€ 495.069**
2012		€ 84.397	€ 52.622	€ 36.000	**€ 173.019**	€ 379.936	€ 43.500	**€ 423.436**
2013			€ 57.759	€ 36.000	**€ 93.759**	€ 342.615	€ 33.500	**€ 376.115**

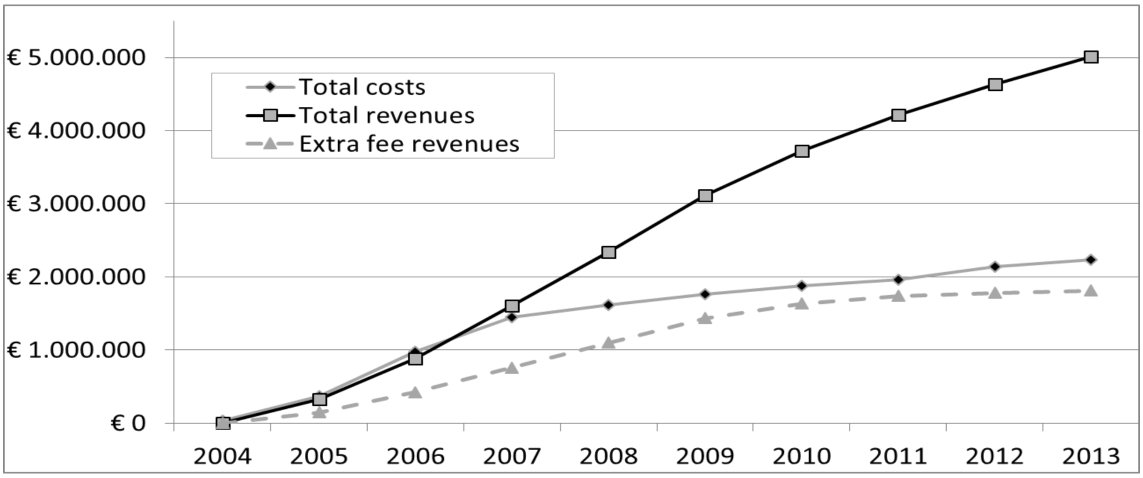

Figure 3. Cumulative costs and revenues for SSRI online over the first ten years

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STRUCTURAL RELATIONSHIPS BETWEEN VARIABLES OF ELEMENTARY SCHOOL STUDENTS' INTENTION OF ACCEPTING DIGITAL TEXTBOOKS

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ABSTRACT

The purpose of this study is to explore variables affecting the acceptance of digital textbooks in the elementary school environment and provide basic information and resources to increase the intention of acceptance. Based on the above research purposes. Surveys were conducted using Google Docs targeting randomly selected elementary school students using digital textbooks. In this study, we used the measurement instruments used in the previous study, after revising according to the research environment, to measure the self-efficacy in using digital textbooks, subjective norms, observability, perceived ease of use, perceived usefulness, and intention of acceptance. We used item parceling to avoid model misspecification and AMOS 20.0 for statistical analysis. The research results were as follows: first the observability and self-efficacy in using digital textbooks affected the perceived ease of use but subjective norms had no effect. On the other hand, the result that subjective norms do not affect the perceived ease of use is different from our initial hypothesis but is consistent with previous research by Oak (2013). Second, the results of investigating the effects of efficacy in using digital textbooks, subjective norms, observability, and perceived ease of use on perceived usefulness, self-efficacy in using digital textbooks, subjective norms, and perceived ease of use, affected perceived usefulness but observability did not provide significant effects. Third, the elementary school students' perceived usefulness significantly affected the intention of accepting digital textbooks. The results are consistent with previous studies (Davis et al., 1989; Kang & Kim, 2013), suggesting that the more students utilize digital textbooks and believe that a digital textbook is helpful to increase learning outcomes, the more easily they are able to accept digital textbooks.

KEYWORDS

Digital Textbook, Technology Acceptance Model, Ease of Use, Usefulness

1. INTRODUCTION

Since the introduction of Apple's iPhone and iPad in Korea in 2009, the trends of using cellular phones and tablet PCs based on iOS and Android have been observed across the economy, society, and culture. In conjunction with these trends, discussions related to the utilization of these applications are vividly increasing in educational environments (Kang, Song, Lee, & Ku, 2010). The Ministry of Education announced that they will develop digital textbooks and spent a total of $11,859 billion in 2011 with the goal of overcoming the limitations of current textbooks, improving current class environments, and spreading individualized adaptive teaching and learning methods. They selected 144 schools nationwide (12 schools in Seoul, 63 schools in Busan, etc.) to study the effects of digital textbooks in 2013.

Technological innovations such as digital textbooks cannot be widespread with only the government's support without technology users' attitudes on preference and ability of using the technology being considered (Schwarzer & Hallum, 2008). Davis suggested the TAM (Technology Acceptance Model) to explain variables determining technology user's intention of accepting new technology. The core of TAM is that the perceived ease of use and perceived usage of new technology affect the attitude toward innovative products and users' attitudes and intentions of use (Davis, 1989). The TAM model is evaluated as a general model without limitations associated with particular information systems, users, research condition, or time and country attitudes about the use of other users' attitudes (Lou, Luo, & Strong, 2000; Venkatesh & Davis, 2000). Another opinion about new technology acceptance, according to the social influence model of technology, is that the norms of the reference group, social environment, and personal characteristics affect a user's new technology acceptance (Fulk, Steinfield, Schmitz, & Power, 1987).

However, there are constraints in that most previous studies consider only single factors rather than considering personal characteristics and environmental variables within a research frame. Such a frame would include interface design, ease of use, and the perceived usefulness (Hong, Hwang, Hsu, Wong, & Chen, 2011), as well as self-efficacy (Venkatesh, 2000). Thus, the current study scrutinizes the causal relationships between variables of personal characteristics, such as self-efficacy, subjective norms of environmental variables, and observable attributes of innovations by countering the above limitations.

Bandura's self-efficacy concept has been applied to new technology and equipment, such as computer self-efficacy (Albion & Ertmer, 2002; Oliver & Shapiro, 1993) and mobile self-efficacy (Kim & Kim, 2011). People with high self-efficacy are more likely to succeed in projects (Oliver & Shapiro, 1993). Self-efficacy refers to one's own belief in being able to complete a given project successfully (Bandura, 1982) and The current study will investigate the research regarding students' self-efficacy on using digital textbooks. In addition, we will refer to self-efficacy in using digital textbooks as a personal characteristic variable affecting the intention of acceptance, and subjective norms as an environmental characteristic variable (Fishbein & Ajzen, 1975). This environmental variable has been shown to have an important effect on technology acceptance (Seo, 2011).

The last variable that we incorporated in this study is observability. Rogers (1983) studied individual differences in the speed of new technology acceptance. As a result, Rogers discovered that five perceived innovative traits significantly affect new technology acceptance. The five traits are relative advantage, suitability, complexity, testability, and observability (Rogers, 1983). However, previous research revealed that relative merits and suitability are similar to perceived usefulness, and the concept of ease-of-use and that of ease of use are the same concept (Lee, Hsieh, & Hsu, 2011).

In this study, we included observability but excluded testability, given that the reliability in measuring testability would be compromised as the subjects had already been using digital textbooks for the semester. Thus far, although numerous previous studies have investigated the variables affecting the receiver's intention to accept innovative techniques based on the TAM model, these studies were conducted based largely on e-learning and mobile environments (Lee, 2012; Gong, Xu, & Yu, 2004; Leung & Wei, 2000). However, research reflecting educational environments is rare.

The purpose of this study is to explore variables affecting the acceptance of digital textbooks in the elementary school environment and provide basic information and resources to increase the intention of acceptance. Based on the above research purposes, we established the following research questions.

Research Question 1: Does self-efficacy in using digital textbooks, subjective norms, and observability affect the perceived ease of use?

Research Question 2: Does self-efficacy in using digital textbooks, subjective norms, observability, and perceived ease of use affect the perceived usefulness?

Research Question 3: Does perceived ease of use and perceived usefulness affect the degree of acceptance? The hypothetical research model based on above hypotheses are as follows in Figure 1 as follows:

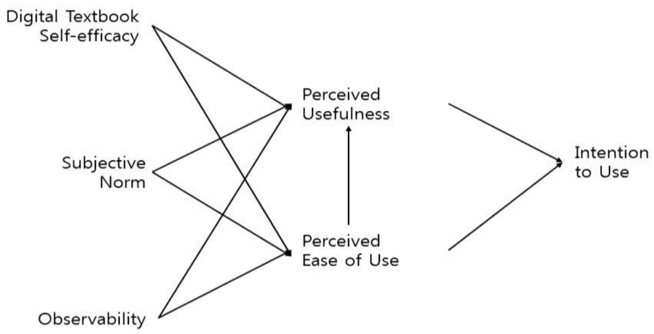

Figure 1. Hypothetical Research Model

2. RESEARCH METHODS

2.1 Subjects

Aside from seven incomplete survey responses, 319 out of 326 survey responses were analyzed. Out of 319, 160 subjects were female (50.19%) and 150 were male (49.84%). There were nine third graders (2.82%), 131 fourth graders (41.07%), 127 fifth graders (39.81%), and 52 sixth graders (16.30%) respectively. Among the schools selected for research, the K, O, P, and W Elementary Schools started using digital textbooks in March 2012, and Y and G started in March 2013. Depending upon the principal's preference, two schools used digital textbooks in Korean and English subjects and five schools used digital textbooks in social studies and science subjects by using tablet PCs, Netbooks, and Notebook Computers.

2.2 Research Procedures

In this study, we conducted online surveys using Google Docs targeting randomly selected students using digital textbooks to explore the variables affecting elementary students' intention of accepting digital textbooks, from November 25, 2013 to December 24, 2013. Subjects self-reported based on their own experience of using digital textbooks.

2.3 Measurement Instrument

In this study, we used the measurement instruments used in the previous study, after revising according to the research environment, to measure the self-efficacy in using digital textbooks, subjective norms, observability, perceived ease of use, perceived usefulness, and intention of acceptance. All items used a 5-point Likert scale (1 point: not at all, 2 points: no, 3 points: usually, 4 points: yes, 5 points: very much so).

To measure self-efficacy, subjective norms, and intention for acceptance, we revised Taylor and Todd's instrument to measure information technology usage. The TAM (Technology Acceptance Model) has the merit of combining the theory of planned behavior and the decomposed theory of planned behavior. It also reflects real life (1995). The measurement includes six items assessing self-efficacy in using digital textbooks (e.g., I feel comfortable when using the digital textbook), nine items assessing subjective norms (e.g., people who care about me think that I need to use digital textbooks), and three items assessing degree of acceptance (e.g., I would like to utilize the digital textbook for further studies). The internal consistency of the original instrument was Cronbach's $\alpha = .84$, for subjective norms $\alpha = .80$, and for intention for acceptance $\alpha = .93$. The reliability of the current study data was .93, .91, and .91, respectively.

To measure observability, we revised the instrument by Moore and Benbasat (1991), which measures the level of accepting innovative techniques in the school environment (e.g., I have seen that other friends study with digital textbooks). Since the instrument by Moore and Benbasat reflects the school environment, it was consistent with our current research environment. The reliability was Cronbach's $\alpha = .88$. Cronbach's α for the four items measuring observability was .76.

The perceived usefulness and perceived ease of use were revised and supplemented based on the instrument developed by Davis (1989); the reliability of this instrument has been demonstrated in many research studies (Agarwal et al., 1997; Chau, 1986). The perceived ease of use was measured by four items (e.g., learning with digital textbooks is simple but difficult.).The perceived ease of use was measured by four items (e.g., I believe that I can study better with digital textbooks). The reliability of the original instrument is Cronbach's $\alpha = .94$ and .91. The Cronbach's α for the current study was .93 and .86, respectively.

2.4 Data Analysis Method

We established a statistical model to investigate the causal relationships among self-efficacy in using digital textbooks, subjective norms, observability, perceived ease of use, and perceived usefulness based on a hypothetical research model and tried to measure the latent variables by using indicator measurement variables. Since all variables were shown to be single factors in exploratory factor analysis, we used item parceling to avoid model misspecification. We used AMOS 20.0 for statistical analysis.

3. RESULTS

3.1 Inter-relational Matrix and Descriptive Statistics

If each measured variable in structural equation modeling does not have a normal distribution, we would get biased estimates and an inaccurate model. Therefore, to confirm normality in the multivariate distribution, mean, standard deviation, skewness, and kurtosis were examined.

The average of values ranged from 3.11 to 3.89, standard deviation from .81 to 1.01, skewness from .11 to .62, and kurtosis from .02 to .30 respectively. If the skewness of the variables is less than 3 and kurtosis is less than 10, a normal distribution in the model can be assumed (Kline, 2011).

We examined the VIF (Variance Inflation Factor) to assess multicollinearity between variables and we confirmed that there were no problematic influencing variables, with VIF from 1.58 to 3.91 (which is required to be less than 10), and we confirmed significant correlations among the variables at the level of .05.

Clearly indicate advantages, limitations and possible applications.

3.2 Estimate of Measurement Model

We estimated the fit of the measurement variables based on the maximum likelihood method, as a second confirmatory process of goodness of fit (Kline, 2011). As displayed in Table 1, the index of TLI and CFI was .995 and .995 respectively, which satisfies the acceptable criteria. The RMSEA value was .038, which suggested goodness of model fit.

Table 1. Fit Indices of the Measurement Model (n = 319)

	CMIN	*p*	*df*	TLI	CFI	RMSEA (90% Confidence Interval)
Measurement Model	**57.089**	**.031**	**39**	**.991**	**.995**	**.038 (.012~.058)**
Criteria				**> .90**	**> .90**	**< .08**

The results of confirmatory factor analysis provide the evidence of convergent and construct validity of the theoretical construct. When the correlation between the measured variables and the latent variable is greater than .50, convergent validity can be confirmed. When the correlation between the latent variable is less than .80, construct validity can be confirmed (Moon, 2009). As a result of examining the relationships between the latent and index variables, the standard loading factor indices of the latent variables ranged from .76 to .96, which were significant at the α .05. This suggests that the selected index variables to measure the theoretical variables in our model demonstrate convergent validity. In addition, cross-correlation between latent variables ranged from .28 to .51, which has discriminatory validity. Accordingly, it was shown that all of the latent variables of the research model have been accurately and reliably measured.

3.3 Examination of Structural Model

Since the model estimate was theoretically confirmed and the model's goodness of fit satisfies the criteria, the fit of the regression model was estimated. The estimated results of the structural model are as follows in Table 2.

Table 2. Examination of Fit of the Initial Structural Model (n = 319)

	CMIN	*p*	*df*	TLI	CFI	RMSEA (90% Confidence Interval)
Initial Structural Model	**126.515**	**.000**	**42**	**.960**	**.975**	**.080(.064~.096)**
Criteria				**> .90**	**> .90**	**< .08**

The fit indices for the initial structural model were as follows: TLI = .960, CFI = .975, and RMSEA = .80. These data suggest a good fit with the estimated model. This means that the intention of acceptance, self-efficacy in using digital textbooks, subjective norms, observability, perceived ease of use, and perceived usefulness have statistically significant causal relationships.

Accordingly, the results of examining the influence between variables are as follows. The effects of self-efficacy in using digital textbooks on perceived ease of use was β = .847 (t = 7.738, p < .05), that of subjective norms on perceived ease of use was β = -.123 (t = -1.446, p > .05), and that of observability on perceived ease of use was β = .126 (t = 2.140, p < .05).

The effects of self-efficacy in using digital textbooks on perceived ease of use was β = .504 (t = 4.210, p < .05), that of subjective norms on perceived ease of use was β = .228 (t = 2.739 p < .05), and that of observability on perceived ease of use was β = .174 (t = 2.179, p < .05). The effect of perceived ease of use on intention of acceptance was β = .260 (t = 3.731, p < .05) and that of perceived usefulness on intention of acceptance was β = .596 (t = 8.596, p < .05).

However, since the relationships between subjective norms and perceived ease of use, and observability and perceived usefulness in the initial structure model were not statistically significant, we established a succinct revised model after removing those variables from the initial model, under the condition that there were no statistical differences after removing them.

We conducted a χ^2 test to confirm that there was no statistical difference between the initial structural model and the revised model since there was a hierarchical relationship between the initial structural model and the revised structural model. We selected the more succinct revised model as our final research model since there was no statistical difference ($\Delta\chi^2$ = 2.885, p = .236). Using maximum likelihood analysis, the revised structural model showed a good fit with TLI = .962, CFI = .975, RMSEA = .078 as displayed in Table 3.

Table 3. Examination of Fit of the Revised Structural Model (n = 319)

	CMIN	*p*	*df*	TLI	CFI	RMSEA (90% Confidence Interval)
Revised Structural Model	**129.400**	**.000**	**44**	**.962**	**.975**	**.078(.063~.094)**
Initial Structural Model	**126.515**	**.000**	**42**	**.960**	**.975**	**.080(.064~.096)**
Criteria				**> .90**	**> .90**	**< .08**

Accordingly, the results of examining effects between self-efficacy in using digital textbooks, subjective norms, perceived usefulness, observability, and perceived ease of use are as follows Figure 2.

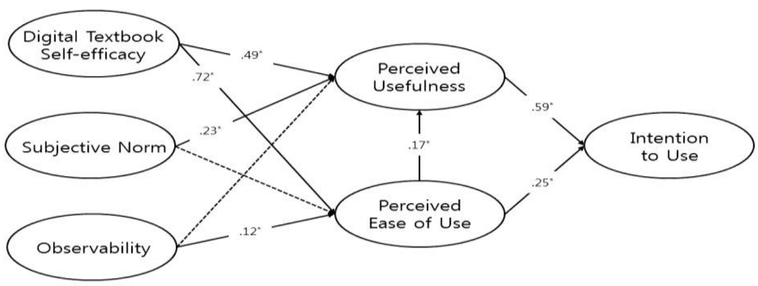

Figure 2. Standardized Path Coefficient of Revised Structural Model

The effect of perceived usefulness on self-efficacy in using digital textbooks was β = .722 (t = 12.214, p < .05), that of observability was β = .121 (t = 2.104, p < .05), that of self-efficacy in using digital textbooks on perceived usefulness was β = .486 (t = 4.584, p < .05), that of subjective norms was β = .227 (t = 2.880, p < .05), that of perceived ease of use was β = .168 (t = 2.264, p < .05), that of perceived ease of use on intention of acceptance was β = .254 (t = 3.814, p < .05), and that of perceived usefulness was β = .589 (t =

8.483, $p < .05$). This suggests causal relationships among self-efficacy in using digital textbooks, subjective norms, observability, perceived ease of use, perceived usefulness, and intention of acceptance.

It was also observed that self-efficacy in using digital textbooks and observability affect perceived usefulness and perceived ease of use. In addition, self-efficacy in using digital textbooks and subjective norms affect perceived usefulness. These factors also affect intention of acceptance. At the same time, since perceived ease of use and perceived usefulness simultaneously affect perceived usefulness, we confirmed the significance of indirect effects among the variables by using the Sobel test (Kline, 2011).

Self-efficacy in using digital textbooks affects perceived ease of use through perceived usefulness ($z = 2.09$, $p = .03$), self-efficacy in using digital textbooks affects intention of acceptance through perceived ease of use ($z = 3.34$, $p = .00$), self-efficacy in using digital textbooks affects intention of acceptance though perceived usefulness ($z = 3.77$, $p = .00$), subjective norms affect intention of acceptance through perceived usefulness ($z = 2.60$, $p = .00$), and perceived usefulness affects intention of acceptance through perceived usefulness ($z = 2.107$, $p = .03$), at the level of α .05 with indirect effects. However, it was shown that the indirect effect of observability on perceived usefulness through perceived ease of use ($z = 1.527$, $p = .12$) was not significant.

4. CONCLUSION

In this study, we investigated causal relationships between elementary school students' self-efficacy in using digital textbooks, subjective norms, observability, perceived ease of use, perceived usefulness, and intention of acceptance, based on a modification of Venkatesh and Davis's Technology Acceptance Model (1996). The following implications were derived.

First, it appeared that the observability and self-efficacy in using digital textbooks affected the perceived ease of use but subjective norms had no effect. The effects of self-efficacy of digital textbooks on perceived usefulness are consistent with previous research results (Wang & Wang, 2009). This suggests that the higher the students' confidence, the less they experience dissatisfaction with using digital textbooks. In addition, observability is consistently shown in previous studies as an effective variable on self-efficacy in using digital textbooks, suggesting that the more students observe the desirable examples of teachers using digital textbooks, the more the students are able to utilize them as well.

On the other hand, the result that subjective norms do not affect the perceived ease of use is different from our initial hypothesis but is consistent with previous research by Oak (2013). This may be because students' peers and teachers were already using digital textbooks in the existing class and the expectations of their peers and teachers cannot affect their utilization of digital textbooks.

Second, the results of investigating the effects of efficacy in using digital textbooks, subjective norms, observability, and perceived ease of use on perceived usefulness, self-efficacy in using digital textbooks, subjective norms, and perceived ease of use, affected perceived usefulness but observability did not provide significant effects.

First, the results of self-efficacy in using digital textbooks on perceived usefulness is consistent with previous research (Joo et al., 2013; Albion et al., 2002). Students who actively utilize new technology with positive attitudes recognize digital textbooks as useful. In addition, it appeared that subjective norms significantly affect perceived usefulness. The positive perception of friends and teachers using digital textbooks positively affected the students' perceptions of digital textbooks. It was shown in previous studies that the perceived ease of use significantly affects perceived usefulness (Davis, 1989; Ong et al., 2003; Rogers, 2003; Venkatesh, 1999). Students perceive digital textbooks as being more useful if they think that it is easy to use them.

On the other hand, the result that observability does not affect the perceived usefulness differs from the previous research by Lee, Hsieh, and Hsu (2011) and Seo (2011) but is consistent with that of Chen, Yen, and Chen (2009). We can predict that the reasons observability does not affect perceived usefulness is influenced by the environment of using a digital textbook. Subjects used digital textbooks only for certain courses within a limited period of time (twice a week, and less than two hours) under teachers' guidelines. Additionally, in several schools, students were allowed to use digital textbooks only within a limited space and constrained class hours to prevent theft and damage. Therefore, students were not likely to easily observe peers utilizing the digital textbooks after class hours. For that reason, it is predicted that observability was not able to affect perceived ease of use in the current study.

Third, the elementary school students’ perceived usefulness significantly affected the intention of accepting digital textbooks. The results are consistent with previous studies (Davis et al., 1989; Kang & Kim, 2013), suggesting that the more students utilize digital textbooks and believe that a digital textbook is helpful to increase learning outcomes, the more easily they are able to accept digital textbooks. Summarizing the above research results, we can assume that we need to increase students’ self-efficacy in using digital textbooks and observability in order to increase students’ perceived ease of use, self-efficacy in using digital textbooks, and subjective norms and perceived usefulness to increase perceived ease of use and perceived usefulness. The implications and practical strategies based on the above analysis results are as follows:

First, it was discovered that self-efficacy in using digital textbooks is a significant variable affecting perceived ease of use and perceived usefulness. Therefore, we need to provide enough time for students’ orientation and practice regarding how to use digital textbooks to increase their self-efficacy in using them prior to introducing them nationwide and the skills and methods of how to use digital textbook should be easily provided so that students are able to easily master usage (Kim, 2013).

Secondly, subjective norms were discovered to have an effect on learner’s perceived usefulness. Therefore, it is suggested that efforts be made to increase adoption by announcing and promoting the successful cases of using digital textbooks through online boards or communication at home (Joo, Kim, & Lim, 2012).

Thirdly, observability appeared to have positive effects on perceived ease of use. Therefore, teachers should provide chances to share their utilization methods or study results through activities or presentations to the class. The government should make every effort to provide more opportunities to observe various methods and results of utilizing digital textbook in a variety of class promotional activities to increase observability (Seo, 2011).

Fourthly, the Korean Education and Research Information Service needs to implement efforts to provide immediate support and guidelines when problems occur in producing and distributing digital textbooks in order to enhance the students' perceived ease of use (Joo et al., 2013). Teacher-centered workshops on how to use digital textbooks should be held so that they are able to implement the practice of digital textbook use properly for students in the field.

Finally, we need to create content based on a variety of subjects and activities so that students recognize that digital textbooks are helpful in achieving their learning goals; this needs to be carried out to improve the digital textbooks’ perceived usefulness. For this, teachers need to provide students with various learning activities such as fieldtrips, cooperative learning, and project based learning to utilize digital textbooks in a variety of situations and have the chance to share regular uploads of historic animation and human QR codes regarding human body structure necessary for learning. In addition, students may perceive digital textbooks as useful for learning by having them share learning content and learning results using these textbooks through group discussions and presentations (Min, 2013). While a number of previous studies (Gong, Xu, & Yu, 2004; Leung & Wei, 2000) have discovered the factors affecting user’s intentions of accepting technology based on e-learning or mobile environments, the research focusing on elementary school students’ intentions of accepting digital textbooks have not been investigated. Therefore, the current study can be differentiated from other research since the main subjects were elementary school students and we investigated their self-efficacy in using digital textbooks, subjective norms, observability, perceived ease of use, and perceived usefulness and intention of accepting technology, based on Roger’s diffusion of innovation theory.

The current study reflects the educational trends of the nationwide diffusion of digital textbooks. It is commendable that the current study tried to find strategies of increasing actual users’ intentions of accepting digital textbooks. The limitations and suggestions for further studies are as follows: First, the current study is limited in generalizing the research results since the participants were elementary school students selected by the Korean Educational and Research Information Service. Therefore, further studies need to broaden the targets to various elementary schools, as well as junior and high school environments to increase the generalization of the study results. Second, further research needs to consider other influential variables than the factors the current study incorporated, such as technical characteristics of system quality and information quality, as well as individual characteristics such as individual innovative orientations.

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DYNAMIC FUZZY LOGIC-BASED QUALITY OF INTERACTION WITHIN BLENDED-LEARNING: THE RARE AND CONTEMPORARY DANCE CASES

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ABSTRACT

The combination of the process of pedagogical planning within the Blended (b-)learning environment with the users' quality of interaction (QoI) with the Learning Management System (LMS) is explored here. The required QoI (both for professors and students) is estimated by adopting a fuzzy logic-based modeling approach, namely *FuzzyQoI*, applied to LMS Moodle data from two academic years of two dance disciplines, i.e., the Rare and Contemporary ones. The distribution of the estimated QoI across the segmented time-period of the each academic year for each user's type and for each discipline show the beneficial role of QoI to shift the educational scenarios and strategies towards a more dynamic design, yet taking into consideration the inherent tendencies and attitudes of the users' interaction within the b-learning context. These are revealed as causal relations in the LMS interaction patterns between users, along with dynamic variations in their individual attitude when interacting with LMS. The findings presented here could shed light upon designing factors of educational scenarios, in general, but also to those involved in cultural preservation and exploitation initiatives, such as the i-Treasures project (http://i-treasures.eu/).

KEYWORDS

Blended-learning, LMS, Quality of Interaction, Fuzzy Logic, Rare and Contemporary Dance, i-Treasures.

1. INTRODUCTION

The extraordinary development of the Information and Communication Technologies (ICTs) in Education has influenced the Higher Education Institutions (HEIs) to adopt online learning solutions/environments. Universities and educators are challenged to provide quality in online learning environments (OLE), since teaching and learning paradigms are emerging and, in general, students are more open in taking online courses. In higher education, there are mainly two well-known modalities for online learning, namely: fully online learning and blended(b-) learning courses (Bates and Sangrà, 2011). For fully online courses, all course materials are provided via the OLE without any face-to-face (F2F) component. For the b-learning case, also known as hybrid or combined mode course, both F2F and online class components are considered. Globally speaking, many people live their lives in a "blended" way, combining physical and online activities/experiences. Here, the b-learning concept not only fits into the contemporary, connected lifestyle, but also provide particular gains to students, teachers, and administration, namely: i) increased access and convenience; ii) improved learning; and iii) decreased (or more flexible) costs (Stein and Graham, 2014).

1.1 Interaction in b-learning Environments

In general, the Learning Management Systems (LMSs) provide educators an environment to place their online course materials and for students to receive that education while interacting with other students/teachers. However, students' interactions, attention and communications are seen as relatively low in the LMSs (Musbahtiti and Muhammad, 2013).

Anderson's online pedagogical model (Anderson, 2004) is based on three types of interactions presented by Moore (1989), i.e., student-student interaction, teacher-student interaction, and student-content interaction. Anderson's OLE primarily focuses on independent and collaborative learning, highlighting the importance of the role of the interaction. It is also known as a model of e-learning, which allows structuring and organizing online learning through six particular types of interaction, i.e., teacher-content, content-student, student-student, student-teacher, student-content and content-content. Indeed, the two identified actors (teacher and student) interact with each other and with the contents. During this interaction, a wide variety of activities (synchronous and asynchronous) can be used, based on the Internet (e.g., audio, video, conferencing, chats, and virtual worlds). These environments are particularly enriched, promoting the development of social skills and collaborative work, as well, at the level of interpersonal relationships between the participants (Anderson, 2004). In fact, Anderson's online pedagogical model can be interpreted and analyzed in two separate parts. In the first part, students can interact with the content that is available in various formats (especially with Web tools), or they can choose to have their learning in a sequential way, i.e., guided and evaluated with the help of the teacher. This interaction can be seen as a community that is mainly stimulated by the use of various e-activities, synchronously or asynchronously, supporting social interaction, collaborative learning content and the development of interpersonal relationships. In the second part, learning tools are based on independent learning; however, even if guided to independent study, the students continue to be followed, since they share the same workspace with other colleagues or peers-to-peers connections that ensure permanent cooperation and communication interfaces. Considering that both b-learning and LMSs opportunities are growing, it is important to understand about the type of interaction available in the OLEs and the way it defines the quality of interaction (QoI). According to Parker (1999), the lack of interaction is considered an important obstacle to online learning; however, several improvements in ICTs over the last years have enhanced the QoI in online environments. From this perspective, there are five types of interactions that educators can consider into the curriculum, namely: i) learner to instructor; ii) learner to learner; iii) learner to content, learner to tools, and learner to environment (Bastedo and Vargas, 2014). At the same time, there is a variety of tools that assist in facilitating interaction in online learning. These tools have been classified into two different categories, i.e.: asynchronous (e.g., quizzes, discussions) and synchronous (e.g., online chat) technologies. Considering the main concepts regarding interactions in OLEs and the corresponding tools/resources that facilitate those interactions, it may still be difficult to decide when and which tool will fit better into an online course. Here, it is important to select the interactions and tools/resources according to the need of the learning goals. In addition, different areas should be considered when an online course is created, namely: 1) course content; 2) delivery of instruction; 3) communication and interaction; 4) student time spent on learning tasks; and 5) assessment of student learning (Zhu et al., 2003). Although the course content may be the same, the delivery of instruction may be given in both modalities (synchronous or asynchronous). Among others, the selected assessment activities can be done using chats, forum discussion, assignments or quizzes. However, since each OLE is unique, the role of the educator is to assess their OLE and determine/adapt if changes are necessary or not.

Taking into account the users' interactions (professors' and students') through the LMS use within a b-learning environment, here, the *FuzzyQoI* model (Dias and Diniz, 2013; Dias et al., 2014a) is adopted. The latter is used as a translator of the knowledge of the experts in the field into fuzzy constructs, and estimates, in a quantitative way, a normalized index of the users' QoI across two consequent academic years at a HEI. This process is exemplified here with two dance paradigms, i.e., Rare and Contemporary Dance disciplines at a HEI, serving as a bet-set for the realization of b-learning scenarios within the i-Treasures project (http://i-treasures.eu/), related with the capture of the Intangible Cultural Heritage (ICH) and learning the rare know-how of living human treasures (FP7-ICT-2011-9-600676-i-Treasures) (Dias et al., 2014b).

2. METHODOLOGY

In the effort to develop a successful evaluating system of the user's interaction with the LMS through the QoI, intelligent systems may play an important role, i.e., provide a model of the domain expert's evaluating system, with the promise of advanced features and adaptive functionality (Levy and Weld, 2000). Based on the latter, a Mamdani-type (Tsoukalas and Uhrig, 1996) fuzzy logic-based QoI modelling, namely *FuzzyQoI* scheme, was proposed by Dias and Diniz (2013). The *FuzzyQoI* model constitutes a Fuzzy Inference Systems

(FISs) structure that is able to produce evaluative inferences upon input data. In particular, the latter correspond to the key-parameters and variables (metrics) of LMS Moodle (https://moodle.org) involved within a b-learning environment concerning the user's interaction with the system, whereas the outputted inference forms a quantitative measure of the user's overall QoI (Dias and Diniz, 2013).

Generally speaking, the users (professors/students) interact with the LMS and the available 110 LMS Moodle metrics are corresponded to 12 categories that serve as inputs to the FIS structure. In an effort to efficiently handle the 12 input variables, these are grouped into three groups and a nested sequence of five FISs (FIS1-FIS5) is used to form the proposed *FuzzyQoI* scheme.

For the construction of the knowledge base of the FuzzyQoI scheme, an expert in the field of analyzing LMS Moodle data within the context of b-learning was used, for defining the structure of the membership functions used for each FIS and the corresponding IF/THEN fuzzy rules. In particular, a three-level of trapezoid membership functions corresponding to Low, Medium and High values, respectively, were used for the FIS1-FIS4, whereas a five-level of trapezoid membership functions corresponding to Very Low, Low, Medium, High and Very High values were adopted for the final FIS5, increasing, this way, the resolution in the segmentation of the universe of discourse in the final FIS5.

Analytical description of the *FuzzyQoI* model can be found in Dias and Diniz (2013).

2.1 Pedagogical Planning

The organization of educational scenarios during the LMS interaction is facilitated here with the adoption of the Pedagogical Planning (PP) (Olimpo et al., 2010). The realization of the latter is achieved by adopting the MindMup tool from the i-Treasures Pedagogical Planner (Bottino et al., 2013), which is a scalable cross-browser Web-based application developed in PHP, MySQL and JavaScript. The PP is essentially a teacher-oriented online tool, yet in the way it is used here, it could serve as a combinatory tool that incorporates both designing and planning of the educational interventions and feedback from the realization of the b-learning delivered instruction. In this way, causal relations between professors' and students' at the level of their LMS-based QoI could be identified and professors' metacognitive processes could be fired towards the enhancement of their pedagogical planning and delivery. The PP comprises of both authoring and display capabilities, with specially designed functions and interface features in both cases. In particular, target population, learning context, content domain, objectives and metrics, along with available tools (such as MindMup), are the core characteristics of the PP (http://i-treasures.eu/).

To exemplify the combination of the FuzzyQoI model with the Pedagogical Planner two cases that resemble the use-cases of the i-Treasure project, i.e., the Rare and Contemporary Dances, are used as paradigms and described in the subsequent section.

2.2 The Rare and Contemporary Dances Cases

Rare Dances at the FHK, actually, belong to the Social Dances discipline, which aims to provide and develop ways to dance, able to contribute to a students' education in a more complete, comprehensive and multifaceted way, through the diversity of approaches and multiplicity of perspectives developed in each dance form. Moreover, the social dimension and respect of the act of dance are taken into account to enhance the knowledge and extend the application domain with multicultural approaches, revealing the nature and specificity of their contents. The planning of this discipline aims to construct a place of experience and experimentation with different materials, choreographic and contextual, along with specific techniques for analysis, leading to "know-how" and the enlargement and consolidation of formal and expressive repertoire of the students.

Contemporary Dances at the FHK are included in the Techniques of Theater Dances discipline, which aims to promote the analysis and study of motor vocabulary characteristic of modern and classical dance forms. The PP includes practice of standardized modeling steps organized in simple exercises with repetitions and chained in sequence dances increasing complexity. Moreover, training skills of observation in situations of mutual learning, are also considered, being consistent with the principles and quality of dance movements. Figure 1 illustrates the PP of the both paradigms (Rare and Contemporary Dance) in the form of the MindMup output, where the principal components, i.e., scientific domains, learning objectives, b-learning context, LMS Moodle tools and forms of assessment, are shown in the form of connected branches.

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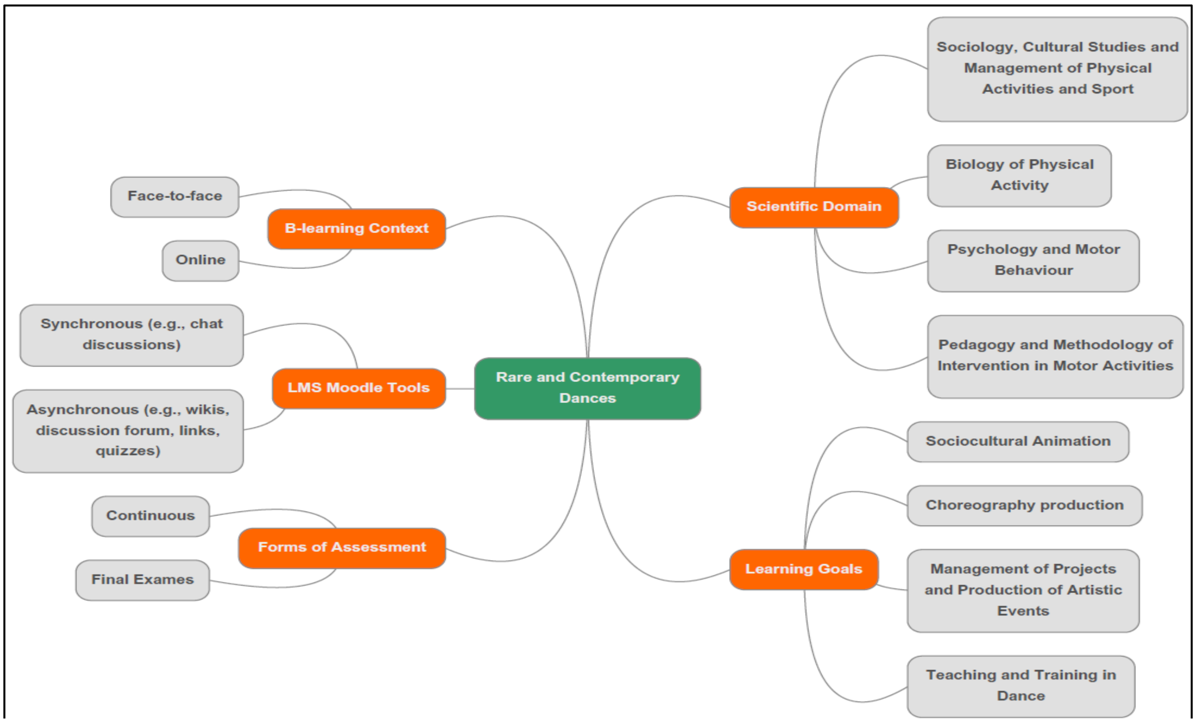

Figure 1. The MindMup output of the PP of the Rare and Contemporary Dances with the main elements (i.e., scientific domains, learning goals, b-learning context, LMS Moodle tools and forms of assessment).

3. DATASET USED

The FuzzyQoI (Dias and Diniz, 2013) was applied to LMS Moodle data from two dance disciplines, i.e., Rare and Contemporary Dances, drawn from the Faculty of Human Kinetics (FHK), University of Lisbon, Portugal, where the corresponding dance disciplines are realized within the b-learning context. For each paradigm (Rare and Contemporary Dance), the 110 LMS Moodle metrics data for two academic years (Y1: 2009-2010, Y2: 2010-2011) from two teachers (combined teaching) and students from [Rare Dance: 29 (Y1) and 57 (Y2); Contemporary Dance: 43 (Y1) and 55 (Y2)], respectively, were used and analyzed. In order to identify any possible changes in the users' interaction behavior correlated with a specific time-period section, a time-period segmentation was adopted. The latter has resulted in time-period sections (e.g., semesters (S1: 2-16, S2: 23-38 weeks), exam periods (1^{st}: 18-23, 2^{nd}: 38-46 weeks), interruptions (16-18, 24-25; 30-31 weeks)) that served as landmarks in 51-week total examined period.

4. RESULTS AND DISCUSSION

4.1 The Rare Dance Case

Figure 2 depicts the estimated QoI and its mean value $\overline{QoI} \pm std$ (grey area) from the FuzzyQoI model for the Rare Dance case across the two academic years examined (2009/10-top and 2010/11-bottom). In particular, QoI values from the Professors and Students are illustrated in the left and right panels, respectively. In Figure 2, the vertical lines denote the specific weeks that define the time-period segmentation.

Focusing at the Professors for the Rare Dance case (Figure 2-left panel), a reduced QoI is seen in both ones during the academic year of 2009/10, with Professor 2 being more active with the LMS, compared to the Professor 1, exhibiting QoI values around 0.5, both at the first and the second semester. On the other hand, Professor 1 exhibits QoI around 0.4, only at the end of the first semester. This absence of high QoI values is also noticeable in corresponding $\overline{QoI}$ values, which exhibit a clear reduction across the first semester and some local increases during the second one. Shifting to the succeeding academic year of 2010/11, Professor 1 shows increased QoI values (0.4-0.5) only at the 2^{nd} exam period (38-46 week), whereas Professor 2, like during 2009/10, exhibits increased QoI both at the two semesters, especially at the beginning, mid and end of them, accordingly. These local bursts of QoI values are also evident in the corresponding $\overline{QoI}$ values. Since the two professors are the same across the two sequential academic years, it seems that, in general, they adopt a conservative approach to the involvement of online material and LMS interaction within their curriculum, being its users themselves. Basically, transition points in the time-period (such as beginning/ending of semesters, exam period) seem to motivate more the professors to interact with the LMS, although the latter is not sustained across the whole academic year.

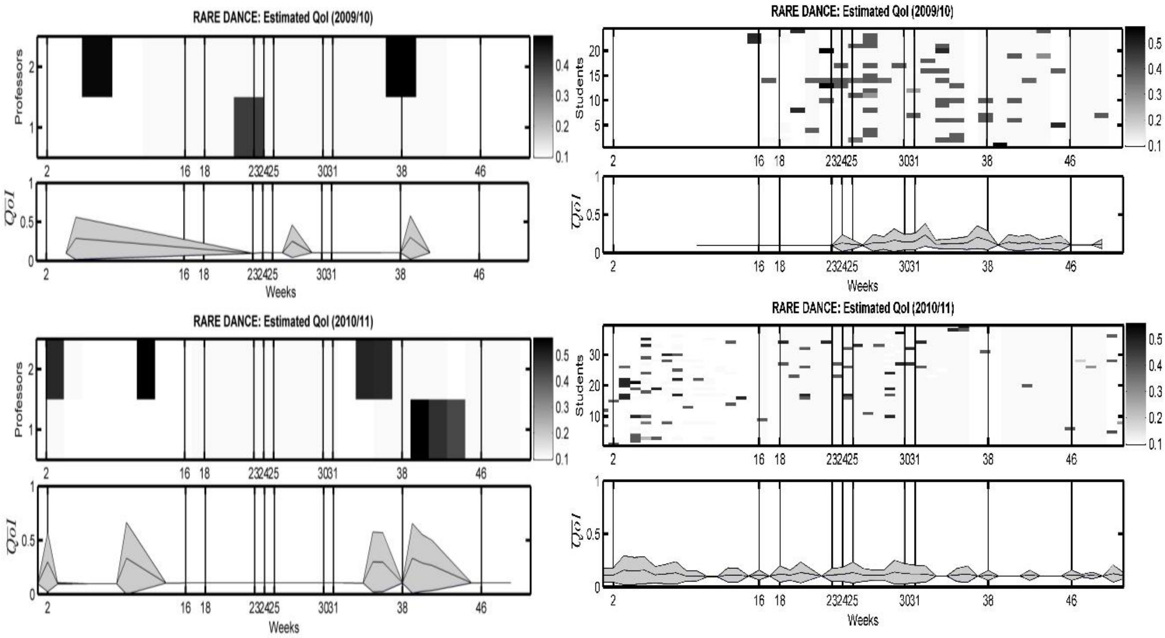

Figure 2. The estimated QoI and its mean value $\overline{QoI} \pm std$ (grey area) from the *FuzzyQoI* model for the Rare Dance case across the two academic years examined (2009/10 and 2010/11). Left panel: Professors; Right Panel: Students. The vertical lines denote the specific weeks that define the time-period segmentation.

Looking at the Students for the Rare Dance case (Figure 2-right panel), the absence of interaction across the first part of the first semester of 2009/10 (weeks 2-16) is evident (also at the corresponding $\overline{QoI}$ values). Then, a sparse activity of QoI values is seen, maximized at the beginning of the second semester and sustained almost across the rest part of the academic year, yet not by all students. This behavioral 'landscape' is reversed at the next academic year (2010/11), where the LMS activity and the achievement of QoI values around 0.5 concentrate at the beginning of the first semester, are reduced as the semester evolves, are sustained across the 1^{st} period of exams and gradually are reduced towards the 2^{nd} period of exams. It is noteworthy, that some students continue to interact with the LMS exhibiting good QoI even after the end of the 2^{nd} exam period (weeks 46-51). By comparing the $QoIs$ from the two academic years in the case of Rare Dance, and taking into account that the students involved are different yet the two professors are the same, it could be seen that in both years, students exhibit higher QoI values at the time-period just after Christmas' interruption (week 18) up to the beginning of the 2^{nd} period of exams (week 38), following, somehow, a hysteresis QoI pattern compared to the professors' one.

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4.2 The Contemporary Dance Case

Moving to the Contemporary Dance case, Figure 3 illustrates the corresponding results as the ones depicted in Figure 2, respectively. Nevertheless, in general, the interaction with the LMS is clearly different in the Contemporary Dance case, as both Professors are more interactive, compared to the ones from the Rare Dance case (Figure 2-left panel). For example, as it is shown in Figure 3-left panel, Professor 2 exhibits sustained QoI values around 0.5 across almost the whole period of semesters and exam periods (weeks 4-43) for the academic year of 2009/10. Professor 1 follows a similar pattern, yet a more sparse one. It is interesting to notice that both of them reduce their QoI with the LMS at the next academic year (2010/11), with Professor 1 activating it only in the middle of the 2nd exam period (week 41) and Professor 2 keep it active only until the end of the Easter interruption (week 31). Looking at the QoI results for the case of Students (Figure 3-right panel), QoI values around 0.4-0.5 are sustained almost for the whole duration of the two academic years, yet with a more uniform distribution appearing especially across the 2009/10. By comparing the $QoIs$ from the two academic years in the case of Contemporary Dance, and taking into account that the students involved are different yet the two professors are the same, it could be seen that in both years, students are almost synchronized with the professors' QoI pattern, exhibiting increased QoI at the same week or the one just after the one noticed in the professors' case (see for example weeks 3-6, 17-18, 23-25 for the academic year of 2010/11).

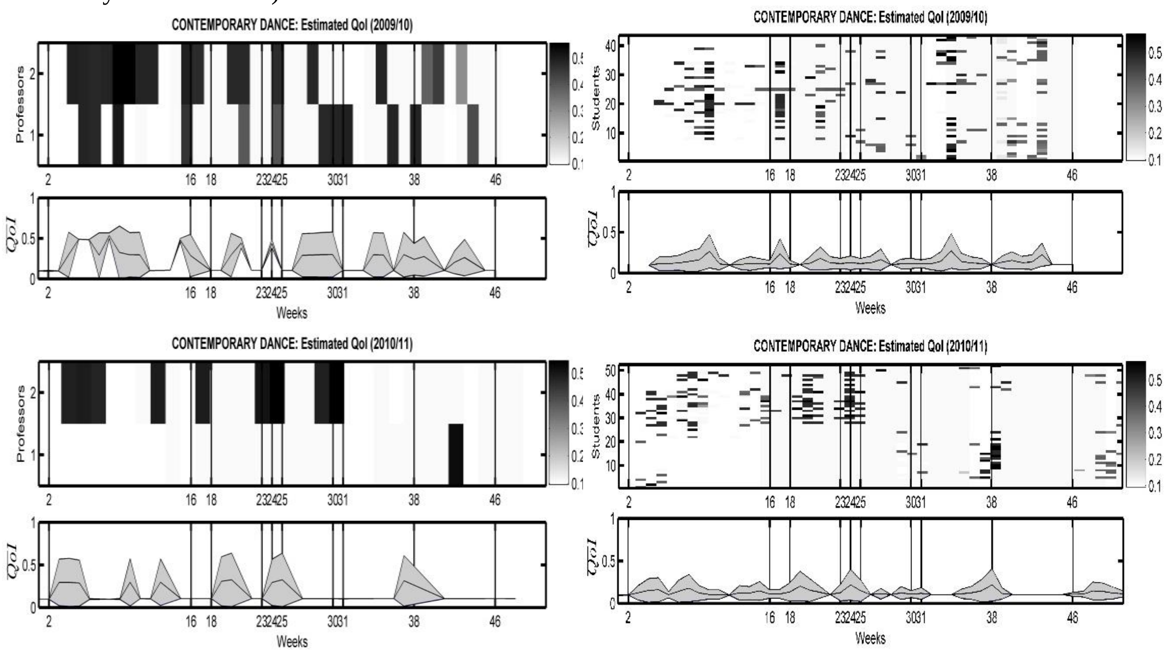

Figure 3. The estimated QoI and its mean value $\overline{QoI} \pm std$ (grey area) from the *FuzzyQoI* model for the Contemporary Dance case across the two academic years examined (2009/10 and 2010/11). Left panel: Professors; Right Panel: Students. The vertical lines denote the specific weeks that define the time-period segmentation.

4.3 Dynamics of QoI

From the results presented in Figures 2 and 3 it is evident that the *FuzzyQoI* model provides a useful index, i.e., the QoI, to represent the behavior of the stakeholders involved with the online teaching and learning processes, that is Professors and Students. Apparently, the distribution of QoI across the whole academic year reveals the dynamics underlying within the profiles of both Professors and Students. This is further reinforced, when QoI is examined across subsequent academic years (as the two ones examined here) and for different disciplines (as the Rare and the Contemporary Dance analyzed here). In this way, ups and downs in the QoI of interaction (both from Professors and Students) could be associated with the time-period segmentation, revealing the influence of the structure of the academic year, in terms of formal teaching, interrupting and examining time periods, to the interaction attitude with LMS.

To further elaborate this finding, the distribution of the students' number that exhibited $QoI > 0.1$ for the two semesters of each academic year and for the two examined cases (Rare and Contemporary Dance) was estimated and illustrated in Figure 4, along with the corresponding time-period segmentation. It should be noted that this analysis was restricted to the students' case only, as the number of professors (just two) did not allow for any valid statistical perspective. For the Rare Dance case and the academic year of 2009/10 (top left panel), the students exhibited zero interaction with the LMS at the first semester, whereas, at the second one, they were clearly interacting with the LMS, mostly at the before and during the 2nd exam period. In 2010/11, a more balanced LMS interaction is noticed across each semester, exhibiting almost similar patterns in both semesters. Interestingly, the latter is also noticed in the case of Contemporary Dance for both semesters and for both academic years, in general.

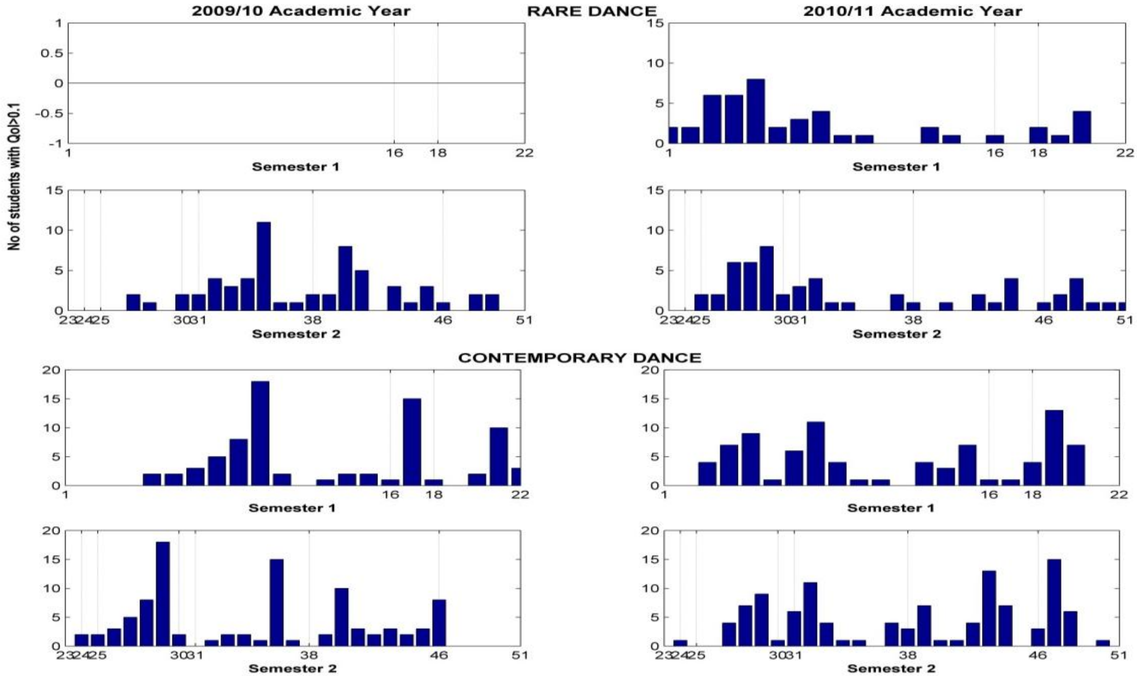

Figure 4. The distribution of the students' number that exhibited $QoI > 0.1$ for the Rare (top panel) and Contemporary (bottom panel) Dance cases, across the two semesters of the two academic years examined (2009/10-left panel and 2010/11-right panel). The vertical lines denote the specific weeks that define the time-period segmentation.

An interesting finding resulting from Figures 2-4 is the way the discipline affects not only the frequency of interaction but also the QoI with LMS, both in Professors and Students' cases. Clearly, the discipline of Rare Dance is restricted to more traditionally defined concepts that follow historical paths and are strongly connected to tradition aspects. In that case, LMS-based activities should convey such information as much as possible, taking into consideration the nature of each rare dance, as well as the students' interests aiming to provide a balance between intellectual tasks (reading, viewing) and interactive tasks, as well as, between group activities and practical experience away from the computer, in order to actively engage students and help them to both understand the dance context, as well as, to learn how to dance. Nevertheless, in the case of Contemporary Dance, more abstract dance issues are examined, supporting LMS-based interactive tasks, so the students could make connections across subject and content areas, thus facilitating their creative thinking and enhancing learning in other subjects as well (e.g. music, history, culture, etc.), making the learning process creative and more motivating. The findings here support these distinct perspectives between Rare and Contemporary Dance disciplines, revealing the way their differences are reflected into the realization of the online component of the b-learning context under a common PP (see Figure 1). The latter could be very useful for effective designing of educational scenarios within the concept of sustaining the cultural heritage, such as teaching rare dances to young generations (New Millennium Learners) and build upon tradition to create a contemporary output, using LMS-based b-learning and the QoI metric, as in the case of the i-Treasures project (http://i-treasures.eu/).

5. CONCLUSION

The exploration of the dynamics of the *QoI* with LMS, both by Professors and Students at a HEI b-learning context, was attempted here. Two disciplines of dance, i.e., the Rare and Contemporary ones, were taken as the analysis focus, and 110 metrics from the LMS Moodle users' interaction across two consequent academic years (2009/10 and 2010/11) were drawn and used as input to a recently developed fuzzy logic-based model, namely *FuzzyQoI*. The latter outputs the metric of QoI, translating the expert knowledge to a series of fuzzification/defuzzification processes. The distribution of the estimated QoI across the segmented time-period of the each academic year for each user's type and for each discipline revealed causal relations in the LMS interaction evolution patterns between Professors and Students, along with dynamic variations in their individual attitude within the online learning environment. These findings could be incorporated into initiatives that involve the design of educational scenarios (such as i-Treasures), especially for cultural preservation, exploration and evolution, such as the b-learning trajectory from rare dances to the contemporary ones.

ACKNOWLEDGEMENTS

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DO ENGLISH LISTENING OUTCOME AND COGNITIVE LOAD CHANGE FOR DIFFERENT MEDIA DELIVERY MODES IN U-LEARNING?

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ABSTRACT

Although ubiquitous learning enhances students' access to learning materials, it is crucial to find out which media delivery modes produce the best results for English listening comprehension. The present study examined the effect of media delivery mode (sound and text vs. sound) on English listening comprehension and cognitive load. Participants were 162 students majoring in Applied Foreign Language at a university in Taiwan. The students were randomly assigned to either single mode (sound) or double mode (sound and text). The research questions are (a) whether students learning with double mode outperformed students learning with single mode in listening comprehension; and (b) whether students learning with double mode hold less cognitive load than students learning with single mode. If the answers to these questions are affirmative, then the modality effect occurs and the redundancy effect does not occur. The results demonstrated that (a) text significantly enhanced English listening comprehension and lowered cognitive load; (b) students with higher English listening comprehension held lower cognitive load, and vice versa; (c) text was added no benefit to schema construction in long-term memory; and (d) complex media deliveries were not necessarily helpful to learning. Results (a) and (b) confirmed that the modality effect occurred, and the redundancy effect did not occur in the present study.

KEYWORDS

U-Learning, Media Delivery Mode, English Listening, Cognitive Load

1. INTRODUCTION

1.1 Background

Listening comprehension is difficult for foreign language learners because it is a continuous process that requires learners to understand messages while listening to them and sometimes can lead to a heavy cognitive load. In order to get rid of listening barriers, various media delivery modes and ubiquitous learning activities should be implemented in the instruction because they are convenient and can enhance students' learning motivation and learning performance (Liu & Chu, 2010). Ubiquitous learning involves a context-aware environment that users engages in with some mobile devices (Tan, Liu, & Chang, 2007). Hence, learners learning in an authentic situation will have better English listening comprehension due to the enhanced sensory stimulation.

The impacts of different media delivery modes on learning remain inconclusive. According to the working memory model proposed by Baddeley (2000), working memory can simultaneously receive information from different channels, such as auditory and visual. Thus, when the efficiency of the working memory is improved, learning performance will also be enhanced. However, Kalyuga, Chandler and Sweller (2000) suggested that some multimedia learning software can lead to cognitive load, which affects learning performance negatively. Sweller (2005) also argued that unnecessary or repeated multimedia messages can result in a redundancy effect, which negatively affects learning performance.

Multimedia helps learners learn, but different media delivery modes affect learners' cognitive load differently (Mayer & Moreno, 2003; Plass, Chun, Mayer, & Leutner, 2003). Sweller (2007) mentioned that the purpose of instructional design is to assist learners to store information in long-term memory. This implies that the way teaching materials presented to learners is a key to instructional design. Attention to cognitive load is a critical concern for instructional designers when designing multimedia teaching materials because unnecessary multimedia messages will worsen learning performance by increasing working memory load and interrupting information processing (Sweller, 2007).

Multimedia instructional systems have been widely applied in teaching and learning, but the media delivery mode that is best for English listening comprehension remains uncertain, and whether unnecessary information led to cognitive load for learners also remains inconclusive. According to the studies done by Jones and Plass (2002) and Diao, Chandler and Sweller (2007), learners learning with double mode (sound and text) outperformed learners learning with single mode (sound) and had lower cognitive load. Studies related to foreign language learning and cognitive load are mostly about digital learning environments. Hence, the present study examined the effect of media delivery mode on listening comprehension in a ubiquitous learning environment to see if there were any differences from the studies on digital learning environments. Which media delivery mode can efficiently help learners store information in long-term memory is another issue to be further examined.

1.2 Research Purpose and Questions

The present study aimed to examine the effect of media delivery mode (single mode: sound; double mode: sound and text) on English listening comprehension and cognitive load in a ubiquitous learning environment. The research questions include:1.Are there any significant differences in English listening comprehension between two media delivery modes? 2.Are there any significant differences in cognitive load between two media delivery modes? 3.Are there any significant correlations between English listening comprehension and cognitive load?

2. METHOD

2.1 Participants

Participants were 162 university students in Taiwan, aged from 18 to 23, majoring in Applied Foreign Language with the same instructor. These participants were randomly assigned to either single mode group or double mode group. There were 82 students in the single mode group and 80 students in the double mode group. The participants had similar academic proficiency because all students had been assigned to the university based on their scores obtained from the Joined College Entrance Examination. Before the experiment started, all the participants had been familiarized with PDA.

The ubiquitous learning activity in the present study was held at the Taipei Zoo. The Taipei Zoo is one of the main Natural Science Education centers in Taiwan, where people can acquire knowledge about animals and nature. Since the topic of the learning activity was related to animals, it was more appropriate for learners to learn in the zoo. Learning in the zoo enabled learners to experience an experiential learning. With the support of PDA, teaching efficiency and learning motivation are enhanced, which can be a contribution to education. The possible career opportunities for students majoring in Applied Foreign Language are tour guides, who can speak more than one second language, and foreign language teachers. So, the experiment in the present study provided an opportunity for the participants to visit the future workplace.

2.2 Research Design

The independent variable in the present study was media delivery mode, which were single mode (sound only) and double mode (sound and text). The dependent variables were learners' English listening comprehension and cognitive load. There were two tests in the present study. The first test was administrated to the participants immediately after the ubiquitous learning activity was over for examining their listening comprehension. The covariate variable was English listening proficiency which was examined by General English Proficiency Test (GEPT).

As shown in Table 1, participants in both groups took GEPT as the pretest. In the ubiquitous learning activity, participants in the single mode group learned with sound-only materials and the double mode group learned with sound-and-text materials. After the learning activity, both groups took English listening tests and cognitive load questionnaire as the posttest.

Table 1. Research design (ubiquitous learning)

Group	N	Pretest	Experiment	Posttest
Single	82	General English Proficiency Test (GEPT)	Sound-only English listening material	English listening test Cognitive load
Double	80		Concurrently sound and text English listening material	

2.3 Research Design

There were four stages in the experiment including pretest (first week), training (second week), and intervention and posttest (third week), as shown in Table 2.

Table 2. Research design

Stage	Description
Pretest (First week)	The pretest was administrated during the class (1.5 hours): 1. The instruction for the test was given by the instructor (0.5 hour). 2. Students took listening test from GEPT (1 hour).
Training (Second week)	The training was provided during the class (3 hours): 1. Introduction of ubiquitous learning, PDA (HP IPAQ 112 Classic, 3.5 inch screen) and GPS, including practical experience on using PDA and GPS. 2. Instructor provided key words that would be included in the material.
Intervention and Posttest (Third week)	Ubiquitous learning and test in the zoo (4 hours): 1. Students were randomly assigned into two groups with either single or double mode material. 2. Students had their PDA to be connected with GPS. 3. The system asked students to enter their student ID. 4. Exploration of animals would be displayed on the screen. Students could see the map of Africa area in the zoo and their current location. Each animal was marked on the map and students could decide the listening order by their preferences. The system guided students to the target by GPS. 5. When students arrived in the observed area, the system would display its material automatically by GPS and ask students if they wanted to start the listening or not. 6. Students were presented to English listening material by clicking on the button "Play". 7. After the speech sound played, students needed to click on the button "Next Page" for the test page. 8. After taking the test, students would then continue to the next animal with the steps mentioned above. 9. Students were required to fill-in the cognitive load rating scale.

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2.4 Instrument

2.4.1 English Listening Proficiency Test

The General English Proficiency Test (GEPT) was utilized in the present study to determine students' proficiency in English listening since the GEPT was a graduation requirement for the students majoring in Applied Foreign Language. There were 20 multiple-choice questions given by sound speech in the test. Each question was worth five points, and the total possible score for the test was 100.

2.4.2 English Listening Material and Test

A total of four animals, including elephant, lion, monkey and giraffe, were chosen from the Africa area in the Taipei Zoo. Each animal was described by a passage, so there were a total of four passages in the test. The English listening training system was developed by the research team in the present study. The content of the teaching material and the test were adapted from the website of National Geographic (http://animals.nationalgeographic.com/) and San Diego Zoo (http://www.sandiegozoo.org/animalbytes/index.html), as shown in Figure 1 and 2. The spoken time for each passage, with length from 180 to 220 words, was about three minutes. There were five multiple-choice questions for each passage, which required students to answer (without time restriction) after listening to each passage. There were 20 questions in the test and one point for each question.

Figure 1. PDA screen of single mode

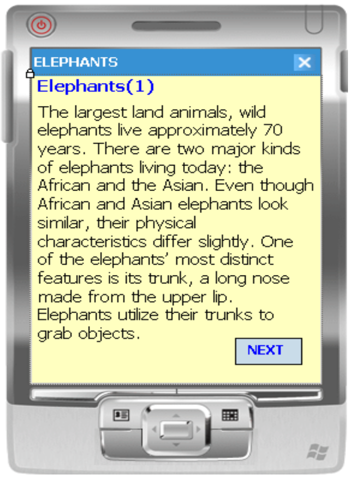

Figure 2. PDA screen of double mode

2.4.3 Cognitive Load Rating Scale

The cognitive load rating scale by Yeung, Lee, Pena, and Ryde (2000) was adopted in the present study, as shown in Table 4. The rating scale included four aspects, which were difficulty, incompetence, negative affect and lack of effort. The reliability for each aspect was ranged from 0.78 to 0.93, which was acceptable. The factor loadings for all the items were greater than 0.5 and the four factors accounted for more than 50% of total explained variance. Therefore, the validity of the rating scale was satisfied. The participants were required to rate themselves on a 5-point Likert-type scale with response options from 1 (extremely agree) to 5 (extremely disagree). The reliability coefficient of the measures of cognitive load was .814, as measured by Cronbach's α, which was acceptable.

3. RESULT AND DISCUSSION

3.1 The Effect of Media Delivery Mode on English Listening Comprehension and Cognitive Load (Research Question 1 and 2)

As shown in Table 3, for English listening comprehension, learners in the double mode group outperformed learners in the single mode group. For cognitive load, learners receiving single mode possessed higher level than learners receiving double mode. As shown in Table 4, Wilk's Λ showed a significant result, indicating that learners in both groups had significant differences in at least one dependent variable (English listening comprehension or cognitive load). The analysis of two-way MANCOVA, with covariance of English listening proficiency, showed that there was a significant difference in listening comprehension ($p < .05$) between the two groups, indicating that learners in the double mode group outperformed learners in the single mode group. There was a significant difference in cognitive load ($p < .05$) between the two groups, revealing that the single mode group had higher cognitive load than the double mode group. Both groups had significant differences in listening comprehension and cognitive load, but the estimated effect size for listening comprehension ($\eta^2 = 0.117$) was greater than cognitive load ($\eta^2 = 0.033$). This implied that media delivery mode had more impacts on listening comprehension than on cognitive load, and both groups had more differences in listening comprehension than in cognitive load.

Table 3. Descriptive statistics for listening comprehension and cognitive load

Aspect	Single mode		Double mode	
	M	SD	M	SD
English listening comprehension	6.667	1.916	8.099	2.262
Cognitive load	51.617	20.458	44.621	19.907

Table 4. Two-way MANCOVA summary on listening comprehension and cognitive load

Wilk's Λ (Sig.)	Source	Aspect	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta. Squared
0.877 (0.000)	Covariance	Listening comprehension	66.780	1	66.780	16.878*	0.000	0.112
		Cognitive load	6183.521	1	6183.521	16.993*	0.000	0.113
	Between-group	Listening comprehension	70.070	1	70.070	17.709*	0.000	0.117
		Cognitive load	1671.568	1	1671.568	4.594*	0.034	0.033
	Within-group	Listening comprehension	530.197	134	3.957			
		Cognitive load	48760.674	134	363.886			
	Total	Listening comprehension	8187.000	137				
		Cognitive load	372151.143	137				

*$p < 0.05$

3.2 The Correlation between English Listening Comprehension and Cognitive Load (Research Question 3)

A Pearson Correlation was performed in the present study to examine if there was a correlation between English listening comprehension and cognitive load. English listening comprehension and cognitive load had a significant negative correlation ($r = -0.393$，$p < 0.001$).

In ubiquitous learning environment, learners who performed well in English listening comprehension held lower cognitive load, and vice versa. This result supported the cognitive load theory and confirmed most study results on cognitive load (Chung, 2008; Diao et al., 2007；Diao & Sweller, 2007；Jones & Plass, 2002) that learners had low cognitive load performed well.

3.3 Discussions

In the ubiquitous learning environment, learners in the single mode group held higher extraneous cognitive load due to the lack of text support. On the other hand, learners in the double mode group possessed lower extraneous cognitive load because they got the support from text. To some learners learning with double mode, they only needed to overcome intrinsic cognitive load from the material itself. Hence, learners learning with double mode outperformed learners learning with single mode. For the double mode, the modality effect occurred, but the redundancy effect did not. These results confirmed some study results on cognitive load (Diao, et al., 2007; Jones & Plass, 2002). A study by Chung (2008) revealed that learners with high English proficiency held lower cognitive load when they learned with double mode. So, the result in the present study that learners who learned with double mode had lower cognitive load could be explained by their sufficient English proficiency. Based on the result of the present study, text enhanced students' listening comprehension and lowered their cognitive load. At the same time, the result also confirmed the viewpoint by Baddeley (2000) that information could be received from both visual and auditory channels for increasing the capacity of the working memory and helping students learn, which referred to the modality effect from the cognitive load theory (Sweller, 2005).

4. CONCLUSION AND IMPLICATION

Although text significantly enhances English listening comprehension, learning without reviews is difficult for learners to build up schema in long-term memory. So, instructors who taught English listening are suggested to provide teaching materials with double mode (simultaneous sound and text) for facilitating learners' listening comprehension. After the listening class is over, instructors should provide review materials with single mode (sound only) for assisting students to build up schema.

English listening comprehension and cognitive load held a significant negative correlation. Based on some relevant studies (Pawley, Ayres, Cooper, & Sweller, 2005; Paas et al., 2003), extraneous cognitive load can be lowered by appropriate instructional designs and learning activities. So, instructors should pay much attention to the impact of cognitive load because learners without unnecessary information in the working memory learn efficiently.

The comparisons among single mode, double mode and triple mode, such as sound, text and image, with different learning environments, including traditional learning and multimedia digital learning, can be included in the future studies. Also, the presentation modes of text can be further categorized into synchronization and non-synchronization to examine the effect of text presentation mode on learning performance and cognitive load. For cognitive load, extraneous cognitive load can be lowered easily by instructional design, so it is appropriate to be a dependent variable in the experiment. Therefore, the present study focused only on examining the effect of two different presentation modes on extraneous cognitive load. Intrinsic cognitive load and germane cognitive load can be considered as the other dependent variables in the future studies.

Learners' prior knowledge or proficiency would be a main factor for determining an appropriate media delivery mode for learners (Chung, 2008). English proficiency was a covariance in the present study. Prior knowledge or learners' characteristics, such as learning styles and media preference, can be other independent variables in the future study. Furthermore, the interaction between learners' prior knowledge and media delivery mode and its effects on learning performance and cognitive load with two-way ANOVA were suggested for the future studies.

The ubiquitous learning activity in the present study was held outdoors, so some students' listening comprehension would be influenced negatively by the crowd, weather or any other exterior factors. Researchers are suggested to hold outdoor learning activities on campus for the future research. If researchers hold the learning activity in a public place, then hold on non-holidays for preventing unexpected interruptions.

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THE USE OF ELGG SOCIAL NETWORKING TOOL FOR STUDENTS' PROJECT PEER-REVIEW ACTIVITY

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ABSTRACT

Numerous e-learning 2.0 studies have advocated the use of social networking sites for educational purposes, but only a few of them have observed social networking sites as an instrument for specific learner skill development. This paper discusses a study which addresses the motivation and challenges associated with the introduction of the social networking tool Elgg for the peer-review activity related to students' projects evaluation. In our study, Elgg was utilized to support the development of skills related to (a) peer-reviewing, (b) collaborative work on research projects and their online presentation, and (c) critical analysis of research proposals and reports. This report therefore aims to contribute to those areas of learner skills' development as well as to the evaluation of Elgg as an e-learning 2.0 tool.

KEYWORDS

Social networking site, Elgg, peer review, e-learning

1. INTRODUCTION

During their average day students spend a lot of time using different social media tools (e.g. Facebook, Youtube, Twitter, Instagram, Google tools etc.). Similar to (mobile)phones, listening to music CD's or watching television as their predecessors of two decades ago, such tools have become a part of students' daily social interaction and media consumption related activities. Due to the proliferation of smartphones and affordable internet connections, today's students tend to spend a lot of their time online and, with the use of various social media, most of them remain connected with their friends (via Facebook, Skype, Viber, WhatsApp etc.) during their active hours.

Social networks provide a means for posting (announcing, presenting, delivering) and retrieving (finding, following, encountering, discovering) different kinds of information. Owing to them, it is possible to track what our social connections are doing, what the latest things that *everybody* is talking about are, what our connections like or recommend, what they are *following*, or what they think is worth sharing with others. In fact, these days students depend closely on the use of online social tools as an important means for everyday interaction with their peers.

The prevalence of social networks use presents challenges for contemporary instructors who wish to appropriately exploit the potential of these social tools in a concrete learning setting. It must be noted that recent developments in e-learning have reinvigorated the higher education environment, opening up new opportunities for learning. However, in e-learning used in a conventional way as part of a *hybrid course* many of its potentials are often not fully exploited and are sometimes even regarded as a minor disturbance. For instance, having to attend face-to-face lectures in a traditional classroom, while being able to simultaneously or subsequently download representative presentations and PDF files of those lectures from the learning management systems (LMS), may result in students' reduced motivation for listening to the lecturer and also for their active participation in class. It must be emphasized that when traditional classroom lectures are supplemented with the use of LMS merely as *content repository*, its prospective use as a place for meeting with peers and collaboration among students is generally omitted. On the other hand, it has been suggested that in the hybrid teaching approach the concepts of community, collaboration and interaction among users should be introduced whenever it is appropriate to overcome limitations of conventional use of a virtual learning environment or LMS (Zhou, Sabino & Rodrigues, 2011).

As educational technology researchers, in this paper we aimed to examine how social networking tools could be effectively integrated with other university course resources, as well as included in the pedagogical design in which the use of those tools is one of course completion requirements in an effort to enhance students' online learning and collaboration.

In our research and hybrid teaching approach the social networking site *Facebook* was not included so as to reduce the risk of unnecessary distractions, like receiving messages or contact requests from friends who do not belong to the class. Such widely used social networking sites can be disadvantageous for education purposes owing to news feeds which are unrelated to course content, commercial advertisements and easy access to online games, among others. Therefore our decision in the academic year 2012/2013 was to implement the social networking tool *Elgg* in the course entitled *Computer-Mediated Communication* at the *Faculty of Organization and Informatics*, *University of Zagreb*. In this course Elgg was used for the organization of students' projects, team collaboration and project related collaborative writing, as well as for publication of project proposals and gradually improved reports in combination with peer-to-peer review activity at each of the project development steps. The aim of this paper is to present the results of the evaluation of learner experiences in the project related peer-review activity using the social networking site Elgg.

2. REVIEW OF RELEVANT LITERATURE

2.1 Social Networks in Learning

Social networks provide a possibility to interact, communicate and collaborate online in innovative, unconventional and complex patterns. Boyd and Ellison (2007) describe social networking sites (SNSs) as technologies that enable *public articulation of social connections* whether they are pre-existing networks or newly created ones based on some common interest. Numerous authors report that the main reason for using social networking sites is *social presence* (Cheung, Chiu and Lee, 2011), as they allow instant communication and connection with our friends, family members or colleagues. Social presence is also reported to be an essential component of education and learning (Brady, Holcomb and Smith, 2010). The use of SNSs can provide a lot of benefits for learners since they "encourage peer-to-peer dialogue, promote the sharing of resources, facilitate collaboration, and develop communication skills" (Siemens and Weller, 2011). Finally, some researchers have concluded that in the educational context social networking is seen not only as a possibility, but also as a necessity (Silius, Miilumaki, Huhtamaki, Tebest, Merilainen and Pohjolainen, 2010).

Several authors have reported the benefits of SNSs in distance education courses as a technological tool for improvement of online communications among students (e.g. Brady, Holcomb and Smith, 2010). The positive use of social networks in team projects (Nygard, Bender, Walia, Kong, Gagneja and Lenoue, n.d.) and language learning (Blattner and Lomicka, 2012) have also been reported. Although Facebook is one of the most popular social networking sites and students have a lot of experience using it, several research papers have reported that students did not feel safe and comfortable using Facebook in the educational context as their privacy might be revealed (Wang, Woo, Quek, Yang and Liu, 2012). Other authors argue that although Facebook has a potential to promote collaborative and cooperative learning, further research regarding how it can affect learning outcomes is necessary (Irwin, Ball, Desbrow and Leveritt, 2012).

Besides Facebook, there are other general-purpose SNSs containing all the necessary social features that could be applied in different contexts. Such sites provide a unique opportunity for educators to enhance the sense of belonging to a certain community and encourage interactions among students, which also lead to creation of new knowledge (Brady, Holcomb and Smith, 2010). In the literature there is a strong emphasis on the need for technological innovations to be accompanied by pedagogical progress in order to be successful within an educational setting. Accordingly, we decided to use the Elgg tool for a specific pedagogical activity, i.e. peer-reviewing.

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2.2 Peer-review Activity

Peer review activity basically refers to an *evaluation of someone's work by one or more peers of similar competences*. The purpose of this activity is to provide the learner with an opportunity to improve their reading skills, writing skills, critical thinking and to learn how to effectively collaborate with other students by giving and receiving feedback. The ability to produce quality feedback is considered to be one of the fundamental skills of graduate students that should receive considerable attention in higher education curriculum (Nicol, Thomson and Breslin, 2014). Peer-review activity results in gains both for the writer and receiver of feedback (Cho, Schunn and Kwon, 2007). Lundstrom and Baker (2009) revealed that the benefit for feedback writers was more significant than that of its receivers. There are several tools which can be used for peer-reviewing and some of them were found to bring positive outcomes (Sondergaard, 2009; Chen, 2012). Indeed, according to Sondegard (2009), "if used properly, peer reviewing can become an important step towards the creation of a culture of mutual support amongst the students in a class". The goal of our research was to test the application of the social networking tool Elgg for peer-review activity and investigate students' opinions and experience regarding its use.

3. RESEARCH AND METHOD

3.1 Research Questions

The goal of our research was to identify, describe, and understand students' experiences in peer-reviewing of student's projects which was facilitated through a social networking platform. In particular, our research questions were:

- What were the students' experiences performing an online peer-review activity using the social networking platform Elgg?
- How did students perceive the use of the social networking platform Elgg for project peer-review activity?

3.2 Study Context

This study was conducted in the winter semester of academic year 2012/2013 with students of a graduate-level hybrid course entitled *Computer-Mediated Communication* at the *Faculty of Organization and Informatics, University of Zagreb*. The Elgg social networking tool was installed on a college server for e-learning projects and administered by the first author of this paper. After registration to Elgg, students had to personalize their profile page (short introduction, their interests and likes). Most of the students had known each other from earlier years of study and many of them had also attended other courses together.

The authors of this paper had already had considerable experience of using different Web 2.0 tools in higher education, as well of using SNSs such as Ning (Bubas, Coric and Orehovacki, 2010). They had also been using Mahara ePortfolio, Wordpress blog and MediaWiki engine in educational settings. The challenge in this research was to experiment with the use of Elgg beyond its evaluation as a tool. In other words, we also intended to examine the peer-reviewing online activity in practice with the use of Elgg, its appropriateness and effectiveness in the development of critical thinking, as well as to obtain students' feedback on their experience using the tool.

In the academic year 2012/2013, the *Computer-Mediated Communication* course was enrolled by 65 students. It was an elective course in the first year of the graduate study. As an online activity for this course the students needed to form groups in Elgg that were named according to their project title. The students had previously selected their project topics by themselves and discussed them with the teachers regarding topic appropriateness and possible improvement. The project topics were chosen by the students (with some teacher guidance) on the basis of recent scientific literature (e.g. the journal *Cyberpsychology, Behavior and Social Networks*) and were related to broad thematic areas of the hybrid course, including internet addiction, online gaming, online relationships, social network use by different age groups etc. After the students and lecturers agreed on the project topic, each team of students was required to develop 5 blog posts which represented 5 consecutive versions of their project proposal and results presentation. Each version was available for peer-reviewing upon its completion on a fixed date. Peer reviewing activity was obligatory and students needed to choose two other projects which they would follow (i.e., read and reflect upon) until the end of the semester. A timetable was set containing dates on which students would need to present each version online and in class, as well as provide their reflections on other's projects. After the project was presented and new project presentation versions were available, students' peers were required to post their reflection with some help and guidelines from the teacher. In that way the successive project versions were developed and progressed fairly well. In the end, only the final – fifth – version of the project was submitted for assessment/grading by the teacher, without the earlier project versions. The main motto for promoting peer feedback was "Help your classmates to develop better project versions!"

3.3 Data and Results

After the semester and grading had finished we offered the students a possibility to reflect on the hybrid course design, on the project peer-review activity, and also on Elgg as a tool to perform collaboration, project presentation and peer-review. The participation in the survey was not obligatory since at that time students also had to complete several surveys in other courses related to teachers' performance, so we expected that they may not be enthusiastic about the obligation to fill in another survey. Nevertheless, 33 students provided their feedback (19 female and 14 male students). It must be noted that out of 33 students in our survey, only 7 of them had participated in peer-review activity before. For others this was their first-time peer evaluation experience.

As mentioned above, after the course completion we applied an online survey with 16 questions that were accompanied with a five point Likert-type scale for measurement of students' responses regarding their experience of participating in the peer-review activity. Students were able to provide their answers to each survey item on a scale ranging from *1 - Strongly Disagree* to *5 - Strongly Agree*. Most of the items and frequencies of students' answers are shown in tables 1-3. On the whole, the majority of students from our sample found the feedback they received or provided useful and delivered with good intentions, stating that, on average, they were satisfied with the peer-review procedure and experience. This was a confirmation of the pedagogical value of the peer-review activity and its possibility to be effectively used in the educational context. More detailed analysis of survey results regarding particular groups of survey items is given below.

Table 1. Responses to survey questionnaire items regarding the acceptance of others' comments in peer-review activity

Statement	***Answer***	***Number***	***Percentage****
1. I find comments that our project received to be useful.	1 - Strongly Disagree	1	3%
	2	5	15%
	3	2	6%
	4	**13**	**39%**
	5 - Strongly Agree	**12**	**36%**
2. We changed some parts of the project because of the comments that we received.	1 - Strongly Disagree	2	6%
	2	2	6%
	3	8	24%
	4	**3**	**9%**
	5 - Strongly Agree	**18**	**55%**
3. Because of reviewers who followed our work I was motivated to make each project version better than the previous one.	1 - Strongly Disagree	6	18%
	2	3	9%
	3	9	27%
	4	**8**	**24%**
	5 - Strongly Agree	**7**	**21%**
4. The intention of our project reviewers was to give us comments/reviews to help us to reveal possible gaps early, so that in the end we could have a quality, well-designed project.	1 - Strongly Disagree	3	9%
	2	0	0%
	3	4	12%
	4	**14**	**42%**
	5 - Strongly Agree	**12**	**36%**

** Note: The total for each statement in the column "Percentage" may differ from 100% because of rounding to the nearest integer.*

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The data presented in Table 1 indicates that the majority of students consider the comments that they received by peer review to be useful (75% of responses *agree* or *strongly agree* with regards to the first survey item in Table 1). Also, most of the students (64%; item no. 2) stated that they made changes to their project according to the comments that they received, and almost half of them (45%; item no. 3) stated that because their successive project versions were followed by the reviewers they were motivated to repeatedly improve them. Finally, as many as 78% considered the intention of project reviewers as positive and directed toward overcoming the shortcomings and possible gaps (see responses to item no. 3 in Table 1). It must be noted that if the survey items 1-4 in Table 1 were considered as a separate self-assessment scale the internal consistency (Cronbach alpha) of this scale measured on our subjects (N=33) would be 0.83, which indicates good reliability.

Table 2. Responses to survey questions regarding skills development of participants in peer-review process

Statement	***Answer***	***Number***	***Percentage****
1. I read reviews that other students wrote for other projects in order to find ideas and inspiration for my own reviews.	1 - Strongly Disagree	4	12%
	2	6	18%
	3	6	18%
	4	**11**	**33%**
	5 - Strongly Agree	**6**	**18%**
2. Reviews of other students that were related to projects other than mine helped me to improve/change the project of our team.	1 - Strongly Disagree	8	24%
	2	7	21%
	3	10	30%
	4	**3**	**9%**
	5 - Strongly Agree	**5**	**15%**
3. The experience of participating in peer reviewing helped me in the development of critical thinking in the analysis of textual content.	1 - Strongly Disagree	5	15%
	2	4	12%
	3	6	18%
	4	**13**	**39%**
	5 - Strongly Agree	**5**	**15%**
4. The experience of participating in peer reviewing helped me in the development of my scientific paper writing skills.	1 - Strongly Disagree	6	18%
	2	2	6%
	3	9	27%
	4	**10**	**30%**
	5 - Strongly Agree	**6**	**18%**

** Note: The total for each statement in the column "Percentage" may differ from 100% because of rounding to the nearest integer.*

As can be seen from the data in Table 2, the *collaborative learning (side) effects* of participation in the peer-review process may have positively influenced the motivation and mental schema ("idea") development for the peer-reviewing process for a considerable proportion of participants in our survey (51%; see item 1 in Table 2). About the same positive effects were reported by respondents regarding the critical thinking ability in the analysis of the texts of research proposals and project reports of peers (54% of the respondents agreed with the content of item 3 in Table 2). Finally, the experience of participation in the peer-review process on the whole was considered helpful by almost one half of the respondents (48% of them, to be exact; see item 4 in Table 2) in developing their skill of writing a scientific paper. However, only a small proportion of students (24%; item 3) stated that reading the reviews of other projects helped them to improve their own project. As for the items presented in Table 2, if the survey items 1-4 in this table were considered as a separate self-assessment scale related to skills development in peer-review activity, the internal consistency (Cronbach alpha) of this scale would be 0.86 (N=33), which also indicates its potentially good reliability.

The final section of the evaluation survey regarding the use of peer review contained items related to several aspects of the use of Elgg (see Table 3.). The data obtained from the survey suggest that students were predominantly satisfied (63% of subjects; item 1 in Table 3) with the use of the social networking tool Elgg during their project creation, as well as with its use for the peer-review activity (69% of subjects; item 4 in Table 3). The Elgg's blog tool also received positive evaluation by the majority of students for both the project activity (57% of subjects; item 2 in Table 3) and peer-review (72% of subjects; item 3 in Table 3). Finally, as in the case of items presented in Table 1 and Table 2, if the survey items 1-4 in Table 3 were considered as a self-assessment scale related to evaluation of the social networking tool Elgg for peer-review activity, the internal consistency (Cronbach alpha) of this scale would be 0.90 (N=33), which indicates very good reliability.

Table 3. Responses to survey questions regarding the evaluation of Elgg for peer-review activity

Statement	***Answer***	***Number***	***Percentage****
1. I am satisfied with the use of social networking tool Elgg during project creation within the CMC course.	1 - Strongly Disagree	2	6%
	2	3	9%
	3	7	21%
	4	**12**	**36%**
	5 - Strongly Agree	**9**	**27%**
2. I consider that the use of a group blog within the social networking tool Elgg is suitable for the project activity.	1 - Strongly Disagree	3	9%
	2	5	15%
	3	6	18%
	4	**12**	**36%**
	5 - Strongly Agree	**7**	**21%**
3. I consider that the use of a group blog within the social networking tool Elgg is suitable for the performance of peer-review activity.	1 - Strongly Disagree	1	3%
	2	3	9%
	3	5	15%
	4	**16**	**48%**
	5 - Strongly Agree	**8**	**24%**
4. I am satisfied with my experience of using the social networking tool Elgg for the performance of peer-review activity.	1 - Strongly Disagree	2	6%
	2	2	6%
	3	6	18%
	4	**16**	**48%**
	5 - Strongly Agree	**7**	**21%**

** Note: The total for each statement in the column "Percentage" may differ from 100% because of rounding to the nearest integer.*

As the final step in the analysis of our survey data we performed factor analysis of the responses to the items presented in tables 1-3. The results of the principal components confirmatory factor analysis with varimax rotation generally confirmed the categorization of items into three groups, i.e. "Acceptance of others' comments in peer-review activity" as factor *F1*, "Skills development of participants in the peer-review process" as factor *F2* and "Evaluation of Elgg for peer-review activity" as factor *F3*. The result of this factor analysis, together with the value of Cronbach alpha coefficients that were calculated as if the items in tables 1-3 were considered as separate self-assessment scales (the values were 0.83, 0.86 and 0.90, respectively), indicate that these items could be useful for similar research regarding evaluation of peer-review activity that is supported by the use of social networking tools.

Although Elgg provides a lot of special features (like wall posting, bookmarking, posting video or photographs etc.) with the possibility of unique sharing of information modes, the use of these features was fairly modest during the peer-review activity in our study (as the students mainly used chat and blog). In fact, the students were predominantly concentrated on the fulfillment of their assignments and on the peer-to-peer communication which was necessary for the ongoing project related activity. This can be explained by the fact that in the hybrid course the students were able to meet each other regularly in class, so they did not need additional types of interaction.

4. FINDINGS AND CONCLUSION

Students like using social networking tools and from the students' responses in our research, it is evident that they accept them as a medium for collaboration and practical learning activities within the higher education context. From the survey results presented in tables 1-3 we can conclude that the adoption of the social networking tool Elgg for peer-review activity had educational value for students.

According to the results of our study, we can suggest the following responses to our research questions: (1) students' experience in performing online peer-review activity using the social networking platform Elgg were predominantly positive; and (2) the majority of students had a favorable perception of the use of the social networking platform Elgg for project peer-review activity.

There are several limitations of this research. Firstly, the survey questionnaire was completed only by the students who chose to do so, so the opinions of other students who also participated in the online peer-review activity are not represented in the results. Secondly, 79% of the students in our convenience sample participated in the peer-review activity for the first time so they could not compare it with their prior experience in other courses, which may also have affected the results of our case study. Thirdly, the number of students in our convenience sample was rather low, which has a negative impact on the statistical significance and generalizability of the results of data analyses.

Nevertheless, we encourage instructors with similar course activities to feel confident about integrating social networking tools like Elgg as well as the peer-review activity into their course curriculum taking into account both their effectiveness and acceptability among graduate college students. It is our conclusion from this and other Web-2.0 related projects that using social networking tools in the educational context contributes to the improvement of students' learning experience, skills development and may also increase their motivation for work.

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EDUCATIONAL MULTIMEDIA PROFILING RECOMMENDATIONS FOR DEVICE-AWARE ADAPTIVE MOBILE LEARNING

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ABSTRACT

Mobile learning is seeing a fast adoption with the increasing availability and affordability of mobile devices such as smartphones and tablets. As the creation and consumption of educational multimedia content on mobile devices is also increasing fast, educators and mobile learning providers are faced with the challenge to adapt multimedia type educational content in order to suit the variety of devices that are used by mobile learners. This paper proposes a solution for multimedia profiling that groups mobile devices in classes based on their resolution in order to allow for the creation of a reduced number of multimedia clip versions. This solution would support educational multimedia visualization on a large set of mobile devices. The paper also makes recommendations for each multimedia profile in terms of audio and video encoding settings.

KEYWORDS

Mobile learning, multimedia profiles, educational multimedia clips.

1. INTRODUCTION

Mobile devices, in particular smartphones and tablets are increasingly used for conducting a multitude of online and offline activities, among which mobile learning. According to a recent market research report the global smartphone sales have crossed the 1 billion mark in 2013, overtaking feature phone sales in the process (CCS Insight, 2013). Moreover, almost 220 million tablets were sold worldwide in 2013, being estimated to overtake combined desktop and laptop PC sales by 2015 (Statista, 2014). At the same time, there has been a fast growth in multimedia content creation and consumption, with mobile video being estimated to increase 14-fold between 2013 and 2018 (Cisco, 2014).

Mobile and multimedia technologies have also changed radically the online learning landscape. The advances in mobile technologies such as improved network speeds, improved processing power, improved graphics and higher-resolution displays enable enhanced, more complex mobile learning experiences. As mobile devices are gradually becoming the primarily means for accessing the Internet (Meeker, 2013), learners are gradually shifting from traditional e-learning to mobile learning (Ambient Insight, 2013).

Thanks to the latest technologies, mobile learners can easily access educational multimedia content anywhere and anytime. Multimedia type educational content has the advantage of providing a rich display of information and can be used to further enforce the understanding of difficult concepts through computer generated animations, lecture recordings or screencasts. However, a number of challenges such as the multitude of mobile devices with different characteristics and the lack of clear multimedia encoding recommendations make difficult the adaptation of educational multimedia content based on learner’s device characteristics (Moldovan & Muntean, 2011).

This paper comes to the help of all those involved in multimedia-based mobile learning being them educators, educational content creators and/or developers and administrators of mobile learning systems and applications. By looking at the current mobile devices market, the paper defines a set of multimedia profiles and provides encoding recommendations that enable optimum educational content delivery to a broad range of mobile devices.

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2. ANALYSIS OF MOBILE DEVICE SCREEN RESOLUTIONS

One of the main challenges in the current mobile learning context, that this paper aims to address through the novel multimedia profiling solution, is posed by the multitude of mobile devices with different characteristics (e.g., screen resolution) that make difficult educational multimedia clips adaptation based on learner's device.

This multi-device screen resolution issue is illustrated in Table 1. The table presents a list of 25 smartphones and tablets with different screen resolutions that have been recently released on the market by various manufacturers and are suitable for mobile learning. Out of the 25 mobile devices, 21 devices were released in 2013, 3 devices were released in 2012, and one device (i.e., Apple iPhone 4s) was released in October 2011 but it is still on sale as of March 2014 due to its popularity. The table was generated based on information from online mobile device specification repositories such as PDAdb[1] and Phone Arena[2].

The screen size of the mobile devices listed in Table 1 ranges from 2.8 inches to 10.1 inches. There are 7 unique aspect ratios across the 26 individual display resolutions, with the most common ones being 16:9 for eight resolutions, 4:3 for 6 resolutions, and 5:3 for three resolutions. The aspect ratio represents the proportional relationship between the resolution width and the resolution height. The analysis of current mobile device screen resolutions includes only resolutions equal and higher to 320×240 pixels. This was defined as the baseline resolution for smartphone devices to be used for mobile learning in the M-learning Standard (Drinkall & Kneebone, 2012) developed as part of Australia's National VET (Vocational Education and Training) E-learning Strategy.

While Table 1 provides an idea on the variety of screen resolutions variety of screen resolutions of devices that can be used for mobile learning, it provides little indication of the actual usage or popularity of different display resolutions. Therefore, to provide a better insight, the popularity of mobile device screen resolutions was investigated based on mobile web data traffic statistics from more than 3 million websites globally provided by the StatCounter Global Stats web analytics service (StatCounter, 2013).

Table 1. Common screen resolutions for smartphones or tablets, and their classification based on standard video resolution classes used by online multimedia streaming services.

Resolution Class	Display Resolution	Aspect Ratio	Example of Mobile Device		
			Device Model	Display Size	Release Date
1080p	2560×1600	16:10	Samsung Google Nexus 10	10.1″	Nov 2013
	2048×1536	4:3	Apple iPad Air	9.7″	Nov 2013
	1920×1200	16:10	Amazon Kindle Fire HDX	7.0″	Oct 2013
	1920×1080	16:9	HTC One	4.7″	Mar 3013
	1800×1080	5:3	Meizu MX3	5.1″	Sep 2013
720p	1366×768	16:9	Samsung ATIV Tab 3	10.1″	Aug 2013
	1280×960	4:3	LG Optimus VU 3	5.2″	Oct 2013
	1280×800	16:10	Toshiba Encore	8.0″	Nov 2013
	1280×768	5:3	BlackBerry Z10	4.2″	Jan 2013
	1280×720	16:9	Huawei Ascend P6	4.8″	Jun 2013
	1136×640	16:9	Apple iPhone 5s	4.0″	Sep 2013
480p	1024×768	4:3	Acer Iconia A1-810	7.9″	May 2013
	1024×600	16:10	Lenovo IdeaTab A1000	7.0″	Jan 2013
	1024×480	32:15	Sony Tablet P	5.5″	Mar 2012
	960×640	3:2	Apple iPhone 4S	3.5″	Oct 2011
	960×540	16:9	Samsung Galaxy S4 Mini	4.3″	Jul 2013
	854×480	16:9	Motorola RAZR D3	4.0″	Mar 2013
	800×480	5:3	Nokia Lumia 720	4.3″	Feb 2013
	720×720	1:1	BlackBerry Q5	3.1″	Jun 2013
360p	640×480	4:3	BlackBerry Curve 9220	2.4″	Apr 2012
	640×360	16:9	Nokia 808 PureView	4.0″	Feb 2012
	480×360	4:3	BlackBerry 9720	2.8″	Aug 2013
240p	480×320	3:2	Acer Liquid Z3	3.5″	Aug 2013
	400×240	16:9	LG Wine III	3.0″	Oct 2013
	320×240	4:3	Nokia Asha 500	2.8″	Oct 2013

[1] PDAdb.net - Comprehensive Database of Mobile Device Specifications, http://pdadb.net/.
[2] Phone Arena - Phone News, Reviews and Specs, http://www.phonearena.com/.

Figure 1 presents the worldwide market share of different mobile display resolutions in 2013, based on mobile data traffic statistics collected between January 2013 and October 2013. The figure shows that in terms of actual presence on the market the 480×320 resolution is the most popular accounting for 18.47% of the mobile web requests. This is followed by the 320×240 resolution with 10.61% of the global share, the 1280×720 resolution with 7.5%, the 568×320[3] resolution with 6.62%, and the 800×480 resolution with 6.39%.

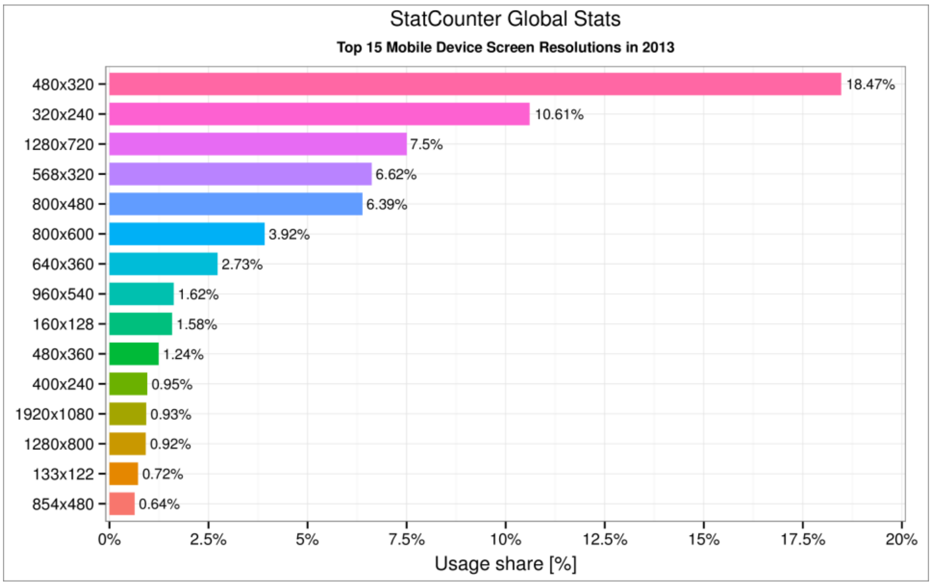

Figure 1. Percentage worldwide market share of the top 15 mobile screen resolutions based on data collected by StatCounter Global Stats between January 2013 and October 2013.

3. RECOMMENDATIONS FOR MULTIMEDIA PROFILING

In the context of this paper, a *multimedia profile* is defined as a set of recommended values for video and audio encoding parameters such as video resolution, video framerate, video bitrate, audio bitrate, number of audio channels, etc. The profiles specify how to create different versions of an educational multimedia clip that are suitable to different groups of mobile devices that have similar characteristics (i.e., device classes).

Ideally, for an optimum quality level each learner should receive a multimedia clip version that fits its particular device screen resolution. However, in practice this is not feasible due to the large number of versions that would need to be created and stored for each educational multimedia clip.

The overview of the current mobile landscape, presented in the previous section has revealed that while there are a multitude of mobile device screen resolutions currently in use, only a limited number stand apart as considerably more popular. Moreover, while there is a trend towards higher screen resolutions, small resolutions will continue to be used especially in lower-end devices targeting lower budgets and emerging markets. In conclusion, although a broad range of screen resolutions should be covered there is no need to cover each and every one. Therefore, the multitude of mobile devices can be grouped in classes based on their screen resolution, and a single multimedia profile associated to each class. Five classes of mobile devices are proposed in this paper one for each of the standard video resolution profiles:

- Very Small Screen Resolution Devices (VSRD) – for the 240p video resolution profile
- Small Screen Resolution Devices (SRD) – for the 360p video resolution profile;
- Medium Screen Resolution Devices (MRD) – for the 480p video resolution profile;
- Large Screen Resolution Devices (LRD) – for the 720p video resolution profile;
- Very Large Screen Resolution Devices (VLRD) – for the 1080p video resolution profile.

[3] This is actually the 1136×640 resolution of Apple iPhone 5+ smartphones, but is reported as for , but report the 480×320 resolution for background compatibility in terms of webpages rendering with older iPhone models.

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3.1 Video Resolution Recommendations

For a given educational multimedia clip and a given mobile device, the recommended multimedia clip version (i.e., corresponding to a particular multimedia profile), should be selected by considering both the clip resolution aspect ratio and the aspect ratio of the device's screen resolution, as the two can often differ in practice. For example, a mobile device with a 640×480 resolution can accommodate the 480p profile (640×480 pixels clip resolution) for an educational clip with a 4:3 aspect ratio, but only the 360p profile (640×360 clip resolution) for an educational clip with a 16:9 aspect ratio.

However, in case of multimedia content production the wide 16:9 aspect ratio has become almost ubiquitous in recent years, with the increasing adoption of HD (High-Definition) 1280×720, Full HD 1920×1080, and more recently of Ultra HD e.g., 3840×2160 resolutions. These resolutions are used from video cameras integrated with mobile devices to professional video cameras.

Therefore, the research presented in this paper recommends the usage of the 16:9 video aspect ratio for encoding the educational multimedia content. Figure 2 illustrates the recommended video resolutions for multimedia profiles associated to the proposed mobile devices classes. As indicated in the figure, the resolution approximately doubles in size with every profile.

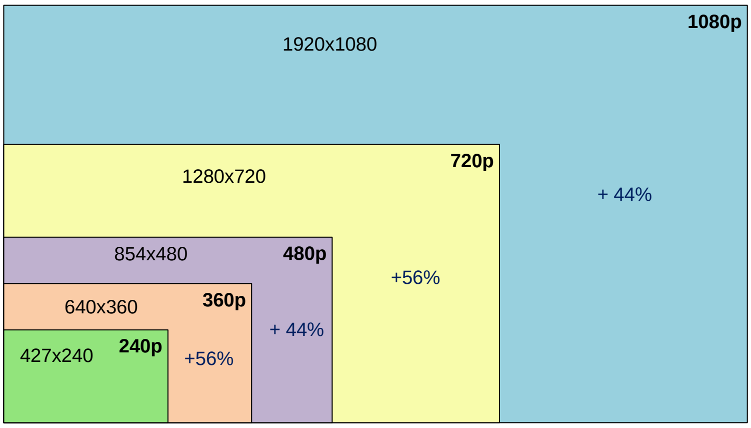


Figure 2. Video resolutions recommended for the multimedia profiles associated to the proposed mobile device classes.

3.2 Video Framerate Recommendations

Another important video encoding parameter is the video framerate. The video framerate usually follows some predefined standard values and is mainly determined by the equipment used for recording the educational multimedia content. However, it can be changed later on during the content editing and transcoding phases. Examples of standard framerates that are widely adopted for video recording of progressive videos, which is usually the case with Internet videos, include 24 fps, 25 fps and 30 fps.

The 30 fps value is proposed as the recommended framerate for the multimedia profiles associated to the proposed mobile device classes. This value provides excellent perceived quality for multimedia content with various dynamicity level (Ou et al., 2011). While the 30 fps framerate is the recommended one, in case of an educational multimedia clip that has a smaller framerate (e.g., 24 fps, 25 fps, etc.), the framerate of the original clip is maintained for all versions. This is because increasing the framerate to 30 fps would have little benefit in terms of user perceived quality.

3.3 Video Codec Recommendations

The resolution and framerate settings are independent of the video codec being used for encoding the clips. As opposed, for a particular video resolution and frame rate, the video bitrate of a compressed educational multimedia clip depends on the video codec being used (some codecs offering better compression for similar quality level such as good or excellent), as well as of particular settings specific for the video codec.

The main considerations when selecting the video codec are: supported across majority of mobile devices, cost and compression quality. Examples of video compression formats that are commonly used nowadays, include the standardised H.264/MPEG-4 AVC (Advanced Video Codec) (ITU-T, 2009), as well as its open source and royalty free alternatives Google's VP8[4] and Xiph.Org Foundation' Theora[5]. Their next generation successors, namely H.265 HEVC (High Efficient Video Coding) (Sullivan et al. 2012), VP9 (Bankoski et al., 2013) and Daala[6], promise to bring significant performance improvements but they have just been recently standardised (i.e., H.265) or are still in development (i.e., VP9 and Daala).

Although it is subject to licensing royalties, H.264 established itself as the most popular video compression format for Internet video delivery (Lawler, 2011), having also playback support on every popular mobile platform including Android[7], Apple iOS[8], Windows Phone[9] and BlackBerry[10]. Due to its widespread use and high compression quality enabled, the H.264 codec is also recommended by the Flexible Learning Advisory Group's M-learning Standard (Drinkall & Kneebone, 2012). Therefore, the research presented in this paper considers H.264 as the recommended video codec for multimedia profiling.

3.4 Video Bitrate Recommendations

Various aspects need to be addressed when selecting the video bitrate for encoding multimedia clips in order to enable an optimum or level of user-perceived quality (Moldovan et al., 2013). The bitrate has to be appropriate to the resolution and framerate (i.e., higher bitrate for higher resolution), and its selection should also consider among others, how the content will be distributed to the learners (e.g., download for local playback vs. streaming), the wireless networks speed, etc.

Table 2 presents the proposed video bitrate range for each multimedia profile associated to the five mobile device classes. These values correspond to a 30 fps framerate and the H.264 video codec, and can be used for encoding educational multimedia clips streamed over a wireless network.

Table 2. Video encoding recommendations for the five multimedia profiles when streaming over wireless networks

Device Class	**Video Profile**	**Resolution** [pixels]	**Framerate** [fps]	**Video Codec**	**Video Bitrate** [kbps]
VLRD	1080p	1920×1080			2000-3000
LRD	720p	1280×720			1500-1800
MRD	480p	854×480	30	H.264	600-1000
SRD	360p	640×360			350-550
VSRD	240p	427×240			150-300

The bitrate intervals are based on guidelines and recommendations provided by Apple (Apple, 2011), Adobe (Levkov, 2010) and Wowza (Good et al., 2011). These companies are big players in the adaptive multimedia area having developed commercial solutions that are widely deployed, and they also contributing to the MPEG DASH (Dynamic Adaptive Streaming over HTTP) standard.

Higher bitrates could be used if the educational clips are intended for download and local playback. However, these bitrate recommendations are more suitable for educational content delivery over the existing wireless networks. A recent study based on real-world usage statistics from 78 mobile providers located in 52 countries indicated that the average mobile connection speed across these operators was 2.71 Mbps (Akamai, 2013). Moreover, a number of research studies (e.g., Kennedy et al., 2010; Moldovan et al., 2011) that investigated the adaptation of the video bitrate in order to support high quality multimedia clips delivered over wireless networks to mobile devices have used bitrate values in the range of the recommended intervals presented in Table 2.

[4] The WebM Project — WebM VP8 Codec SDK, http://www.webmproject.org/docs/vp8-sdk/.
[5] Theora, video for everyone, http://www.theora.org/.
[6] Xiph.org :: daala video, http://xiph.org/daala/.
[7] Android Supported Media Formats, http://developer.android.com/guide/appendix/media-formats.html.
[8] iOS Media Layer Overview, http://developer.apple.com/library/ios/documentation/miscellaneous/conceptual/ip honeostechoverview/ MediaLayer/MediaLayer.html.
[9] Supported codecs for Windows Phone, http://msdn.microsoft.com/en-us/library/windowsphone/develop/ff462087.
[10] BlackBerry media support, http://developer.blackberry.com/devzone/develop/supported_media/.

3.5 Audio Encoding Recommendations

The audio stream usually represents the smaller fraction of the overall multimedia clip. However, this is of high importance especially in case of educational clips that provide additional verbal explanations to the material presented in the video.

Since users are more sensitive to changes in the audio quality, as opposed to changes in the video quality (Ozer, 2013), this research recommends the audio to be encoded using the same settings for all multimedia profiles. The audio sampling frequency is the most important encoding parameter to be maintained constant in order to avoid audible pops when switching between the different versions of the clip (Ozer, 2013). A typical value for the audio sampling rate is 44.1 KHz.

The H.264 video codec is often used together with the standardised AAC (Advanced Audio Coding) (ISO/IEC, 2006) audio codec. For this particular codec, an audio bitrate of 128 kbps is recommended for all multimedia profiles. This value was recommended based on results from subjective listening tests that have shown that the AAC codec provides good to excellent user-perceived audio quality levels at bitrates as low as 64 Kbps (Jiang et al., 2012).

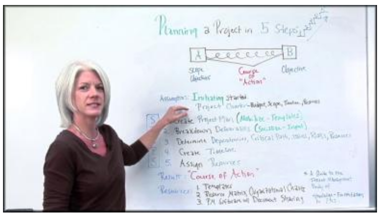
4. EXPERIMENTAL CASE STUDY

A subjective study was conducted in order to analyse if the proposed recommendations for multimedia profiling provide an excellent user-perceived quality level. To address the variability of the educational multimedia content, six educational clips were used in the evaluation case study. The clips are representative for the broad spectrum of educational multimedia clips, and correspond to six different categories of educational clips that are common nowadays: *animations*, *demos*, *documentaries*, *presentations*, *screencasts* and *slideshows*. These were selected from a large number of educational multimedia clips that are available on the Internet through iTunes U[11] and YouTube Education[12] multimedia services. Figure 3 presents representative frames for the six educational multimedia clips used in the study. More details about the clips can be found (Moldovan et al., 2014).

a) Animation clip 'AtomSize'

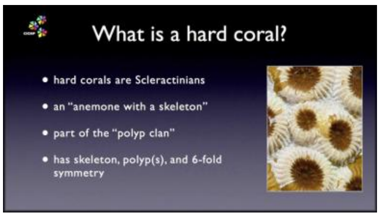
b) Demo clip 'NitrogenIceCream'

c) Documentary clip 'ArtOfBook'



d) Presentation clip 'ProjectPlanning'

e) Screencast clip 'PhotoEditing'



f) Slideshow clip 'CoralsIntro'

Figure 3. Representative frames for the six educational multimedia clips used in the subjective case study.

[11] Apple iTunes U, http://www.apple.com/education/ipad/itunes-u.
[12] Education - YouTube, http://www.youtube.com/education.

The evaluation study consisted in a number of 60 participants viewing the six educational multimedia clips on a mobile device and rating their video quality on a 0-100 continuous scale with the following levels: Bad (0-19), Poor (20-39), Fair (40-59), Good (60-79) and Excellent (80-100). A Google Nexus 7 tablet device running on Android operating system was used for displaying the multimedia clips used for testing. The device has a 7″ LED-backlit IPS LCD capacitive touchscreen with a resolution of 1280×800 pixels, a Nvidia Tegra 3 1.2 GHz CPU and 1 GB of RAM. The clip playback, quality rating and data recording, was done through a purpose build Android app. Standard procedures for multimedia quality assessment as recommended by International Telecommunications Union were followed (ITU-T, 2008).

The educational multimedia clips were encoded for the multimedia profile 720p that is suitable to the screen resolution of this tablet device (i.e., H.264 video codec, 1280×720 pixels resolution, 30 fps, 128 kbps). Two versions of each multimedia clip were assessed, one at the minimum recommended streaming bitrate of 1500 kbps and one at the maximum recommended streaming bitrate of 1800 kbps.

The video quality evaluation results are presented in Figure 4. The results show that both the 1500 kbps and the 1800 kbps video bitrate values offer an excellent level of user perceived quality. The average video quality as indicated by the Mean Opinion Score (MOS), across the six educational multimedia clips was 97.82 for the 1800 kbps bitrate and 95.06 for the 1500 kbps. The standard deviations of the subjective MOS scores, indicate that for the 1500 kbps bitrate there is a higher variability between the quality ratings of individual participants.

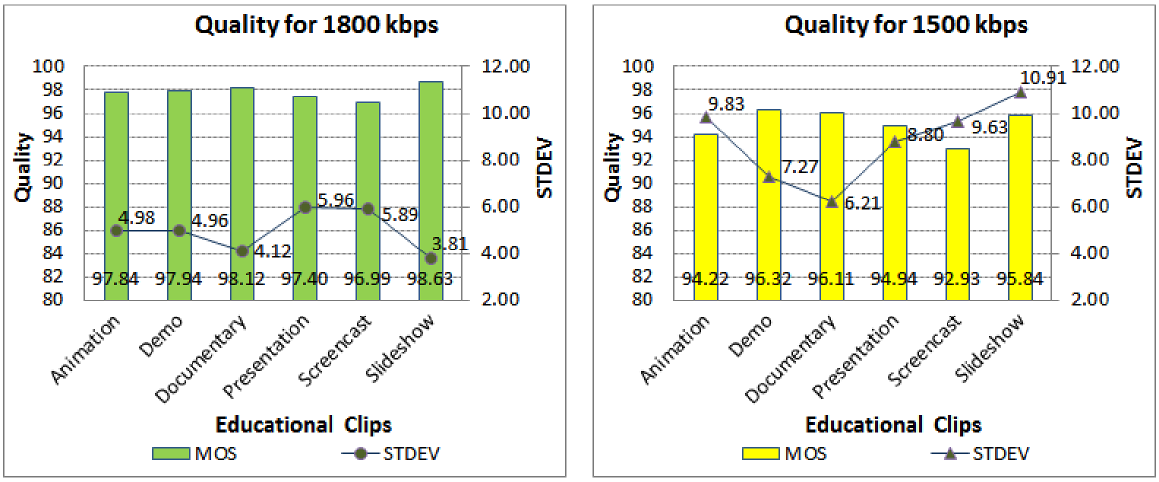


Figure 4. Video quality evaluation results

5. CONCLUSION

This paper has proposed a solution for multimedia profiling to address the difficulties in creating educational multimedia content for the multitude of mobile devices that can be used for mobile learning. The mobile devices are grouped in five different classes based on their screen resolution and a multimedia profile is associated to each device class. Based on the features of the latest mobile devices released on the market and the multimedia encoding technologies currently available, the paper also proposed encoding setting recommendations in terms of video resolution, video framerate, video codec, video bitrate and audio encoding. These recommendations can be used by educators, content creators or developers of mobile learning applications and services. As these recommendations cover multimedia profiles up to the 1920×1080p video resolution, they will remain applicable in the future even as more devices with high resolution displays will be released. An experimental case study involving 60 participants rating the quality of six types of educational multimedia clips on a table device, has confirmed the excellent level of user-perceive video quality provided by these recommendations.

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INSIDE, OUTSIDE, UPSIDE DOWN: NEW DIRECTIONS IN ONLINE TEACHING AND LEARNING

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ABSTRACT

Advancements in technology and innovations in education allow universities to entertain new ways of teaching and learning. Some views of what higher education should look like today include that it be easily accessed by anyone who wants to be educated, that it cost less than it currently does, and that there be a significant increase in student engagement, experience, and the quality of education. This paper presents quasi-experimental data of how various online tools and teaching strategies impact student learning outcomes, satisfaction and engagement. Specific variables impacting social presence, affect, *etc.*, where tested to determine their impact on different student outcomes such as grades, feelings of isolation, student engagement, and perceived authenticity of course materials. Findings suggest that, despite the literature, only some factors had a significant impact on student outcomes and that while some outcomes transferred well online, others did not; particularly, peer activities and participation in some course components were hindered online. Considered here are students' experiences with online learning, including hybrid and inverted courses, and teaching strategies that help meet challenges in different higher-education learning contexts.

KEYWORDS

Online Learning, Pedagogy, Active learning, Student Engagement, Social Presence, Learning Outcomes.

1. INTRODUCTION

Advancements in technology and innovations in education allow universities around the world to think up new ways of teaching and learning that can sometimes help instructors avoid limitations experienced in traditional models of education. Technology drives and enables a lot of the new and different methods of online teaching and innovation that we hear so much about in the media, amongst our colleagues, and across institutions. Some views of what higher education should look like today include that it be easily accessed by anyone who wants to be educated, that it cost less than it currently does, and that there be a significant increase in student engagement, experience, and the quality of education. Whether for online courses, hybrid courses, or some other learning context, many instructors are wary of using too much technology since it can be distracting and they worry that some educational technologies can take away from their teaching and students' learning experience. There is a good argument that one can use technology in ways that brings classes together; so for example, using technologies and devices that students are using anyways but embrace them in ways that create meaningful interactions rather than distractions, or using them in ways that empower both instructors and students, and engages them online or in and out of the classroom.

It seems obvious that online learning technologies help instructors innovative, but what's the evidence that online learning, or the tools and teaching methods facilitate learning? Presented here is *Part-Two* of a three part quasi-experiment that considers teaching strategies and educational technologies that push learning beyond boundaries often found in traditional teaching models. Boundaries considered here include social presence, affect, behaviour and cognition. *Part-One* of this research series, has been published elsewhere (Berry & Kushnir, 2013). Data in *Part-One* compared face-to-face and online teaching and learning; *Part-Two*, adds new data on teaching approaches, strategies and course/curriculum design that focus only on online teaching and learning.

In *Part-One*, half of the students completed an Introductory Psychology course in a traditional face-to-face setting while the other half completed the same course completely online (with the exception of term tests and the final exam to ensure academic integrity). In *Part-Two*, all students completed the same Introductory Psychology course entirely online (again with the exception of term tests and the final exam). Added here are the findings from the two additional quasi-experimental groups of online students. One of the two groups of students received 30-60 minute lecture videos as part of the online course materials, while the other group received the same lecture videos chunked into 5-15 minute lecture video segments with embedded quizzes that popped up during the short lecture clips. Specific variables impacting social presence, affect, *etc.*, where tested to determine their impact on student outcomes (*e.g.*, grades, feelings of isolation, student engagement, feeling like the course materials were authentic, *etc.*). Results show that, despite the literature, only some factors had a significant impact on student outcomes. This research series helps researchers, instructors and other education specialists understand factors that impact online teaching and learning. It also contributes to our understanding of how specific teaching strategies can impact online learning in different higher-ed contexts such as online, inverted, and hybrid courses.

2. LITERATURE REVIEW

Enrollment in online education continues to grow at a quicker pace than enrollments overall in higher-ed. As many universities and colleges struggle with issues of space, scheduling conflicts and budget cuts, some believe that online education offers cost effective alternatives to traditional classroom teaching. In 2010 the Sloan Consortium reported that online enrollments were up 17%, compared to 12% the previous year. In 2011, at least 33% of college students had participated in at least one online course and the majority of these students (over 82%) were undergraduates (Allen & Seaman, 2011; Parry, 2010; Salcedo, 2010).

Online courses can be convenient in higher-ed, mitigating constraints of time and space in traditional face-to-face courses, and allowing institutions to offer more courses and effectively meet the growing and changing needs of students (Gould, 2003; Macon, 2011). The literature is positive for the most part; some argue that it might be more cost effective for institutions to offer online courses since they often require less overhead than physical classrooms. Others argue that online courses expand the reach of the institution, potentially attracting international students and increasing revenue. Some consider online courses as a way of retaining undergraduates and ensuring that they graduate on time, while others see the benefits of allowing students to learn at their own pace, the flexibility around studying and working (either part-time or full-time), the related savings on commuting, of childcare, *etc*., (Lei & Govra, 2010; Macon, 2011; Salcedo, 2010; Wuensch, Aziz, Ozan, Kishore & Tabrizi, 2008).

Online learning is not always viewed positively. Some curriculum committees routinely question the academic rigor of online courses, express concern about academic integrity, and worry that academic rigor is often compromised to facilitate online delivery (Schoenfeld-Tacher, McConnell, & Graham, 2001). Before institutions invest in online courses, it is important that there be added value, a positive impact on student learning and engagement, and assurances that rigor and academic integrity are maintained.

Some authors argue that online courses increase the workload of faculty. According to Pallof and Pratt (2007), it can take 2 to 3 times more time to prepare and deliver the curriculum for online teaching compared to face-to-face teaching. Most of this time is due to the effort required to develop online materials (*e.g.*, record/edit lecture videos), manage and upload the resulting large files. Despite the extra work, over 30% of faculty report teaching online and this is reportedly increasing (Simson *et al.*, 2006).

Consistent with Means *et al.*, (2009), for this study, online learning is defined as learning that takes place partially or entirely over the internet. This definition excludes purely print-based correspondence education, broadcast television or radio, video conferencing, video cassettes, and standalone educational software programs that do not have a significant internet based instructional component.

2.1 Student Engagement and Interaction in Online Courses

While the literature is generally positive about online interactions, and some authors reporting high levels of student engagement and interaction (Schoenfeld-Tacher, McConnell, & Graham, 2001), classroom interactions and feelings of community are often the reported benefits of face-to-face courses (Homberg-Wright &Wright, 2012). When considering the types of interactions (*e.g.*, using Blooms Taxonomy), some report high-level interactions in online instruction compared to face-to-face instruction (Schoenfeld-Tacher *et* *al.*, 2001). Some students rate interactions online to be about the same as those face-to-face (Allen & Seaman, 2011), but students who prefer face-to-face classes, do so because they enjoy the classroom interactions (Daymont & Blau, 2008). Quality online courses must incorporate a substantial amount of varied interactions (Clark-Ibáñez & Scott 2008) and the level of interaction in online courses is often seen as a predictor of students' perceived learning (Rovai & Barnum, 2003).

2.2 Student Satisfaction and Social Presence in Online Courses

Student satisfaction in a course is often seen as an indicator of successful learning (Parkhurst *et al.*, 2008; York, 2008). The argument being that there is a relationship between student satisfaction and students' perception of the quality of their learning (Piccoli, Ahmad, & Ives, 2001). Substantial and timely interactions between the students and instructors can reflect high levels of student satisfaction, and this high level of satisfaction can also indicate that teaching methods strongly reflect learning goals and student expectations (Moore, 2005). However, the link between student satisfaction and student learning is not clear since students might report that they are more satisfied with a course that they perceive as being easy, fun, or less demanding; these attributes may not necessarily be linked to real measure of success. Macon (2011) reported that undergraduates tend to be more satisfied with face-to-face courses than with online courses, while York (2008) found that students were as satisfied with online course work as with face-to-face course work; Fillion *et al.*, (2007) also found online students to be more satisfied than face-to-face students. Despite these competing findings, it is reasonable to expect that in a classroom where successful learning is evident, then student satisfaction will be higher (Driscoll *et al.*, 2012).

Online students who are more satisfied with their learning experience and satisfied with their instructors have been found to have a greater sense of social presence in the course (Lyons, Reysen & Pierce, 2012; Richardson & Swan, 2003). There is lots of research that suggests that it is difficult to develop social presence online at a level that satisfies students. Instructors have to work hard at creating an online presence (Richardson & Swan, 2003; Salcedo, 2010).

2.3 Student Learning Outcomes in Online Courses

For the most part, when grades are considered, the literature reports no statistically significant differences in learning outcomes between online and face-to-face students; some authors report that online students slightly outperform their face-to-face peer in the same course (Beeckman *et al.*, 2008; Beyea *et al.*, 2008; Lim *et al.*, 2008; Parkhurst *et al.*, 2008; Salcedo, 2010). Few show significantly higher differences in learning outcomes for online students, and as mentioned above, academic integrity is often a serious concern (Schoenfeld-Tacher *et al.*, 2001). Some authors have found that online learning is at least as effective and robust as face-to-face learning (Brownstein *et al.*, 2008), providing the same level of instruction (Carter, Emerson, 2012; Driscoll *et al.*, 2010; Russell, 1999). In some cases, online instruction is reported to be less effective than face-to-face instruction (Urtel, 2008) with students having difficulty keeping up with the requirements of the course (Keramidas, 2012). Also, some authors report evidence that hybrid instruction (*i.e.*, combining online and face-to-face elements) has a greater advantage relative to purely face-to-face or purely online instruction (Means *et al.*, 2010).

3. RESEARCH RATIONALE

This study evaluated the impact of various teaching strategies and online tools (*e.g.*, the use of lecture videos, quizzes with rapid feedback, peer-to-peer activities, and online assignments) on the following factors:

1. Student engagement, interaction and feelings of isolation
2. Satisfaction of learning experience, social presence (and how well students felt they got to know the instructor), and authenticity of course materials
3. Student learning outcomes

We set out to investigate what are students' experiences online, if there are variables or teaching strategies that impact the factors listed above, and if certain strategies correlate to better outcomes.

4. DESIGN OF THE STUDY

4.1 Participants and Description of the Study

A total of 60 students enrolled in an introductory psychology course at an urban university participated in *Part-One* of this study. About half of those participants were enrolled in a face-to-face section (n=31; section 1, *Part-One*) and the other half in an online section (n=29; section 2, *Part-One*). The students were self-selected and chose in which section of the course they enrolled; they were only restricted from switching between sections after final date to register in the course (a date set by the University Registrar's Office). A total of 52 students participated in *Part-Two* of this research series. Similar to the first, about half of the participants were enrolled in one section (n=25, students received 30-60 minute lecture videos, and all course messages delivered using the text announcement tool in the institution's learning management system; section 1, *Part-Two*) and the other half of students were in the other section (n=27, students received 5-15 minute lecture clips with embedded videos, and course messages delivered via a video messaging tool to increase social presence; section 2, *Part-Two*). As was the case in *Part-One*, students were self-selected and only restricted from switching sections after the final registration date (though students in this second part of the study had no reason to move between sections since they were unaware of any explicit differences between the groups; as far as they were concerned there were just two online sections of the course available concurrently). Across all groups, there were no significant differences between first year university average, cumulative average, and high school entrance average. All online students received a "presence" video from the instructor as well as all of the lecture material online. Students came to class (physically) only 3 times to complete the requirements of the course (for two term tests and a final exam). The face-to-face group (section 1, *Part-One*) met for 3 hours, 2 times per week for lectures during a compressed summer semester of 6 weeks. A key component in the face-face section was peer activities, which were facilitated with student response system (clickers). This particular course component was replicated in the online groups by using online quizzes and a discussion board in the institution's learning management system. Initially, break out rooms in Adobe Connect were used to facilitate synchronous peer activities but this had to be abandoned due to a problem with the tool and therefore Adobe Connect was only used for synchronous online office hours. Students received the same course content and course components in all sections of the courses delivered by the same instructor (*i.e.,* Summer 2012 and Summer 2013).

Online student experience was assessed using a half-way checking in survey, while all students received an end-of-term survey and other learning outcome comparisons included 6 quizzes worth 10% of the final grade, 2 term tests each worth 20% of the final grade, a final exam worth 30%, an assignment worth 10%, peer activities and participation worth 10%, and overall final course grades for all groups were compared).

4.2 Analyses

Analysis of the data included independent *t*-Tests to measure any differences between final grades for the online and face-to-face students in *Part-One*, and between the two online groups in *Part-Two*. ANOVAs were calculated to measure any differences between all course grades across the four groups in both parts of the research series. Qualitative analyses of the open-ended survey questions included response frequencies of the survey questions across the groups and weighted word lists that were calculated and puzzled out into a word clouds that were generated from the students' text answers. The word clouds represented a summary of the text that students wrote in their open-ended answers. A user generated word cloud visualizes information that is related to a specific survey question and, in essence, it depicts visually, the frequency of specific topics that students write about in their answers. The importance (or frequency) of specific words is displayed using font size (as in the example below), font colour, or some other attribute (see Bateman *et al.,* 2008 for an overview of word/tag clouds).

5. RESULTS AND DISCUSSION

5.1 Student Engagement, Interaction and Feelings of Isolation

Class interactions and feelings of community are some of the reported benefits of face-to-face courses (Homberg-Wright &Wright, 2012) and in some cases, students who prefer the face-to-face classes do so because they like interacting with the instructor and their classmates (Daymont & Blau, 2008). This suggests that online environments should provide lots of opportunities for engagement and interaction. In our study, students were asked to indicate in which part of the course they felt most engaged; as indicated in Figure 1, students reported that the peer activities and the Science Meets Art project (a course assignment that was shared amongst classmates) provided the most engagement. The demonstration videos as well as the lecture podcasts also contributed to student engagement. Online students were also asked whether they wanted more interactions with their classmates, and if so, what sort of interactions they wanted. Interestingly, the request for face-to-face interactions and study groups came up frequently in students' responses (Figure 2). This provides support for a flipped or inverted classroom where the lectures and usual in class material are placed online for students to access outside of class, and where class time can be used for activities that would normally be done at home such as homework and assignments. This gives students and instructors the opportunity to have engaging, interactive sessions such as collaborative work and in-class activities that focus on higher level cognitive activities (Bull *et al.*, 2012; Brunsell & Horejsi, 2013; Milman, 2012).

Figure 1. What part of the course or course activities helped students to feel most engaged

Figure 2. Students indicated that they would have liked more interactions with classmates;
these are the sorts of interactions that they wanted to have (online students only)

When asked if they felt isolated, online students in section 2, *Part-Two* (the group with 5-15 minute lecture clips with embedded videos, and course messages delivered via a video messaging tool to increase social presence) reported the least isolation (see Figure 3). This suggests that these students feel more included and connected in the course compared to the other online groups who seem lonelier.

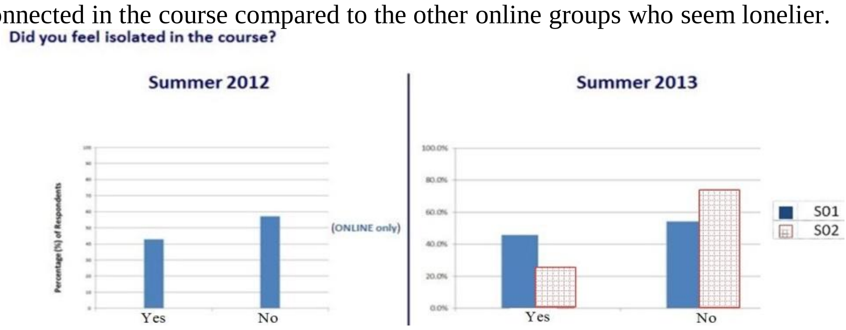

Figure 3. Online students' report of feeling isolated in the course

5.2 Student Satisfaction, Social Presence and Authenticity

We also asked students about what they found most satisfying about the course. Overwhelming, across all groups students reported being satisfied with their experience and their learning; figure 4 shows what students found most satisfying. As reported earlier, online students who are more satisfied with their learning experience and satisfied with their instructors have been found to have a greater sense of social presence in a course (Lyons *et al.*, 2012; Richardson & Swan, 2003) indicated here (in Figures 5 & 6) by how well they got know the instructor, and what course factors helped them feel like they knew the instructor (Figure 7). We also found that this had an impact on students' perceived authenticity of the course materials, and how real or artificial the course felt to students (Figure 8).

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Figure 4. What satisfied students most about the course

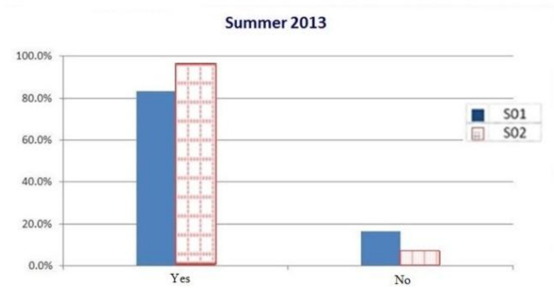

Figure 5. Students report of whether they felt like they got to know the instructor

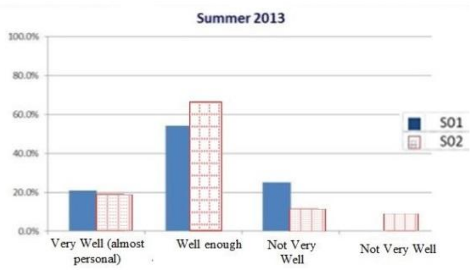

Figure 6. How well students felt like they got to know the instructor

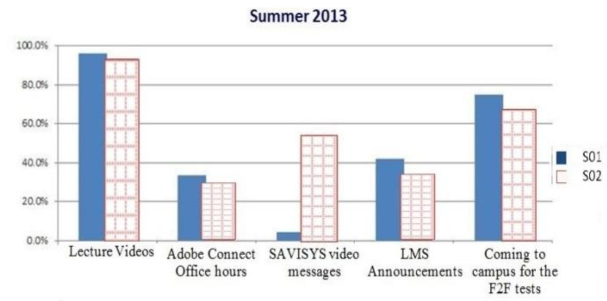

Figure 7. What aspects of the course made them feel like they got to know the instructor

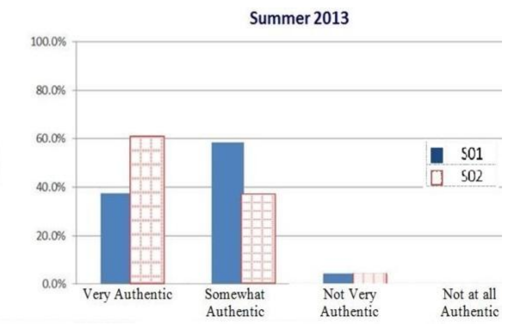

Figure 8. How authentic the course felt

5.3 Learning Outcomes

Students were asked what aspects of the course contributed most to their learning (Figure 9). While students reported that the interactive and active components contributed most to their learning, there were no significant differences between the groups on their grades for any of the course component (*i.e.*, 6 quizzes, 2 term tests, final exam, course assignment, peer activities, course participation, or final course grade).

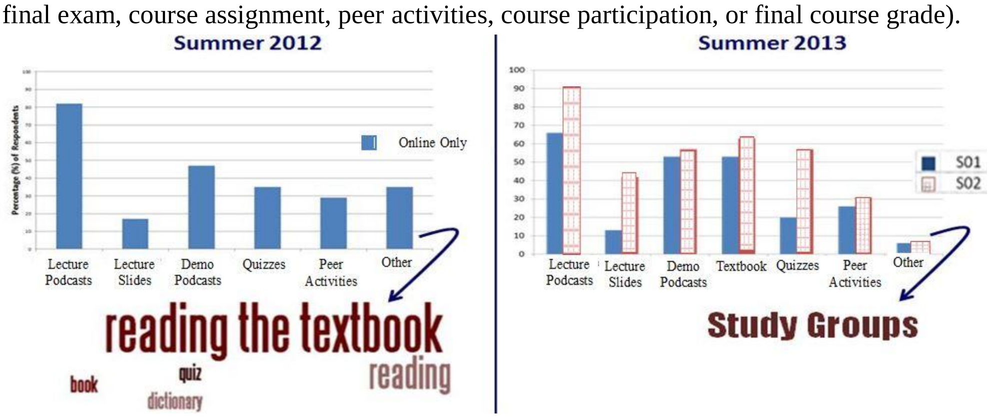

Figure 9. What students believed helped most in their learning

6. CONCLUSION AND RECOMMENDATIONS

We set out to evaluate the impact of various online tools and teaching strategies (podcasts, online assignments, quizzes, rapid feedback, discussions, and peer activities) on student learning outcomes engagement and satisfaction of their learning experience. We discovered that students had similar experiences across the different groups supporting the argument that online instruction can provide at least the same level of instruction and satisfaction as face instruction (Driscoll *et al.,* 2010; Russell, 1999). In our study, we discovered that the teaching strategies that we chose actually influenced the teaching tools, which in turn, had some influence on our strategies. This is important that online courses be built on sound pedagogical principles in order to facilitate meaningful and successful learning. We took the necessary steps to design the online course around our teaching and learning goals that supported instructional needs and student learning outcomes, and not around the teaching tools that happen to be available. As more and more university instructors look to educational media and technologies to help engage students and enrich learning environments in different learning contexts, it will be helpful if future research focuses on the use of different learning contexts and online innovations to facilitate different teaching and learning methods, both in and out of the classroom. Advancements in technology and innovations in education allow universities to think up new ways of teaching and learning. It is in understanding the pedagogy behind the technology that will get us further along in understanding how to best implement educational media and technologies to enrich these learning environments.

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A STUDY ON THE METHODS OF ASSESSMENT AND STRATEGY OF KNOWLEDGE SHARING IN COMPUTER COURSE

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ABSTRACT

With the advancement of information and communication technology, collaboration and knowledge sharing through technology is facilitated which enhances the learning process and improves the learning efficiency. The purpose of this paper is to review the methods of assessment and strategy of collaboration and knowledge sharing in a computer course, and find out how these approaches improve students' learning. The computer course is aimed at helping students to master knowledge, building their operational capability and equipping students with analytical skills in using and operating computers. While traditional evaluation model restrains students' learning interests and innovation, e-learning is introduced to support course delivery and enhance collaboration and knowledge sharing among students. Different assessment methods are discussed with respect to the impact of collaboration and knowledge sharing on students' learning. The assessment methods are carefully analysed and evaluated in order to find out how the collaboration and sharing of knowledge among students improves learning experience. Suggestions for improvement are made to increase the quality and quantity of collaboration and knowledge sharing in and beyond the classroom setting.

KEYWORDS

Knowledge sharing, assessment method, computer course.

1. INTRODUCTION

During the 21st century, the rapid development of Information and Communication Technology (ICT) has a strong impact on all walks of life all over the world (Weide, 2012). In Hong Kong, the wide adoption of ICT systems in both public and private sectors assures Hong Kong as one of the world's most advanced digital cities. In order to equip tertiary students with adequate skills in computer applications and increase their competitiveness in the job market, the study of information technology has probably become one of the compulsory modules in the curriculum offered at higher education institutions in Hong Kong.

Hong Kong Community College (HKCC) of the Hong Kong Polytechnic University (PolyU) is a self-financed post-secondary institution which offers Associate Degree (AD) and Higher Diploma (HD) programmes. HKCC offers IT course for all students to acquire basic computer knowledge. For instance, the course "Applied Computing" is a generic course for all year one students under the associate degree scheme in science and technology. The course objectives are outlining information technology and its applications, developing end-user computing skills and integrating end-user computing techniques into business applications. The course is aimed at helping students to master knowledge, building their operational capability and equipping students with analytical skills in using and operating computers. While traditional evaluation model restrains students' learning interests and innovation, e-learning is introduced to support course delivery and enhance collaboration and knowledge sharing among students.

In this paper, we are going to study the methods of assessment of the course "Applied Computing" and find out how students' engagement in collaboration and knowledge sharing can improve learning. Through analysing the methods of assessment, strategies for improving students' learning and classroom instruction will be formulated. This paper will start with a literature review of knowledge sharing and principle of assessment for learning. The methods of assessment of the course will be discussed, with a review of how knowledge sharing among students is conducted to improve learning and reach the purpose of Assessment for Learning (AfL) (Berry, 2008). Suggestions on increasing the quality and quantity of knowledge sharing in the course will be stated and some concluding remarks will be given at the end.

2. LITERATURE REVIEW

2.1 Knowledge Sharing

Knowledge sharing, in the meantime, is a core component of and a challenge issue for knowledge management. Knowledge sharing takes place when an individual provides information and know-how to help others and collaborate with others to solve problems, develop new ideas, or implement policies and procedures (Wang & Noe, 2010). Knowledge sharing can occur via face-to-face communications or written correspondence through networking with other experts, or documenting, organising and capturing knowledge for others. The term differs from knowledge transfer and knowledge exchange, where knowledge transfer refers to the movement of knowledge between the knowledge source and the recipient, and knowledge exchange includes both knowledge sharing and knowledge seeking.

Technologies are crucial to the sharing of information, which provide an efficient and automated means to track data over time, interact with others, post information, and share discoveries (Petrides & Nodine, 2003). With the advent of powerful and sophisticated hardware and software tools, the collection, storage, and distribution of knowledge can be better supported and easily performed with a few clicks. At the same time, it is important to look beyond technical capabilities and focus on other factors that influence knowledge sharing, for example, organisational context, interpersonal and team characteristics, cultural characteristics, individual characteristics, and motivational factors (Wang & Noe, 2010).

In the field of education, traditional education model is arranged such that teacher always acts as a repository and transmits knowledge to students in classrooms. The incorporation of state-of-the-art technology assures learning is moving towards practice-based, interactive-based learning. The latest Web 2.0 technologies offer platform for creating collaborative learning environments which foster meaningful learning (O'Reilly, 2007) and allow knowledge sharing on a globe scale (Tarik & Karim, 2011). Web 2.0 helps students not only in receiving information, but stimulates them in brainstorming, collaborating and learning through knowledge sharing. In higher education institutions, learning management system is sometimes adopted as a knowledge management system to elicit and support the sharing of knowledge among students. By means of an appropriate mix of e-learning and traditional classroom learning, blended learning extends the student learning continuum through the e-learning components and activities outside classroom (Lam et al., 2011; Lam, Hung, Chan, Yan, & Woo, 2011). By implementing Web 2.0 technologies and appropriate strategy of knowledge sharing, students' collaboration in and beyond the classroom setting can be enhanced and strengthened. As a consequence, learning is better supported in the new era.

2.2 Assessment for Learning

The concept of assessment for learning gives a general direction of where assessment should go. Ten assessment principles for assessment for learning have been developed, presented within the framework of Assessment of Learning (AoL), Assessment for Learning (AfL), and Assessment as Learning (AaL), as staed in Berry, 2008. The core features of AoL, AfL, and AaL are on product of learning, process for learning, and learner taking control respectively, which are closely related to learning in numerous ways. Teacher, students, and system can all contribute to making assessment effective. The ten guiding principles listed below will be of help when actions are being considered.

1. Aligning assessment to teaching and learning
2. Exploring the use of multidimensional assessment methods
3. Selecting those assessment methods which are susceptible to learning
4. Considering drawing on joint efforts among colleagues
5. Assessing students continuously throughout the learning processes
6. Allowing students to take part in the assessment process
7. Using assessment to uncover students' learning

8. Making marking criteria accessible for students
9. Providing feedback to facilitate students' learning
10. Analysing and reporting students' results

The fundamental principle of assessment for learning illustrates how assessment and learning are closely related. Assessment plans should be carefully designed to promote, induce and reinforce learning. Students are actively involved in their own learning, with the ability to assess themselves and understand how to improve. Teachers are responsible for monitoring the assessment results to give timely feedback and adjust teaching where appropriate. Within the parameters of assessment for learning, students' involvement in the assessment activities is taken seriously, as they are the key players of learning. Teaching, learning and assessment have to come together and work together if we are to raise students' standards of achievement and help students achieve deep learning (Berry, 2008). In the next section, the methods of assessment and strategy of collaboration and knowledge sharing are discussed and evaluated based on the abovementioned assessment principles.

3. THE METHODS OF ASSESSMENT AND STRATEGY OF KNOWLEDGE SHARING IN COMPUTER COURSE

The course "Applied Computing" is a generic course for all year one students under the associate degree scheme in science and technology. This year, around 900 students enrolled in the course and were placed in one of the nine classes being taught by five teachers. The course delivery was identical for all classes, with the same set of course materials and methods of assessment. The assessment components included two individual assignments, a group project, and an examination. Based on one of the classes of this course, this paper will examine the impact of collaboration and knowledge sharing on individual assignments and group project, and discuss how these methods of assessment help students improve learning.

3.1 Individual Assignments

The course included two individual assignments, i.e., a take-home programming assignment and an in-class practical exercise. For the programming assignment, students were asked to write computer programs in order to solve a given problem. For the practical exercise, students were asked to answer 15 multiple-choice questions during class. The course made use of an e-learning platform and an automated assessment system to construct a better learning environment for students (Berry, 2003).

3.1.1 e-Learning Platform

To engage students in the learning process, e-learning is adopted to improve their learning experience. An e-learning platform, which is a Moodle-based learning management system, is used for managing course materials and course activities. In this study, students were provided with lecture notes and reading materials in the course website. By making use of the assignment and quiz functions, both programming assignment and practical exercise were made available online. Students could make use of the discussion forum to post and discuss questions with teacher and other students. With the grading function, teacher could provide assessment feedback and grading to students easily, and monitor students' learning progress systematically. Other built-in functions of the e-learning platform, e.g., announcement, calendar, etc., were also applied in the course setting.

In the beginning, most students did not have much knowledge of writing computer programs and came up with lots of questions while working on the programming assignment. As such, students were encouraged to fully utilise the online discussion forum to post and discuss questions with other students. This helped students to share their knowledge with peers in different aspects, thus achieving active knowledge sharing among students. Besides, as students might have similar questions in mind, they could discuss their difficulties in the forum and work collaboratively to solve their problems. Teacher could monitor and guide the online discussion, as well as address their difficulties in class if needed. In brief, there were a number of advantages to use an e-learning platform (Slack, Beer, Armitt, & Green, 2003).

- *Efficient.* With e-learning platform, students can discuss problems or difficulties in the online forum which helps them to have more understanding on related topic through discussion and develop a habit of communicating with others through network. Thus, learning is no longer restricted to the classroom and contact hours, but knowledge sharing can occur anywhere and anytime. When students start discussion in the forum, teacher can monitor their discussion and offer guidance and timely feedback to facilitate their learning where appropriate. In this way, teacher can make sure students' learning is on the right track throughout the learning process, resulting in improved efficiency and effectiveness of learning. Teacher can also assess students' learning progress in a continuous manner and make necessary adjustment accordingly. That is, principle 5 and principle 9 of AfL are achieved.
- *Collaborative.* Students can learn from each other through discussion in the online forum. Students share their own knowledge and experience in the discussion. For programming exercise, one may come across different problems under different situations. Through discussion, highly capable students can help less capable ones in problem solving, and learn from their mistakes and have a deeper understanding of the topic simultaneously. This improves learning of all engaged students of the course and creates an inclusive learning environment.
- *Consistent.* Teacher can post announcement and make amendment on assignment conveniently and consistently via e-learning platform. For programming exercise, it is often necessary to make clarification and amendment from time to time. Meanwhile, assessment criteria can be posted and made accessible by students. This fulfills principle 8 of AfL. As a result, students understand clearly what is expected from the assessment task and are able to learn through assignment with clearer learning outcomes (Rust, Price, & O'Donovan, 2003).

3.1.2 Automated Assessment System

Computer technology can be used for assessment purposes at various levels ranging from management of assessment information to a fully automated assessment system. In this study, students submitted their programming assignment online where all submissions were marked by an automated assessment system. The assessment results were generated with statistical analysis for both students and teacher. With the automated assessment system, assessment information could be retrieved and presented in different ways to meet the needs of students, teachers, course organisers and external examiners. With the computer-based assessment, students' learning and knowledge sharing among students were improved and enhanced in the following ways.

- *Prompt Feedback and Report.* The computer-based assessment is programmed to provide assignment details to students, grade the submitted assignments, and return immediate results to corresponding students and teacher. In Hong Kong, students are result-oriented and urged to get assessment feedback within a few days. Through the computer-based assessment, students can get full report of the assessment within a short time period. For the programming assignment, teacher needs to test different cases during marking in order to reflect different errors in the programs. The computer-based assessment can provide correct answers immediately while identifying errors made by students. With the full marking report, students have a full picture of their performance and improvement can be made based on the feedback. This helps students to learn from their mistakes and achieve deeper learning ultimately. In general, an assignment alone is merely not enough or complete in the learning process. Without reflecting upon the assignment it may be forgotten quickly or its learning potential may be lost (Brady & Kennedy, 2005). As students may forget what they have done in an assignment after a period of time, a marking report provided promptly allows students to recall details of the assignment and learn from their mistakes more efficiently.
- *Adjust Teaching Strategy.* With automated assessment, assessment against each submission will be consistent, including scope, content, and presentation of the assessment report. It facilitates the setup of a comprehensive assessment. Teacher can further elaborate analysis of the assessment results and find out common mistakes made by students. Teaching strategies can be adjusted accordingly which improve students' learning and learning efficiency. Teacher can align learning outcomes with assessment in order to reinforce teaching and learning. Besides, teacher can upload more reference materials related to the assignment to enhance knowledge sharing of related topics with students.

3.2 Group Project

The course included one group project which students were asked to develop a webpage with a particular topic. Our analysis is based on how students learn through group work and the peer and self-assessment by means of computer technology.

3.2.1 Learn through Group Work

Group project is widely adopted as a teaching and learning activity. It provides useful information about students' understanding and knowledge of particular learning areas, their abilities to apply knowledge in particular investigations, and their abilities to communicate subject-specific information clearly (Chapman & King, 2005). Through this group project, students acquired understanding and technique by discussing with their group members. They shared knowledge, built up team spirit, and worked with each other to complete the group project enthusiastically. Teamwork is one of the key factors for knowledge sharing. With the ICT applications, group project supports students to learn more efficiently.

- *Independent Learning.* AfL is a source of motivation and a key element in the development of independent learner. For group project, students work in a team environment to discuss and set their learning goals and get a clear direction at first, which help them to understand the criteria clearly and answer the questions "Am I getting it?" and "How am I doing?" Besides, students need to search for reference materials to develop the project which helps them to learn a particular topic deeply and independently. As students need to apply the theory learnt in the project, this helps them to revise the course content. Technology is considered to be an important contribution since students can collaborate even without physical presence. In addition, technology can act as a facilitator to encourage and support knowledge sharing by making knowledge sharing easier and more effective (Riege, 2005). Team members can share their views and materials collected via e-learning platform which help them to perform their work more efficiently. Through the group work, students are trained to be active, independent learners whom take ownership of their learning.
- *Leadership.* Leadership development is also an important factor for knowledge sharing. Team leader facilitates knowledge sharing and engenders trust among group members which contribute to team effectiveness. Students working in a group need to build up team spirit and communicate with each other. Through discussion, each student takes turn to present their ideas and comment on others' work. The project can be sub-divided into several tasks such that each student leads one part of the project and works together for different parts of the project. Through the group work, students develop leadership skills and learn to work with each other to accomplish the group project.
- *Self-reflection and Peer Evaluation.* Group project can provide students with a valuable learning experience by combining talents of group members through contributing knowledge and ideas. Engagement and commitment are required to make the most of the contributions of all students. Self-reflection helps students to develop self-discipline and carry out self-evaluation, as well as identify strengths and seek assistance for overcoming weaknesses. Besides, peer assessment is not merely a means for awarding marks, but allows students to give valuable feedback to their group members to facilitate collaborative learning. It adds a valuable dimension to learning, i.e., the opportunity to talk, discuss, explain and challenge each other, which provides opportunities for students to evaluate and develop objectivity in making judgments about their own work and the work of others. In general, peer assessment helps students to develop self-regulation, which promotes independence in learning and assures students take some significant responsibility for setting their own project goals and evaluating progress against these goals (Nicol, 2010).

4. EVALUATION AND SUGGESTIONS FOR IMPROVEMENT

The methods of assessment of the course "Applied Computing" were designed to facilitate the sharing of knowledge among students and improve their learning experience. To evaluate the overall arrangement, interviews were conducted to obtain students' feedback and identify areas for improvement.

4.1 Results of Interviews with Students

In this study, semi-structured interviews were conducted with three students who studied this course. A set of questions were formulated to obtain students' feedback on assessment practices and how these assessments affect their learning experience.

The questions were classified into three categories, which included general questions, strengths and weaknesses of the methods of assessment. For general questions, we aimed at understanding students' general impression on knowledge sharing through e-learning platform. After that, some questions were prepared for collecting students' experience of strengths and weaknesses of the methods of assessment. Transcripts of the three interviews were consolidated and coded, which is shown in Table 1. Through analysing the interview transcripts and gathering research findings from similar studies, suggestions for improvement are summarised in the next section.

Table. 1. Coded Transcripts of the Semi-Structured Interviews

Category	**Transcripts**	**Coding**
General	"We can download course materials easily." (Henry) "We can get the notes whenever we want, and can reprint the notes easily." (Alvin) "The assessment criteria can be retrieved easily via e-learning platform." (Simon)	e-Learning helps students to manage their study with ease.
	"Discussion with classmates through e-learning platform helps us to better understand the assignment." (Henry) "Teacher responses to our questions quickly." (Simon)	e-Learning helps students to communicate with teacher and peers.
	"Teacher would clarify the uncertain points quickly via e-learning platform or address them during class, which helps a lot." (Simon) "More feedbacks are received through e-learning platform." (Alvin) "Students can improve their project after obtaining feedback from teacher and other students." (Henry)	Timely feedback is useful for improving students' learning.
Strengths	"Getting the assessment results of assignment timely helps us to better understand our learning." (Alvin)	Automated assessment system helps students to improve learning.
	"Group project helps us to learn how to work together and work out the solution as a team." (Henry)	Group work introduces another learning culture and practice and encourages collaboration.
	"Sometimes we can find out the solution through discussion." (Simon) "We acquire computer skills through project implementation." (Alvin)	Group work builds self-confidence and improves self-esteem.
	"With self-reflection, we know what we have learnt in a better sense." (Henry) "Peer evaluation in group project is important to reflect our contributions." (Simon)	Peer and self-assessment engages students in reflecting upon their learning process.

Weaknesses	"Some classmates may not join online discussion as they are not used to the e-learning mode." (Henry) "Teacher may not answer all questions in e-learning platform." (Alvin)	Participation in online discussion is not sufficient.
	"Sometimes we may not have enough support on the use of e-learning technology." (Henry)	Support on e-learning is to be strengthened.
	"Assessment results of assignment are expected to include more details." (Alvin)	Automated assessment is to be enhanced with more feedback.

4.2 Suggestions for Improvement

4.2.1 Promote Participation in Online Discussion via e-Learning Platform

The e-learning platform is adopted as a communication channel outside classroom. Students make use of the discussion forum to post and discuss questions with other students. However, it is found that some students are not aware or do not check the discussion forum regularly. To promote participation in online discussion, teacher can highlight some of the posts in discussion forum during class and encourage students to check for details via e-learning platform. In addition, the sharing of knowledge through online discussion can be included as a form of assessment activities, where such assessment criteria can be based on quality (content) and quantity (number of posts) of knowledge sharing.

4.2.2 Provide More Feedback on Automated Assessment

Automated assessment is efficient and time saving, while ensuring consistency in the comments. However, the reports generated by automated assessment system may not be sufficient for students to understand their performance and learn from their mistakes. Teacher can clarify the assessment criteria and provide more feedback on automated assessment during class. Besides, related reference materials can be shared with students via e-learning platform.

4.2.3 Implement Self-Assessment in Assessing Individual Assignments

Self-assessment allows students to become more engaged in their own learning by reflecting on the quality of their work (Taylor & Nolen, 2005). Practice quizzes and written assignments are both examples of self-assessment. Implementing self-assessment helps students to develop self-regulation and evaluate their learning progress. It encourages students to identify strengths and seek assistance for overcoming weaknesses. By allowing multiple attempts to practice quiz and/or written assignment followed by additional instruction, benchmark measures can be identified for students to measure progress (Mehta & Xavier, 2007/8).

5. CONCLUSION

This paper has reviewed the methods of assessment of a computer course with the incorporation of computer technology and strategy of collaboration and knowledge sharing. e-Learning platform provides a channel for online discussion among students which reinforces their learning and promotes collaborative learning. Automated assessment assures consistency in the comments such that students can receive prompt feedback. Group project allows students to work in a team environment to study the project requirement, research on the topic, discuss on the findings and accomplish the project. Peer and self-assessment engages students in reflecting their own learning process and evaluating the work of others. Throughout the course delivery, knowledge sharing is incorporated into assessment in order to improve students' learning and achieve deeper learning.

To promote and enhance knowledge sharing in the course, a number of suggestions have been stated. In general, the scope of knowledge sharing can be expanded from students of the same class to all students of the course, and to a wider community. With the latest Web 2.0 technologies and appropriate strategy of knowledge sharing, quality and quantity of knowledge sharing in and beyond the classroom setting can be significantly increased. In other words, learning can be better supported and active learners can be benefited in the new era.

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USING AGENT-BASED TECHNOLOGIES TO ENHANCE LEARNING IN EDUCATIONAL GAMES[1]

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ABSTRACT

Recent research has shown that educational games positively motivate learning. However, there is a little evidence that they can trigger learning to a large extent if the game-play is supported by additional activities. We aim to support educational games development with an Agent-Based Technology (ABT) by using intelligent pedagogical agents that can intervene to offer hints, assistance and suggestions when the learner is lacking knowledge, but does not intervene otherwise, so as not to interrupt game flow. In this paper we describe the possibilities of using pedagogical agents to infer learner's motivation and emotional state as they allow communication and interaction in a digital learning environment. Our approach emphasizes on improving pedagogical agent interactivity: from pedagogical agent techniques to *Tutor and Tutee* Agents' techniques to create a high social and collaborative Digital Educational Game (DEG) environment.

KEYWORDS

Educational games, motivation, emotional state, agent-based technology, tutor agent, tutee agent

1. INTRODUCTION

Recently, one direction of technology enhanced learning that has been attracting increased attention is the study of educational agents, which are human-like virtual characters that play specific educational roles in their interaction with students during learning. With this development we have deem it necessary to incorporate the agent-based technologies in educational games development in order to improve its' learning goals that they were originally meant for. Agent-based technologies can help students develop a positive relationship with the educational agent, and further enhance their motivation in terms of attention, relevance, and satisfaction.

There are two reasons for embracing agent-based technologies in educational games development. First, the educational agents are regarded as friendly interfaces that can facilitate interaction with students, leading to enhanced motivation and the perception of improved ease and comfort.

Such features can also be applied to benefit student learning so that they can become engaged in the learning environment (Gulz, 2005). Second, a number of advantages have been reported to learning with the support of different types of educational agents on specific aspects, such as exploration (Höök et al., 2000), reflection and articulation (Tholander et al., 1999), communication (Johnson et al., 2000), and negotiation (Bull, 2004). This might be because pedagogical agents can serve as learning companions offering virtual participation in a DEG. By doing so, students are encouraged to interact with the learning agent (Pedagogical Agent) in a social context and experience an enjoyable learning process, which, in turn, results in the aforementioned learning advantages.

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In this paper we further describe the relevance of adopting an agent-based technology in educational game development. First we provide some background on agent-based technologies in learning systems and related technologies in educational games. Next, we would give a brief overview of pedagogical agent intervention and we would discuss the features of improving single pedagogical agent techniques to Tutor and Tutee Agents' techniques, and they implementation in adaptive educational games.

2. AGENT-BASED TECHNOLOGIES IN LEARNING SYSTEMS

When we talk about agent-based technologies in learning system we are referring to educational agents. Educational agents are human-like computer simulated characters that are designed to improve student learning in an individual environment through virtual participants (Chou, Chan, & Lin, 2003). In recent time educational agents have tremendously make valuable remarks in cognitive and affective aspects in digital learning environment. This is because the influence of the educational agents on student learning can be expanded by taking the affective qualities of the virtual character into account in the design (de Vicente & Pain, 2002).

Educational agents are good tools worth considering when designing a learning system. They are tools that exist with external goals, there are easy to use, in order to influence the user's external goal. For example some good educational games are difficult to play, as a result of increased challenges provided to the player. Whereas typical interactive systems like educational agents, system build for human learning should be easy to use. The external goal is for the user to learn how to perform a given task, so the system should make the process of learning how to accomplish that task easy — the process of learning the task, not the task (E. Sklar 2003).

Current developments on Intelligent Tutoring Systems (ITS) also consider a co-operative approach between the learner and the system. Many research groups created environment-using simulation where the teaching-learning process is simulated by a set of agents in order to have interaction among them and allow us to observe the dynamics changes that occur during the interaction process. One example is presented by Moussalle (Moussale 1996), where all the agents must be opened to change strategies and believes/knowledge about how to solve problems.

One major significant about agent-based technologies in a learning system is that it brings about social learning environment which mean collaborative work. Mitssuru said: one of the major educational significance of the collaborative learning is to enhance the participant's motivation to awaken mature reflections on their own understanding and externalize the result of it (Mitssuru 1997). This kind of environment can be created when one or more agents are simulated in the computer: Tutor and Tutee. As a tutor the agent intervene by giving hind, the right solution at the appropriate time etc. And the Tutee Agent provides collaboration support and tries to test the student's self-confidence and his knowledge.

3. ADOPTING AGENT-BASED TECHNOLOGIES IN EDUCATIONAL GAMES

3.1 Pedagogical Agents in Educational Games

Pedagogical agents in educational games facilitate the pedagogical assignment task in a learning session context. The idea of an agent-based approach is to represent the pedagogical knowledges and its use in a tutoring context. The fundamental reason for adopting agent-based technologies in educational games as a tutoring knowledge element is their capabilities of communicating and interacting.

According to Vassileva (Vassileva 1997), an agent must act in a world populated by other agents, because many agent's goals require the help of another agent. In this way, relationships among agents can be viewed as another kind of resources for achieving goals in a game playing environment.

3.2 Pedagogical Agents' Intervention

In the context of educational games, using pedagogical agent all forms of adaptive intervention provided by Pedagogical agent is summarized as either cognitive or motivational (Ofut and Shabalina 2013b).

Cognitive interventions. Pedagogical agents could posses some cognitive intervention functionalities to strive to enhance cognitive abilities and support the learner based on his/her user model. A number of subtypes of this type of intervention are distinguished below:

- competence activation interventions, when a learner is stuck in a certain task because results led to the assumption that the learner possesses the necessary Skills, the temporary inactive skills could be reactivated. E.g. the agent can hint the learner "we have come across this issue already before";
- competence acquisition interventions, when the agent concludes that the learner lacks certain skills, the agent could provide the necessary information;
- problem solving support, this intervention consists of providing support in an ongoing problem solving process via hints and indications that bring the learner closer to the solution;
- progress feedback. In this intervention the agent provides the learner with information about learning progress of the game (through NPC or scoring mechanisms). This fosters monitoring and reflection on the learner's own performance;

Motivational Interventions. Pedagogical agents could also possess some motivational interventions striving to enhance and retain the learner's motivation and engagement on a high level. A number of subtypes of this type of intervention are distinguished below:

- praising interventions consists of congratulating the learner after successfully completing a game level, the learner is awarded a certain scores;
- encouraging interventions could be applied in case of failure. To promote further attempts to find the solution, the learner is encouraged to try again by the agent;
- incitation intervention is to foster motivation by announcing pleasing outcomes as rewards;
- affective interventions foster emotional-affective aspects of the game and social interaction with other game characters;
- attention-catchers, if the agent detects a decreasing attention through interpretation of the learner's actions, it could introduce unexpected changes or incidents to increase variability and keep the game interesting.

4. USING PEDAGOGICAL AGENT TO INFER LEANER'S MOTIVATION AND EMOTIONAL STATE

4.1 Pedagogical Agent as Motivational-Oriented System

Motivating students is a major issue for current ITS (Qu 2005). Modern theories of motivation such as Self Deterministic Theories (Reeve 2004) have shown the positive motivational impact of autonomy-support. Autonomy-support as a way of enhancing motivation is one of the major points of the Self Determination Theory (Reeve 2004) among others. It is on that note that we support the introduction of pedagogical agents in educational games to create motivations by acting as an autonomy-support tool for learning. One of the methods used by agents to provide autonomy is by encouraging the learner to make choices during game play activity. Alternatively, any action which controls or restrains the learner's behaviors has a negative impact on him/her sense of autonomy, which results in lowering his/her motivation to persist in the activity.

"*Students with autonomy-supportive teachers compared to student with relatively controlling teachers, show greater mastery motivation, perceived competence and intrinsic motivation, greater conceptual understanding, higher academic performance, and greater persistence in school*" (Reeve 2004).

Pedagogical agent in educational games with increasing teaching autonomy support results in an enhancement of Learners' engagement in a learning task.

4.2 Pedagogical Agent as an Emotional-Oriented System

Emotion is an important aspect of human intelligence that should be considered while designing pedagogical agents in educational games, because it plays a very important role in the human teaching and learning process. According to Scherer (Scherer 2000), emotion is the relatively brief episode on synchronized responses for most or all organic systems for the evaluation of an external or internal event as being of major significance.

Pedagogical agents with emotional intelligence possess abilities such as: recognizing the current emotional state of the learner and addressing it, provide intelligent interactive learning environment, and can also create a more personalized and friendly environment for learning.

In our work (Ofut and Shabalina 2013b) we have strongly argued that the inclusion of emotional features in pedagogical agents is with high importance for improving the level of interaction in man machine communication system.

5. IMPROVING PEDAGOGICAL AGENT INTERACTIVITY: FROM PEDAGOGICAL AGENT TECHNIQUES TO TUTOR AND TUTEE AGENTS' TECHNIQUES

We have decided to improve pedagogical agent interactivity techniques by introducing two types of pedagogical agents: Tutor and Tutee Agents to create a high social and collaborative atmosphere in a DEG environment.

The Tutor Agent (TrA) primary function is to interact directly with a learner and explicitly guide him/her through the domain. These pedagogical agents are applicable in teaching components and user interfaces. They encourage the learner by providing feedback within the learning environment.

The Tutee Agent (TeA) is an agent that serves as a peer-mediated learning agent. This type of agent is positioned in the user interface to act as interactive partners in a learning process. One of the major objectives of this agent is to provide collaboration with each other in a game play environment.

We are of the opinion that the absence of learner's companion agent and lack of social interaction in the games give rooms for low motivation and poor emotions. That is why we have decided to diversify the functionality of a Pedagogical agent by introducing a Sub-agent (TeA) as a learner's companion (Ofut and Shabalina 2013a).

6. IMPLEMENTATION OF AGENT-BASED TECHNOLOGY IN ADAPTIVE EDUCATIONAL GAME

In this session we discuss the implementation process of Tutor and Tutee agents in an Adaptive Educational Game. The Goal of the Game is to make the learning of programming as simple as possible by not just using a pedagogical agent as an instructor, but also by introducing a learner's companion agent to serve as a peer to the learner to improve interactivity.

Responsibilities/characteristics of TrA

1. Introducing the learning task at the beginning of the a game level
2. Providing coaching instructions to learner by communicating verbally and none verbally.
3. Providing assistance to learner when the learner is slow to act or repeatedly unable to get a task right.
4. The TrA would motivate the learner by appraisal, when he/she is doing well.
5. The TrA would express emotions when the learner fails a particular task by calling the learner by name and encouraging him/her to try again.
6. TrA provides progress feedback intervention to the learner with information about learning progress of the game (through NPC or scoring mechanisms). This fosters monitoring and reflection on the learner's own performance.

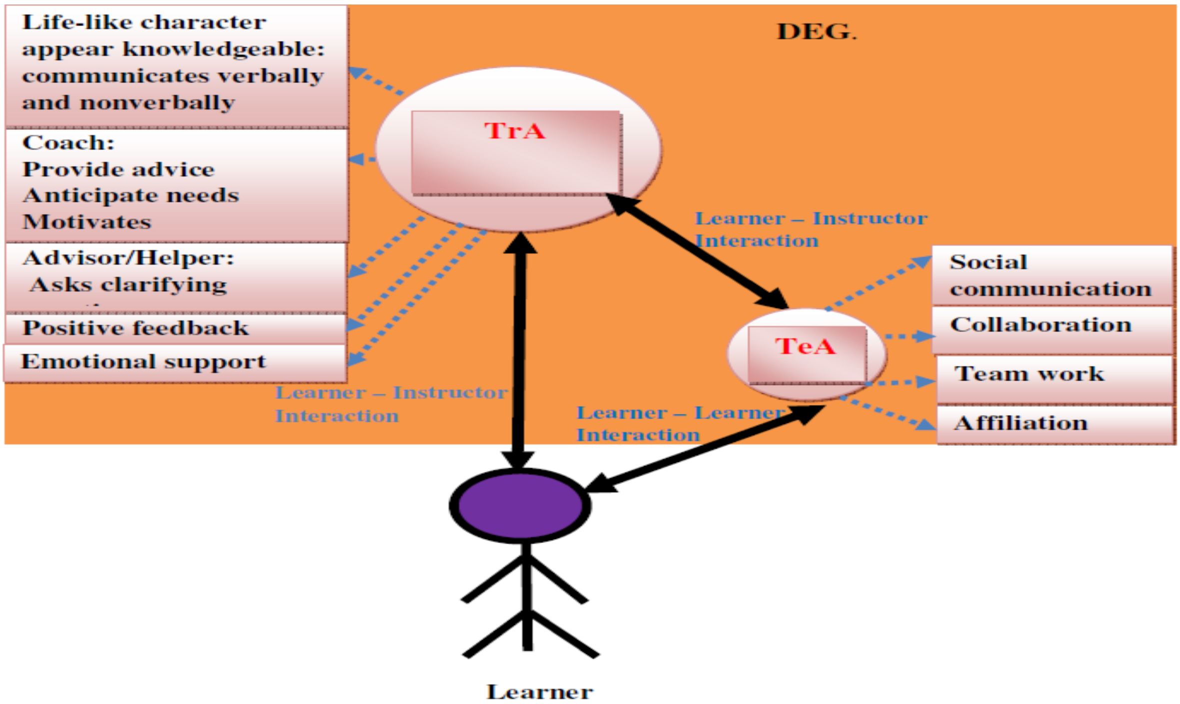

Figure 1. DEG interactivity with Tutor and Tutee Agents

Responsibilities/ characteristics of TeA

1. TeA provides problem solving support in an ongoing problem solving process via hints and indications that bring the learner closer to the solution.
2. TeA Provides solution to a task which the learner could not complete within a reasonable number of actions/time. These ensure the game flow continuity.
3. If the learner is presented with an unclear or ambiguous task the TeA can be contacted for clarity.
4. The TeA can attempt to provoke the learner's reflections about his/her own abilities, thinking process and confidence
5. The TeA can also congratulate his co-learner in the case of success to motivate him/her
6. The TeA could encourage the learner in case of failure. To promote further attempt to find solution.

The Game's Interface: The Java Pyramid Game is a one player game and the task of the player is to demolish the pyramid completely at every game level.

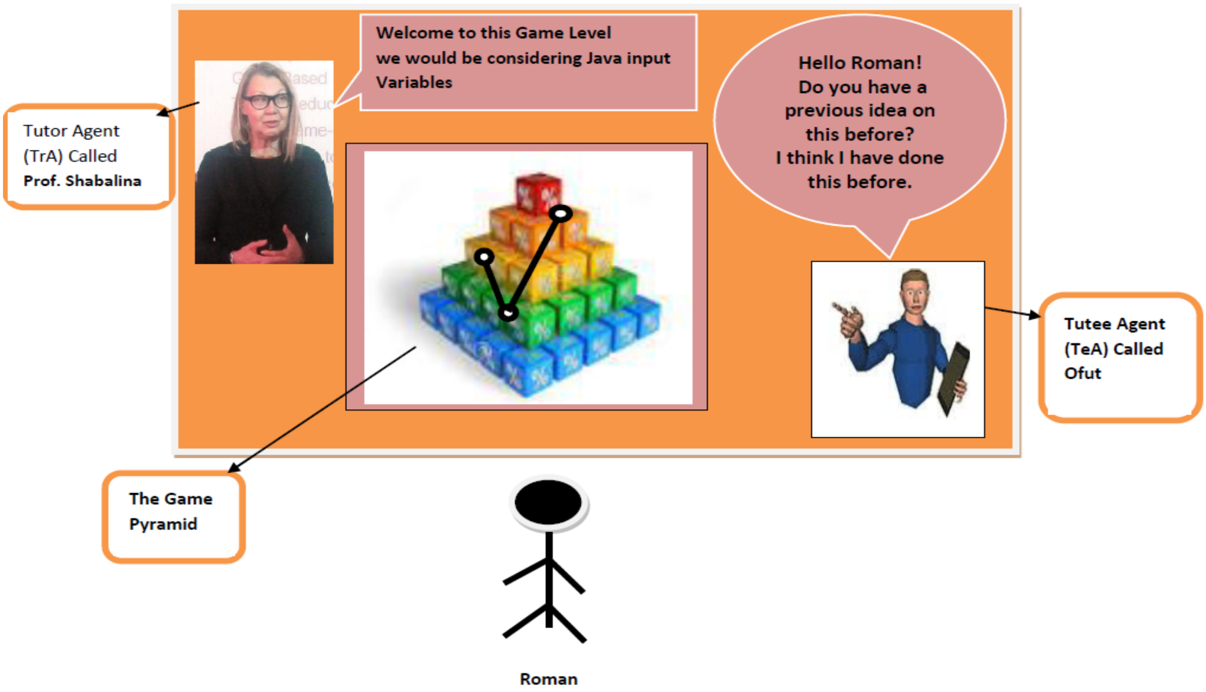

Figure 2. Java Pyramid game interface showing Tutor and Tutee Agents interactive approaches.

In the first instance the player is welcomed by the Tutor Agent and required to enter his/her name. This would enable both the Tutor and Tutee Agents to refer to the player by his/her name.

The Tutor Agent can now call the player by his/her name and introduce the Tutee Agent to the player.

The interactivity level of the game at all level is high as both the TrA and TeA communicate with the learner based on his/her action during game play. The interaction is modeled in such a way that the emotion and motivation is boosted at every point of intervention by both agents. The social interaction between the agent and learner is either in verbal (Voice) or non verbal (dialog box) form.

The TeA knowledge is modeled to have a better understanding of every task in all the game level in order to mentor the learner as well as provide collaboration support. The TrA interacts directly by coaching the learner throughout the game play.

7. CONCLUSION AND FUTURE WORKS

This paper presents the relevance of Pedagogical agent's technology as an approach in enhancing the interactive learning in a game based environment. We have compromised a lot in the pedagogical agent strategies and we stick to two, which are agent collaboration strategy and learner's companion/peer agent. Both the collaboration strategy and learner's companion are being influenced by the Tutee Agent (TeA) in the game environment. The idea is that we are taking advantage of the social interactions between the learner and the TeA to improve the game interactivity. Currently we are designing a game prototype to demonstrate the effectiveness of our approach.

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DESIGNING A CULTURALLY SENSITIVE WIKI SPACE FOR DEVELOPING CHINESE STUDENTS' MEDIA LITERACY

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ABSTRACT

Due to technological development and intensification of integration processes all over the world, people from different cultural backgrounds have more opportunities to maintain academic and professional cooperation. To make this cooperation more effective, it is important to take into consideration diverse ethnic values and their influence on interaction. That is why many researchers focus on the issues that arise when there is a need to use modern web technologies in a multinational context. This paper addresses the problem of providing education to Chinese students in a foreign country by means of wikis.

KEYWORDS

Wiki; culturally sensitive; collaborative learning.

1. INTRODUCTION

Web 2.0 has become an integral part of our daily lives and a focus of interest of numerous researchers but it seems that it still has an undiscovered pool of opportunities in the educational sphere. Numerous researchers discuss issues arising in connection with wikis in education; some of them touch upon cultural challenges posed by Web 2.0-based instruction; but few offer culturally sensitive educational models with wikis involved.

The present paper describes an experiment designed to prove that wikis can be an effective instrument for developing Chinese students' media literacy by means of creating a culturally sensitive learning environment for them.

The aim of the educational experiment was to improve media skills of Chinese students who major in English Literature and Philology which was achieved through the following steps: 1) to draw up a "cultural portrait" of Chinese students and determine the effects of the cultural features on students' performance; 2) to define the structure and content of media literacy and principles of its formation as a part of the professional competence of a philologist; 3) to work out the selection criteria for mass media texts as well as the principles of organizing instructional materials with Chinese students' cultural characteristics in mind; 4) to design exercises for the culturally sensitive learning environment and check their effectiveness.

It was hypothesized that teaching media literacy to Chinese students with wikis involved could be effective if 1) it is based on the analysis of cultural characteristics of students; 2) the formation of media literacy includes the following components: a) media critical skills, b) media communicative skills, c) technological skills, d) media interactive skills; 3) it is based on the principles of developing media literacy as a part of the professional competence of a philologist.

The following research methods were used: 1) analysis of academic literature; 2) analysis of regulatory documents; 3) analysis of course books for developing media skills; 4) observations of Chinese students' learning process; 5) questionnaires and tests; 6) quantified analysis of data; 7) experimentation.

2. CHINESE CULTURAL CHARACTERISTICS

The cultural portrait of Chinese students was formed on the basis of the previous research in this sphere and our experience of teaching Chinese students (Flowerdew, 1998; Lixin, 2006; Zhao and McDougall, 2008; Jiang, 2008; Zhu et al., 2009; Chou and Chen, 2010; Parrish and Linder-VanBerschot, 2010; Earl and Cong, 2011; Qian and Tian, 2013; Wang, 2013).

1. Students' attitude to teachers. The image of a strict but fair teacher dominates the Chinese classroom. Chinese students are supposed to show enormous respect to teachers and rely heavily on them as a source of knowledge, guidance, and self-esteem. It means that the same image of power and care should dominate the online learning environment where Chinese students need clear instructions, teacher's assistance, and reasonable and immediate feedback.

2. Students' attitude to each other. Chinese students' relationship within the classroom can be described as harmonious, cooperative, conflict-free. They care not only about saving their own face but also about the reputation of their group mates avoiding criticizing each other or showing off too much. It means that an online discussion between them may never start and wiki pages meant for peer reviewing will stay blank or contain a few positive remarks.

3. Students' learning style. The learning style of Chinese students may be characterized as needs for precedent, visualization, and time. That is to say, they succeed in completing a task when they have clear instructions and patterns to follow, acquire knowledge better with the help of visual cues, and have long term orientation, which means they prefer to get deeper knowledge and understanding of the subject without tight time constraints.

4. Students' attitude to new technologies in education. Although Chinese students are always well-informed about the latest news in high-tech world, and they are good at using devices and applications, one should not expect that they will not have any problems when it comes to mastering some Internet tool. Moreover, many Chinese students are wary of online studies because they tend to consider distance education or any elements of it to be second-rate. That is why the implementation of any devices, applications or Internet tools would be highly appreciated by Chinese students if a teacher explains all the goals and real benefits of this procedure.

Overall, the aforementioned features form a type of learner behaviour that can be described as the combination of industriousness and lack of creative learner autonomy, empathy and oversensitivity to criticism, ability to co-operate and fear of failure, interest to new technologies and concern about the quality of education these technologies can provide, accompanied by cogitative needs for clear instructions, visualization, and time. These characteristics should be taken into consideration as they may pose challenges and open prospects.

3. MEDIA LITERACY

At the Faculty of Philology of our University, Chinese students majoring in English Literature and Philology are offered a course in reading, watching, and discussing news in English. Thus, teaching this course implies development of students' media literacy within their professional philological competence. While doing the course, they find it quite difficult and demotivating which can be attributed to the design of the course itself, the lack of English language proficiency, the lack of media literacy (which is explained by the fact that media education is still at its initial stage in China), and the influence of the cultural peculiarities described above (Liao, 2008; Wan and Gut, 2008; Tan, 2012; Xu, 2013). The list of the problems Chinese students face when reading analytical reviews and features or watching talk shows and discussing them includes: 1) inability to spot key points of the text they read or watch; 2) learning texts by heart instead of summarizing the information; 4) inability to give their own opinions and develop argumentation; 3) lack of knowledge about cultural realias of English-speaking countries; 4) lack of active and passive vocabulary; 5) lack of contextual deduction; 6) lack of understanding complex grammar structures; 7) low (mostly extrinsic) motivation.

The challenges mentioned above led to the idea of creating a model for developing Chinese students' media literacy with the help of a culturally sensitive wiki space in order to increase their motivation, improve their performance, and foster their learner autonomy, creativity, and activeness not only in the classroom but also in the online environment.

According to the model of developing media literacy within their professional philological competence, Chinese students have the following skills to acquire:

1) media critical skills (analytical skills enabling students to find key content elements of mass media texts, such as topic, problem, facts, main idea in analytical articles and episodes of talk shows; and elements of users' comments, such as position, examples, and informative value);

2) media communicative skills (communicative skills including reading and listening to mass media texts in English, expressing and discussing opinions about mass media texts in English, both orally and in the written form);

3) technological skills contains (technological skills including collaborative doing of tasks, editing of wiki pages, creating wiki pages, participating in wiki discussions, communicating with other students and the teacher);

4) media interactive skills (interactive skills implying organizing a simulation in the form of a TV talk show where participants discuss socially important issues);

The development of media literacy shall be based on the principles of the integration of media education and professional education. Thus, we followed the principles of the integration of media education and English language learning: 1) the principle of complementary development of media literacy and communicative competence in English; 2) the principle of considering cultural characteristics; 3) the principle of critical thinking development; 4) the principle of developing skills necessary for the usage of mass communication tools; 5) the principle of the practical usage of skills (Masterman and Mariet, 1994; Sefton-Green, 2000; Bean, 2001; Hartley, 2002; Buckingham, 2003; Branston, 2006).

The principle of complementary development of media literacy and communicative competence in English implies the priority of the communicative component within the media literacy of Chinese students and the usage of English mass media texts for the development of their communicative skills in English.

The principle of considering cultural characteristics presupposes that students might demonstrate certain strengths and weaknesses when trying to acquire media literacy skills due to their cultural background. Thus, the educational process must be organized in such a way that turns off any challenges caused by cultural characteristics of students.

The principle of critical thinking development means that students must be taught to analyse important social problems presented in mass media texts and formulate and maintain their own opinions.

The principle of developing skills necessary for the usage of mass communication tools states that every media literate person should be able to use diverse mass communication tools for storing, processing, producing, and exchanging information including mass media texts.

The principle of the practical usage of skills means that all those media critical, media communicative and technological skills that students acquire must be used in practice, i.e. for organizing projects, case studies, simulations and other types of interactive activities that imitate diverse kinds of professional communication.

The application of the principles mentioned above enables a teacher to make the most of mass media texts in English chosen for developing media literacy skills, however, the classroom time is not enough for improving all the media literacy skills. Hence, there is a necessity of organizing students' extracurricular time with the help of a mass communication tool that could be also used as a means of developing students' technological skills and would enable a teacher to create culturally sensitive tasks.

4. WIKIS

As well as other similar Web 2.0 tools, wikis are perfectly fit for collaborative learning rooted in the theory of constructivism (Paloff and Pratt, 2005; Parker and Chao, 2007; Sandifier, 2011). However, to create a culturally sensitive online learning environment it is important to take into consideration all the four parameters characterizing Chinese students that were described above: 1) students' attitude to teachers; 2) students' attitude to each other; 3) students' learning style; 4) students' attitude to new technologies in education.

Firstly, Chinese students need to feel the teacher's presence in the wiki: in the same way as a teacher dominates the classroom in China, he or she should dominate the wiki providing clear and consistent guidelines, providing timely consultations through wiki mail or other instruments available in the wiki, checking, correcting or commenting on homework, setting deadlines and giving marks.

Secondly, wikis are an ideal place for a harmonious, cooperative, and conflict-free learning that Chinese students strive for. It is easier to save face online because students have time to think, and wikis provide an opportunity to work a) in groups or b) individually but in collaboration (which means each student does some part of a common task and bears responsibility for his or her part individually): when students share a task, they have less psychological pressure because they either bear responsibility as a group (not individually) or at least get their peers' assistance when working individually.

Thirdly, wikis suit Chinese students' learning style as they meet their needs for precedent, visualization, and time. All these needs can be easily satisfied in the wiki space which presupposes the use of visual content and asynchronous communication, which make Chinese students feel more comfortable than in face-to-face communication in the traditional classroom when they have to rely more on verbal perception and produce answers immediately. Both of these wiki features complemented by clear organization of learning activities and well-formulated tasks can make wikis a smart addition to face-to-face studies.

Fourthly, the usage of wikis in the educational process can be motivating for students if a teacher explains how to use the wiki space and the main goals of using this tool.

5. CULTURALLY SENSITIVE WIKI ACTIVITIES

For the purpose of designing culturally sensitive wiki activities the following selection criteria for mass media texts were used: 1) compliance with communicative and general cultural competencies of Chinese students; 2) being in accordance with ethical norms; 3) diversity of themes and formats (printed media, audio, video, illustrations); 4) analytical texts containing not only information but also authors' opinions; 5) authenticity; 6) informative value.

The principles of organization of instructional materials included the principle of thematic organization and the principle of considering cultural characteristics of students.

According to the principle of thematic organization the instructional materials were grouped into nine units with articles on the following topics: Sport (Health, Olympics), Culture (Social Networks, Problems of Education), Science and Technology (Achievements, Ecology), Business (Products of Big Companies, Employment). Each unit also contained comments on different media critical topics to develop students' media critical skills: Types of Mass Media Texts, Headlines, Structure of Article/Video, Key Elements of Article/Video (topic, problem, facts, idea), Summary of Article/Video, Key Elements of Comment (position, example, informative value), Opinion about Article/Video, Participation in Discussion.

According to the principle of considering cultural characteristics of students, tasks were divided into two groups (wiki activities and in-class activities) with Chinese students' learning style in mind. For example, listening activities were presented as wiki tasks for homework because Chinese students are used to rely heavily on visual materials in their educational system and, as a result, their listening skills need considerable improvement, so it is much easier for them to save face when they do listening tasks at home in the wiki where every student may watch a video in the task as many times as necessary.

Using the principles mentioned above, we have designed a set of activities for wiki and in-class studies. While learning activities in the wiki space were considered to be the preliminary and closing stages for in-class studies including vocabulary work, information search (realias), revision of media critical theoretical comments, listening and writing practice, acquisition of technological skills, in the classroom students mainly learnt theory, studied articles and did normal pre-reading, reading, and post-reading activities, which also included lexical and grammar exercises as well as speaking activities (reports and discussions).

In order to develop media literacy, the wiki site named Wikispaces was chosen (http://www.wikispaces.com) and used to create a wiki space. The wiki space had the following structure: 1) home page (contained teacher's announcements about new home tasks posted in the wiki space); 2) thematic pages (contained tasks for collaborative learning); 3) checklist (contained an assessment chart with students' marks).

As soon as students got a notification via wiki mail, they opened the home page of their wiki space and went via the most recent link to a thematic page. The theme of a page depended on the issues discussed in articles chosen for an upcoming class. Each thematic page contained links for downloading handouts for upcoming classes and the set of activities for individual work and work in mini-groups depending on the difficulty of an activity. The wiki and in-class activities are described below:

1. Wiki activities:

1) Illustration (warm-up activity for mini-groups, done before an upcoming class). Students were asked to think in mini-groups of a picture posted on a thematic page, and explain its irony as well as use it to predict key topics and problems touched upon in mass media texts chosen for in-class studies.

2) Vocabulary and Realias (vocabulary activity for individuals, done before an upcoming class). The activity was done individually but in collaboration with each other. The teacher created a list of theme-based expressions and realias (culture-specific information) derived from articles (chosen for an upcoming class) and a video (posted on the same thematic page). Students were to translate expressions into Chinese and provide Chinese definitions for realias. The list was divided into portions and shared by students so each student did not have to do the whole list but a small part of it and had to post translations and definitions on the thematic page before a specified time in order for other students to see his or her portion of work and, consequently, see other students' posts. As a result, students did the vocabulary work in collaboration which facilitated their homework and in-class studies, and implied joint responsibility. After the specified time, the teacher checked the posts, did corrections, and put the marks into the assessment chart immediately, so students could get the immediate feedback on the same day. In the classroom, students could check the list of expressions and realias, when necessary, getting the access to the wiki space via smartphones and tablets.

3) Drills (vocabulary activity for individuals, done before an upcoming class). Again the task was done individually. The teacher posted a number of exercises created on the basis of the vocabulary list (gap-filling, matching, multiple choice, odd one out, rephrasing, etc.) on a thematic page. Each student got some kind of exercise which included a part of the vocabulary done by other students and he/she had to post the answers on the page before a specified time for the teacher to check, do necessary corrections, and put a mark into the assessment chart.

4) Video (listening activity for mini-groups, done before an upcoming class). Not all the students were equally good at listening, so they were divided into mini-groups for doing this exercise. The task was chosen for wiki work because in the classroom students usually did not have enough time to watch a video as many times as they needed. Watching and listening were facilitated by the previous vocabulary work in the wiki space. Students were to use a link on the thematic page to go to Youtube or any other site with video content and watch a short video thematically connected with all the previous tasks and the articles for in-class work. Afterwards, students were offered to post answers to questions about the content of the video or do a true-false exercise on the thematic page. The homework was checked and assessed by the teacher.

5) Link to China (speaking activity for individuals, done before an upcoming class). Students were offered a few questions in connection with the theme of the page and the upcoming class. The main idea of the task was to make students think of the issues in question in connection with their own country: if a situation which takes place in some English-speaking country is the same in China or not, and why. So, students had enough time to think and look for the relevant information, if necessary, before discussing it in the classroom.

6) Theory Revision and Writing (writing activity for mini-groups, done after a class). In the classroom, students got media critical theoretical knowledge and practical skills but in the wiki space they were to do the revision of the material. Depending on the material students studied in the classroom, they were asked either to formulate a problem using prompts, match problems and facts, read a given comment for a mass media text and define the commenter's position, write one's own comment in response to a given comment and so on. The homework was checked and assessed by the teacher.

7) Wiki skills (set of instructions for students to learn how to use wiki instruments).

2. In-class activities:

1) Illustration (warm-up activity for mini-groups, done at the beginning of a class). This exercise was a counterpart of the first activity with a picture in the wiki. It was used to check how students interpreted the picture at home in mini-groups and used it to predict the topic and problems of an upcoming class.

2) Check Vocabulary and Realias (done by the whole group). The exercise was used to check meanings of new theme-based words and definitions for realias that students wrote in the wiki.

3) Theory (done by the whole group). Blocks of media critical theoretical comments were included into the set of in-class activities for students, firstly, to learn about the key elements of mass media texts for improving their analytical, reading, and watching skills; secondly, to learn about the structure of opinions that they need to create on the basis of mass media texts and ways to develop argumentation in discussions for improving their speaking and writing skills.

4) Group Speed Task (done in mini-groups). This task included pre-reading and reading activities. The pre-reading activity helped students to predict what the text was going to be about. As for the reading activity, it was done in mini-groups who had one article cut into several pieces (for example, topic sentences and bodies of paragraphs) that needed to be matched and put together in the right order as fast as possible. The task was aimed at developing students' media critical and reading skills. Its content depended on the theory they had learnt. After completing the task, students did exercises with evaluative words as well as grammar exercises.

5) Individual Task (done individually). The task included the same pre-reading activities as in the previous task but students had the whole text of the article which they were to read and analyze individually. After reading the article they had to do exercises based on the theory they had learnt.

6) Link to China (done by the whole group). This post-reading task was a counterpart of wiki activity №5. Before each class students were offered a few questions connected with the theme of the class. They had to think of these issues at home to be able to compare situation described in articles with similar situations in China. Thus, students used their ideas and participated in discussions about the articles they had read improving their speaking skills.

At the end of the course, students participated in a creative activity. They were offered to participate in a simulation reproducing a situation of a real talk show using all those media skills that they had acquired. They presented the simulation in the classroom but all the preparatory job had been done at home with the help of the wiki space which was used to post the scenario of the talk show and words for the roles so the teacher could check them and post tips and recommendations.

All in all, the organization of the educational process was in line with Chinese students' cultural characteristics. Firstly, while working autonomously at home, students had clear instructions to follow (in terms of using the wiki space and doing the activities), they could communicate with the teacher if they had any problems and could see that their homework was constantly and immediately checked by the teacher.

Secondly, the wiki environment prevented students from losing their face as they had enough time to refine their posts and worked either in mini-groups or individually but collaboratively, so, they could feel their group mates' support all the time.

Thirdly, students' cogitative needs for precedent, visualization, and time were satisfied as they got clear instructions for using the wiki space and doing activities, used visual content, and communicated asynchronously, so they had enough time to work on tasks and think of their answers.

Fourthly, there were a couple of introductory classes for students where they learnt how to use the wiki space (registration, creating and editing pages, uploading/downloading files, posting comments, using wiki mail) and where they were told about the main goals of using this tool (well-organized and user-friendly storage of study materials where they can be easily found anytime and anywhere, no need to print study materials which can be easily read in a smartphone/tablet; collaborative language learning activities which enable them to share knowledge and, thus, spend less time on homework, charts with marks which enable them to follow their progress).

6. EXPERIMENT AND RESULTS

The set of activities described above was tested in the spring semester of 2013. There were two groups of Chinese students in their third year of University who participated in the experiment (18 students in the control group, and 19 students in the experimental one). Students' proficiency in English in both groups was B1-B2. The experimental group studied offline and online using the above mentioned set of activities while the control group studied offline using the textbook "Reading the News" (Sharma, 2007).

The experiment included a pre-experimental test, experimental trainig, and a post-experimental test. The experimental training took 13 face-to-face classes, 10 wiki assignments, and one final face-to-face class.

The aim of the pre-experimental test was to measure students' media literacy level before the experimental training. The test included the following tasks: a) read an article, provide a summary, and give one's opinion about the problem described in it; b) watch a video, answer the questions, write a short summary and one's opinion about the problem discussed in it; c) register in the wiki (http://www.wikispaces.com/) and create one's profile; d) make a dialogue on one of the topics (Sport, Culture, Science and Technology, Business).

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The following parameters were used to define the levels of media literacy skills. For each parameter a student got one point.

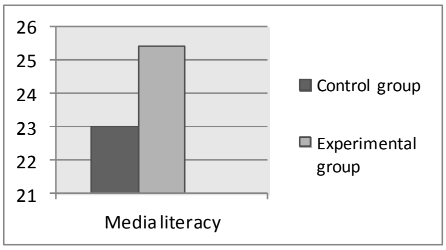
1.Media critical skills: a) knowledge of types of mass media texts; b) knowledge of lexical and grammatical features of news headlines; c) knowledge of structure of mass media texts and their key content elements (topic, problem, facts, idea); d) ability to tell what a mass media text is about using headlines, first and last paragraphs; e) ability to define the main topic of a mass media text; f) ability to define the main problem of a mass media text; g) ability to find and connect the facts that prove the problem exists; h) ability to define the main idea of a mass media text; i) ability to read an Internet comment on a mass media text and define the user's position regarding the problem described by the author of the mass media text; j) ability to find those examples that a user provided to prove his/her position in a comment; k) ability to define how a user feels about the informative value of the mass media text he/she commented upon.

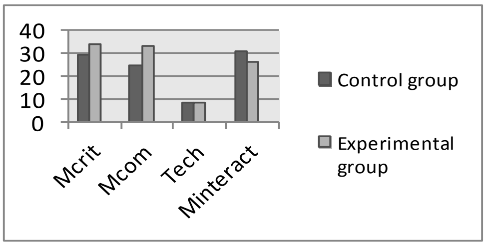
2. Media communicative skills: a) knowledge of thematic vocabulary; b) knowledge of evaluative words and expressions; c) knowledge of cultural realias; d) knowledge of discourse markers; e) knowledge of grammar rules; f) ability to distinguish between facts and opinions while reading/listening to a mass media text; g) ability to make a short summary of a mass media text (orally, in the written form) defining its topic, problem, facts, main idea; h) ability to give one's opinion about a mass media text including one's position concerning the problem of a mass media text, one's examples, and description of the informative value of this text; i) ability to make a dialogue discussing socially important issues; k) ability to use discourse markers in one's monologues and dialogues.

3. Technological skills: a) knowledge about application of wikis; b) knowledge about wiki functions (creating and editing pages, uploading and downloading documents, checking recent changes, posting comments, sending wiki mail etc.); c) ability to register and create one's profile; d) knowledge of wiki space structure and ability to look for study materials; e) ability to download and upload materials in a wiki space; f) ability to check recent changes and restore older versions of documents; g) ability to post comments; h) ability to use wiki mail to keep in touch with other students and a teacher.

4. Media interactive skills: a) knowledge of key stages of organizing a simulation; b) knowledge of a simulation scenario; c) knowledge of discourse markers used in a scenario; d) ability to choose a theme for a simulation and find relevant mass media texts; e) ability to create one's utterances for a chosen role; f) ability to change a scenario in a creative way without destroying its main structure; g) ability to present a simulation; h) ability to reflect on simulation experience.

The results of the pre-experimental test are presented below:





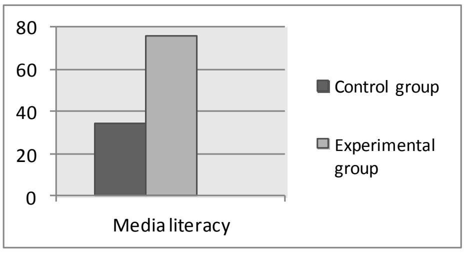
Mcrit - media critical skills, Mcom - media communicative skills, Tech - technological skills, Minteract - media interactive skills

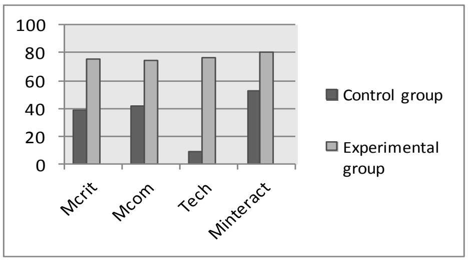
Figure 1. The levels of media literacy and media literacy skills in the control and experimental groups (%)

The analysis of the first diagram that presents the levels of media literacy shows that before the experiment these levels had been low (23 and 25,4%) with not much difference between the control and experimental groups. The second diagram presents similar levels of media critical, media communicative, and media interactive skills in both groups which vary from 25 to 35% while technological skills are the least developed (about 8%) which is easily explained by the fact that students had not used wiki sites prior to the experiment.

The aim of the post-experimental test was to measure students' media literacy level after the experimental training. The test included the following tasks: a) read an article, provide a summary, and give one's opinion about the problem described in it; b) watch a video, answer the questions, write a short summary and one's opinion about the problem discussed in it; c) answer questions about wikis (for the experimental group only); d) make a dialogue on one of the topics (Sport, Culture, Science and Technology, Business).

The same parameters were used to define the levels of media literacy skills. The results of the post-experimental test are presented below:





Mcrit - media critical skills, Mcom - media communicative skills, Tech - technological skills, Minteract - media interactive skill

Figure 2. The levels of media literacy and media literacy skills in the control and experimental groups (%)

The first diagram proves the positive dynamics in both groups: the level of the control group rose by 10% while the level of the experimental group increased considerably, by 50%. The second diagram demonstrates the highest levels of media interactive skills in both groups (53% in the control group, 80,25% in the experimental group). The levels of technological skills differ significantly (about 10% in the control group, 76% in the experimental group) because the wiki site was not used in the control group. As for media critical, media communicative, and media interactive skills, the experimental group was able to improve their performance by 40-55% while the control group managed to increase their score by 10-20% only.

The results of the experiment showed that the wiki space (along with the changes of the course content) contributed to the development of Chinese students' media literacy as a part of their philological competence. In other words, students from the experimental group gained better media critical, media communicative, technological and media interactive skills than those in the control group who studied offline only.

After the experiment, students were given questionnaires for getting their feedback concerning the usage of the wiki space. Chinese students made a note of the following advantages of implementing wikis into the traditional educational process: 1) more convenient than e-mail because the wiki space is well-organized and it is easy to find links to study materials; 2) even if students miss a class, they may find all the handouts in the wiki space; 3) no need to print study materials; 4) the wiki space is convenient for multi-tasking (doing homework, sharing homework, being in connection with the teacher and group mates via wiki mail, check one's study progress); 5) convenient for team work (sharing homework, feeling of belonging to a group, one does not feel lonesome when doing homework); 6) easy to follow one's study progress and compare one' s marks to those of other students; 7) opportunity to edit pages, change something oneself.

As for the wiki drawbacks, students mentioned 1) bugs; 2) lack of interesting applications integrated with the wiki space; 3) irresponsibility of some students who did not do their portion of homework in time and let other students down; 4) discomfort caused by the fact that other students could see one's marks in the assessment chart; 5) plain design.

7. CONCLUSION

Overall, the positive results of the experiment as well as generally positive feedback from students showed that a culturally sensitive wiki space could work if the following points are taken into account: Teacher Support (clear instructions, assistance, feedback), Peer Support (sharing homework, work in mini-groups, face-saving online environment), Focus on Cogitative Needs (clear instructions and patterns, visual content, flexible time constraints), Technology Insight (introductory classes for students to learn about wiki application purposes, wiki functions, and wiki activities).

It is also important to note that wikis and the aforementioned principles of designing a culturally sensitive wiki space may not work for students of all ethnic backgrounds and may not be fit for all educational purposes.

Anyway, the present case demonstrates that it is worth a try if students and teachers face certain challenges (including those connected with cultural differences), and traditional classroom techniques and tools do not provide sufficient help.

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SHARED COGNITION FACILITATED BY TEACHER USE OF INTERACTIVE WHITEBOARD TECHNOLOGIES

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ABSTRACT

This paper reports on a study designed to examine the dialogic processes teachers used to sustain focused discussions, using questioning techniques and Interactive Whiteboards (IWBs). IWBs and their related technologies such as plasma touch screens and projected tablets have passed through several phases of implementation as classroom objects, from initial adoption by a few enthusiasts, through the building acceptance phases, and finally a phase of maturity characterized by widespread use. This study shows that teachers who value shared collaborative learning spaces, can draw on distributed cognition, and promote sustained thinking, cognitive engagement and that this enables development and refinement of students insights.

KEYWORDS

Interactive Whiteboards, Shared Cognition, Dialogical teaching moments,

1. INTRODUCTION

When IWBs were first introduced, the early studies in the United Kingdom focused on pedagogies related to interactivity that involved teacher and students, and between students (Smith et al, 2006; Tanner et al, 2005; Moss et al, 2007). Teachers tried to realize the affordances of IWBs. Criticisms focused on IWBs easily being absorbed into the existing practices of teachers without pedagogical changes, and reflected past practices of teachers. A major UK study concluded "IWBs are mainly being used: as a data projector which can navigate to multiple screens; as a surface which can generate a dynamic rather than static form of display; to enhance presentation from the front of the class" (Moss et al, 2007 p. 5). IWBs may have lead to less thinking time when the teacher retains control. This study sought to see if more thinking time could happen.

Studies have tried to evaluate the IWBs impact on pedagogy, on uses to reinforce whole class teaching, and teacher engagement with the "surface features" of interactive teaching (Rudd, 2007; Smith, Hardman & Higgins, 2006); Mercer, Hennessy & Warwick, 2010). Others are equivocal, while claiming some positives. Warwick and Kershner, (2008), commented: "Research evidence on educational gains from IWB use across both primary and secondary phases of schooling is mixed" (p.269).

There has been limited understanding about how pedagogy develops with IWBs in the UK, USA and Australia (Hennessy et al 2007). In Australia attempts to classify IWB impacts in terms of a hierarchy of pedagogical skills, led to questions of whether the affordances of the technologies could stimulate higher order thinking skills through interactivity (Vincent & Jones, 2008; Sweeney, 2008)), similar to other studies quoted here, these sought to examine the impact of the technology in changing pedagogy.

This paper presents one teacher's use of the IWB to support shared cognition. Perhaps earlier disenchantment with IWBs arose because the wrong question was being asked: what can the technology do *for* teachers/students? A more useful question might be: what can the technology do *with* me/students? This teacher's lesson review indicates that she works *with* the affordances of the technology, to support dialogically meaning making moments in her classroom. Her pedagogical work aligns with the seven pedagogical practices for using technologies (Osborne and Hennessy, 2003). This teacher's in class voice, and again her voice in the interviews, indicates she understood that a shared language needed to be created before students could engage in discussions, and before they could question and think about what was happening (Redman, 2010). Her class can be seen to be working with ideas afforded by the teacher using the

IWB, because they have the necessary language needed to enter collaborative and challenging thinking spaces.

Luckin (2008) and Beauchamp (2011) used the same concept of 'working in partnership' with machines. This is done with a view to redefine and enhance performance as noted by Salomon, Perkins and Globerson, (1991), now this includes IWBs and digital interactive technologies. Luckin and Beauchamp also take account of the local setting and culture within which tools are embedded. Luckin (2008, p 451), describes learning taking place within an ecology of resources, 'a set of inter-related resource elements, including people and objects, the interactions between which provide a particular context'. This message, with a few exceptions, became lost in the euphoria of the early adoption of IWBs. It is now being re-examined.

A possible pedagogical contribution that IWBs can make to pedagogy practices is by enabling students to work through their ideas both verbally, and, graphically. Warwick and Kershner (2008) report on a teacher who linked the IWB's multimodality affordances with the IWB, using it as "supportive of the collective memory of the group" (p. 276). The thinking of the user is made visible to all, empowering students to more effectively, and knowingly, participate in collaborative reasoning and hypothesis testing that may well "go well beyond those afforded by more established classroom devices…. [the IWB] provides a dynamic and manipulable object of joint reference which offers new forms of supports for 'intersubjectivity'" (Hennessy et al, 2007 p.284).

Hennessy has shown IWBs assist teachers development of a culture of shared dialogue leading that can lead to 'shared cognition' in classrooms (Hennessy et al, 2014). Notably, Hennessy is reporting on a study that was conducted with teachers who already had belief and practices revolving around student dialogue. The project concluded that when teachers purposefully create the right conditions to support risk taking and changing of minds, rich new forms of dialogue and activity emerge, and both at the board and away from it. Hennessy states the pre-existing teachers' views about learning, and the classroom cultures they nurture, are central to developing the more productive dialogic uses for IWBs. Their willingness to at least partially relinquish control over the IWB and to take the time to consider students' views was identified as critical. This suggests that a dialogic culture has to exist first.

Classroom situations in which collective intelligence and shared cognition can potentially be fostered through IWB use is reported on by Alvarez et al (2013). Harnessing group intelligence to extend students' productivity and depths of understanding, and of distributed cognition by sharing thinking and insights appears to be possible only once the teacher creates a shared platform. These are affordances offered by the IWB, and other devices. These activities were rarely seen, or documented, in the early phases of IWBs use, noted by most of the authors already mentioned.

Alvarez et al (2013) observed Swedish teachers, in upper primary schools, use a framework that supported collaborative and shared solutions. Using the IWB, teachers provided students opportunities to share and deepen their thinking. These students reported that they "had a better understanding of how to solve a problem as a result of the greater communication they had with their peers and their teacher" (p. 376).

2. METHODOLOGY

2.1 Project Outline, Participants and Data Collection

This project originated as part of ongoing research within the Melbourne Graduate School of Education on the quality of teacher-student interactions and teacher-teacher with technologies generally (Chandler & Redman, 2013; Delaney, Trapani, Chandler & Redman, 2014). It sought to examine the dialogic processes in three classrooms in a primary school when confident teacher IWB users incorporate technologies. In depth reporting on a classroom teacher and her interpretations of her actions are reported on and examined here. Drawing on the work of Hennessy et al (2014) and Mercer, Hennessy & Warwick (2010) the project focused on how teachers developed skills mediated by the IWB to support dialogic interactivity. It examined how they built a dialogic pedagogy that actively develops and extends learners' contributions, so that they jointly construct knowledge. The aim of this research was to observe pedagogical responses to the affordances of the IWBs, especially in relation to teacher questioning and teacher organisation of the thinking dialogues. The three teachers involved in one primary school were observed but not part of any training program. The purpose was to examine the impact, if any, of the IWB affordances on these teachers' dialogues with their students, and any evidence of the IWB contributing to shared cognition across groups of students.

IWBs have features that are potentially different from a standard classroom display and knowledge sharing facilities. The 'potentially' needs to be there because there are many studies that point out that the IWB can easily be used exactly like the older technologies such as screens and conventional whiteboards (eg Moss et al, 2007, Higgins et al, 2005). The IWB does, however, have the potential affordances of enabling shared thinking across groups; interactive motion; audio feedback; and animated feedback among others.

Three teachers participated, from Prep (year 0), year 3 and year 6. They were identified and selected by the school as 'accomplished' practitioners. They were recognised for the quality of their interactions with students, and as regular and confident users of IWBs. In two cases the teachers had more than six years experience of teaching, and one teacher was a new graduate with an outstanding reputation from her two-year postgraduate Master of Education course. The researchers observed three lessons with each teacher, filming the lessons and coding all the uses of the IWBs.

Data collection was conducted in as naturalistic manner as possible. Filming took place discretely at the rear of each classroom. Teachers volunteered the lessons they wished to have filmed. Teachers were not trained or tutored in any way, and no alterations to the timetable schedule occurred. The researchers fitted around the needs of the teachers. This not to ignore the fact that any intrusion, like a camera and researcher, into the complex system that is a classroom, is likely to have some impact on the learning environment.

Teachers had freedom to choose the lesson topic, interestingly, the bulk of the observed lessons, were in mathematics. Each teacher was briefly interviewed before each lesson to establish the goals for the lesson. Each video film was then edited to isolate occasions on which interactive dialogue of various sorts occurred. A little later, but always less than 7 days, each teacher undertook a video-stimulated interview using the edited film, and was asked to comment on and explain the actions observed.

The interviews were then analysed to focus on all the areas where the teachers were able to articulate that learning was happening due to the sharing of knowledge and where meaningful dialogue and questioning arose from the work with the IWB.

3. RESULTS

The outcomes of this project derive from the observations of, and interviews with, three expert teachers. The data collected was extensive and too complex to fully report here. This report concentrates on points of intersection between teacher questioning and the IWB, and the IWB intersections with the students, and evidence of shared cognition by the students.

The teacher reported on in detail here is a graduate teacher, teaching grade four, and she has selected a mathematics lesson. The lesson focused on moving from angles as objects to measuring of angles of rotation. This teacher was in her first year of teaching, having completed a two-year post-graduate Masters program. In this initial teaching course she had excelled and observations in her classroom belied her inexperience. The mathematics lesson being used for the case study was introducing the use of the protractor and the concept of measurement of angles.

Here the transcripts provide a sense of the lesson structure. The following transcript comes from excerpts from video recording. The teacher commences the lesson by raising a protractor.

Teacher: Today we are going to be using this. What is a protractor used for? Tell me? Pretend you are explaining what the protractor is to someone who has absolutely no idea.

Student C: Angles

Teacher: Angles? What do you mean by angles? I understand what an angle is. So a protractor has something to do with angles. Let's use a full sentence to describe what it might do. (**Student N**) do want to have a go and build on (**Student C's**)

Student N: I've got two things. One, you can get it on a computer and two; it's to show the degrees of the angle.

Teacher: Beautiful, so you're measuring the degrees of that angle okay?

Now the teacher focuses on the IWB where she has an angle drawn.

Teacher: Can someone please draw for me where the angle actually is on this diagram?

Teacher makes time to establish the specific ideas that she wants the children to consider and share. She has used the IWB as a conventional board. The angle could have been on any board, and most of the interaction has been verbal. At this point comes a dramatic turn in the lesson. Next the teacher brings up a very large moveable protractor on the IWB while **Student S** volunteers to come up to the board. The teacher now moves to one side away from the board, and only rarely returns to it for the remainder of the lesson.

Teacher: So that is what we're actually measuring. Now I have this protractor but I have no idea how to use it. Has anyone used a protractor before? Ah, so we have a few experts in here. Let's see if we can share our knowledge. If I was to measure this angle where do I put the protractor? Who knows?

Student M: On the bottom line and next to the point

The teacher has focused on the IWB now showing a projected large protractor that she can move around the screen. She now inquires from the students and asks them:

Teacher: What do I do? Put the two points together, but there are two sets of numbers here and I'm really struggling to know why two sets of numbers, and which ones are I use.

Gesturing she now points to some of the children inviting them to, Have a guess, have a guess, I don't know.

The teacher has taken up a storyline, of 'not knowing' and she is questioning the students, prompting their thinking and asking what it is she needs to do. She has used the pronoun '**I**' signaling to the children she is the one who needs help (Redman & Fawns, 2010). She has positioned them as helpers, saying '**we** have a few experts in here', and explicitly asked for sharing cognition from them, '**we** can share our knowledge'.

After the lesson the teacher is reviewing the video and she is responding to questions in a conversational style approach. Here she is reviewing **Video Clip**. The teacher is pretending that she doesn't know how to use the protractor to measure an angle and asks the children.

Interviewer: Just unpack that for me again what you did there to make them...

Teacher: Just in terms of me playing dumb?

Interviewer: That particular one why do you play dumb there?

Teacher: Just because I feel like that it's something that they can come to themselves. They've seen what protractor looks like. Ideally in this situation it would be good if they could have all had their own protractor in their hands, and then they could see the structure of it and make the own conclusions from using it. Because well its not obvious but you could come to the conclusion that that's where you've got to put the point because it's the intersections of the lines, so it's a way for them to come to that understanding themselves, but also the sharing In terms of the collaboration. Those ones that are experienced with the protractor can share their knowledge and the others can use that time to really build up their knowledge.

After explaining that she seeks for her students to support and assist each, now she reviews the in-class **Video Clip** recording. It shows her using IWB to investigate where to place the protractor on the surface.

Interviewer: So you have now started to make the board support your question. What happens now?

Teacher: They look at the common reference point on the board they have established that it needs to line up with the middle….

Interviewer: What is the board doing at the moment?

Teacher: It is the common reference point. So it's acting as a collaborative effort, measuring this particular angle. The kids feel like they can infer that you mention the angles using the numbers and then from here I think with my questioning I specifically lead them to the point where they realize that they have to line up the zero with the line so you can measure the angle from zero, and so they're sort of going through that process themselves.

This graduate teacher is explicitly stating how she is working with the board, she states it is acting as a collaborator, and she has the control, she leads with her questioning, she uses the board as central point of reference.

4. DISCUSSION

The teacher, while maintaining a flow of probing questions, withdraws to the side, and provokes the children to articulate their ideas by reference to the IWB. She more than once uses the device of pretending to know nothing in order to place the children at the forefront, allowing them to both refer to and to come up to IWB to share their insights with the whole class. She claims that the IWB is 'the common reference point' which provokes collaborative development of understanding.

As the lesson develops by using the animated protractor to build an understanding of why there are two 180-degree scales, and finally measuring, the teacher repeats these processes. Sometimes she plays ignorant, sometimes she invites specific children to verbalize what they are seeing on the IWB and to share their insights with the class, and occasionally she steps in to assume control herself.

In her **Video Clip,** the graduate teacher uses the very large protractor and introduces the problem of reading the scale into opposite directions.

Teacher: It's quite difficult trying to teach them the protractor without having that sheer size on the board.

Interviewer: Why is it important that they can see it easily?

Teacher: Because I want them to understand that if they don't line it up with the zero, then it's very difficult to calculate how many degrees in between but if they lined up with the zero they can easily see how many degrees it is from there. So it's reinforcing the fact that they have to have it lined up from zero.

In the **Video Clip** the graduate teacher asks how do we know whether we're going to look at the less than 90 scale or the larger than 90 scale for a specific angle. Student A answers that it depends on whether the angle is acute or not.

Interviewer: So what did you do then with him?

Teacher: The vocabulary. So it's fantastic when they can use the vocabulary. It's connecting the factors between the words. So that's a big step for him. In terms of the start of the year, he really couldn't even form a cohesive sentence. To deal with these … and it's quite a challenging concept, bringing back that vocabulary from previous lessons and then that's the starting off point for this sequence of questioning as it really connects those things.

Interviewer: Do you think with a child, like student A, there is a sense that the visual is actually helping send to long-term memory?

Teacher: I honestly don't think this lesson would have been possible without the interactive whiteboard. Because it's a very difficult thing to collaboratively focus upon (a real protractor) because it is physically so small and I think this visual of having this angle - and he can see from our previous lessons that that's an acute, a right or an obtuse angle, and he's making that connection with the visual.

Video Clip. In this section of video film where teacher uses the visual large protractor on the screen to illustrate the crucial importance of knowing whether we're working with an acute or obtuse angle and clarifying the language for those who are struggling.

Interviewer: So you are drawing and creating angles and stressing the two scales. Why do you have to do that?

Teacher: I think just to make it explicit for them. Also in terms of like their levels of thinking. It has gone from the sort of basic levels that, if you're looking at Bloom, like the understanding and the making the connections to the applying and then we're going onto the creating and we will be looking at that further. It's just about them understanding visually those connections that they have already made verbally but then reinforcing that.

The **Video Clip** shows the teacher-supporting student T, who is struggling, as a model for developing an idea of how to measure the angle on the interactive whiteboard.

Interviewer: Can you unpack that section because that was quite a lot of questioning?

Teacher: He is a bit of a struggler in terms of grasping concepts, so it was good for him to be able to go through that process, but in terms of like looking at which set of numbers to choose it was about him beginning to realize and making connections to-like past lessons and knowledge that he already had, and then making new connections to what he is looking at the moment. So in terms of him looking at the top numbers we went back to basics and looking at whether it was bigger or smaller than the right angle, and then going through the process of discovering - okay we have to look at this set of numbers - and I think that process to him would have been a very similar situation for quite a few of the kids in the class, going through the process… that step by step, and then essentially thinking that maybe I can ask myself these questions while I am doing it. So it's giving them ideas almost like a checklist - what they need to go through.

Next the **Video Clip** is about Student A being asked to verbalize this thinking every step of the way.

Teacher: So he has that very particular need to verbalize. So depending on the individual needs of the kids I will really ask them to do different things.

Interviewer: And he does it very well - why do you think he does it very well?

Teacher: Because there's been a lot of lead up and also the previous questioning could have helped him as well.

In this lesson, the IWB is being used, and has become a visual means of inviting the children to share their insights. The teacher is insistent that correct language is a key part of the understanding and of sharing the concepts, she promotes actively the correct mathematical language. She glories in the achievements of the children when their use of the vocabulary indicates their own absorption of the concepts in relating previous understanding of the static views of angles as 'acute', 'obtuse' and 'right' to the new dynamic concept of measuring angles of rotation. She actively encourages students to verbalize these ideas to their peers. In this whole section, the teacher is barely seen on the lesson video because she has handed much of the thinking and verbalizing to the students.

Near the end, as she uses the interactive features to make and measure rotations, she chooses a student who normally struggles, to unpack the process of measuring step by step. This was possible because the child could speak about each action as he activated the animation on the IWB. The teacher claims that the choice of this student was deliberate so that that process to him would have been a very similar situation for quite a few of the kids in the class, going through the process… that step by step and then essentially thinking 'maybe I can ask myself these questions while I am doing it'. So it's giving them ideas almost like a checklist, what they need to go through. She claims she can use such students as models because of the support given by the IWB affordances. The sharing with the class through the IWB then aids the rest of the class to clarify their understanding.

5. CONCLUSIONS

There have been numerous studies lamenting that IWBs have failed to produce the educational change and improvements in pedagogy that were expected or hoped for in the first decade of the 21st century. The case studies described here are suggesting that important pedagogical change can occur under certain circumstances. In particular, it can occur, and is likely to occur, if the teachers already incorporate sharing of ideas, creating time to think in dialogue, high level questioning and thinking, and recognition of the importance of children owning and sharing their own learning into their teaching

Analyzing the pedagogical changes that were observed, it is clear that many of them fall into the category of dialogic interaction, and thus re-enforce the work of Hennessy. In this study all three teachers stood back from the board and invited their student to verbalize while access to the boards has produced regular examples of shared cognition, where the insight of a student supports the learning of peers. All three teachers constantly ask particular children to model ideas while interacting with the IWB, and all claim they choose each child for two purposes: to help the child who is modeling by verbalizing ideas; and to share this with the rest of the class, in the belief that children can often explain better to peers than the teacher if they have the visual and interactive support of the IWB.

All three teachers used IWBs to provide waiting time for children to think and verbalize. To most teachers this is a difficult area. Waiting time gives opportunity for other children to move off-task. All three observed teachers here deliberately used the visual and interactive affordances of the boards to focus and engage the class, giving the child doing the modeling, time to think and verbalize. This was seen when student T needed time to explain about an aspect of the number on the protractor, and the teacher explains their pedagogical thinking:

> He is a bit of a struggler in terms of grasping, concepts so it was good for him to be able to go through that process, and I think that process to him would have been a very similar situation for quite a few of the kids in the class, going through the process… that step by step…When students have time like this, not only can they order their thinking, but they can more effectively share it.

All these teachers deliberately absented themselves from the IWB. Each teacher ensured students felt they had command over the board as the teachers stood to one side. This appears to be allied to these teacher beliefs that children must own and share the learning that is taking place, and there was a reluctance to dominate, and a deliberate signaling that the child controlled that learning moment.

It was clear from the observed lessons that all three teachers were skilled questioners. All three used the IWB visuals to support open-ended and thinking-rich questioning. However, while IWBs appear to make conditions for higher-level questions easier, it is almost certain these three "expert" teachers would use higher level questioning under any teaching conditions. Whenever teachers asked a child to describe or explain a set of steps in a process of measuring angles, a quiet ‘why’ was heard as teachers gently interjected.

So maybe we have been asking the wrong questions. Instead of asking, “what can the special affordances of IWBs *do* to change teaching?” perhaps the question is “what can teachers do to adapt the IWBs for the enhancement of good teaching practice?”. By focusing on the natural practices of expert teachers when they come into contact with a teaching medium that includes powerful multimedia, a screen large enough to be accessible to all students, and interactivity through touch or wireless, we have begun to see in this project many examples of enhanced practice. It is clear that in these case studies, dialogic interaction, advanced questioning, student ownership of learning and recognition of thinking time are part of the teachers’ common practice. However, it is equally clear that when teachers already have these practices embedded in their pedagogical armory, they have absorbed the special affordances of the interactive whiteboards into their teaching to greatly enhance their teaching effectiveness.

It is significant that the teachers observed were not necessarily experienced. One was a first year probationer. The reason why these three teachers successfully integrated the IWB affordances into their teaching did not appear to be connected with experience or age, but rather their willingness to develop an environment of shared cognition, deep thinking and high level questioning. It is worth revisiting Salomon, Perkins and Globerson’s 1991 proposals that working in partnership with machines can redefine and enhance performance. Salomon asks us to consider that perhaps “it is not technology alone affecting minds, but the whole ‘cloud of correlated variables’ technology, activity, goal setting, teacher’s role, culture–exerting the combined attempt”.

What this project has observed is indeed precisely that, redefining and enhancement is arising from the cloud of correlated variables. It is not, therefore sensible to expect IWBs to transform teaching. The teaching comes first. If teachers have the expert pedagogies, IWBs, then the successive waves of current and future educational technologies will be successfully incorporated into their growth as teachers and student growth as learners. The first year graduate teacher, from the Melbourne Graduate School of Education, at the University of Melbourne, has been educated in the Master of Teaching model that develops a practice of clinical teaching. The clinical teacher aims ‘to be constantly evaluating a student's learning and progress and intervening in specific, targeted ways that are clearly underpinned by research and theory’ (Redman, 2014). In conversational style classroom interactions, this young teacher was constantly diagnosing, responding and intervening, working towards increasing student understandings. She combines her research-based understanding of the difficulties students have in this topic, with her knowledge of her students as learners, and utilises the IWBs’ affordances to construct active empowering moments of shared cognition.

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MODELING PEDAGOGY FOR TEACHERS TRANSITIONING TO THE VIRTUAL CLASSROOM

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ABSTRACT

This study is a review of the creation and evolution of a professional development program modeled on social constructivist principles and designed for online educators in a virtual high school who transitioned from the conventional classroom to the virtual educational environment. The narrative inquiry focuses on the critical events within the professional development program and which were transformational in the process of transitioning from conventional brick and mortar instructor to online educators. In addition, the research examined whether or not the social constructivist inspired methodology modeled in the professional development transferred into the online teachers' classroom practice. The results of this research have contributed to an understanding of the key components required for the design and implementation of a professional development program for teachers who have been trained for conventional classroom practice, but who are now called on to teach online in virtual classrooms.

KEYWORDS

Professional learning, social constructivism, online communities of collaboration, recognition of acquired competencies, metacognition, reflective practice

1. INTRODUCTION

Over the course of the last decade, the rapid emergence of virtual schools across the educational landscape has not only created a need for a new category of teacher, that is, the online educator, but also it has highlighted a pressing need for new models of professional development for educators who are called on to teach in online classrooms (Blankenship & Kim, 2012). Ukpokodu (2009) emphasizes the importance of effective professional development programs for online teachers since these programs influence the pedagogical strategies the teachers will employ in their virtual classes which in turn have an impact on student outcomes. An essential starting point in designing a professional development program for online instructors is a clear understanding of the knowledge and skills that are specifically associated with effective pedagogy in the virtual classroom setting and how these strategies compare to those employed in a conventional classroom environment (DiPietro & Sivy, 2011). In terms of professional development in general, Blankenship and Kim (2012) clearly demonstrated that traditional models of professional development have been ineffective because these models generally responded to institutional requirements first without providing authentic and meaningful learning opportunities for the teachers themselves. This is a pivotal issue since virtual schools are regularly faced with the challenge of training teachers from the face-to-face environment to teach in a virtual classroom environment; however, it is also critical to note that most programs do not adequately prepare these teachers as the emphasis in the majority of the professional development programs has been upon the use of related technology and not on pedagogy and online methodology (Barrett, 2010; Faulkner-Beitzel, 2008). Research has shown that the most effective learning within a professional development program for teachers occurs when the learning itself is clearly contextualized and when there are social interactions in which authentic practice occurs (Bell & Morris, 2009). Barrett (2010) makes an important point when he states that the virtual classroom is unlike the conventional classroom, and as a result, educators moving into this environment must "unlearn" their previous ways of providing instruction and consider effective strategies that both encourage and nurture the online student. This notion of a differentiated pedagogy for online delivery is further supported by DiPietro

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and Sivy (2011) who call for professional development for prospective online instructors that sensitizes these educators to these differences and adequately prepares them for an environment with which most are not familiar.

When educators, who have spent most of their careers in conventional face-to-face classrooms, are expected to teach in a virtual school setting, the training and preparation they receive is of critical importance since the variables that influence teaching and learning are different for both environments (Wiesenberg & Stacey, 2008). Professional development programs for online teachers that help develop more than technological proficiency and that focus on teaching strategies which optimize the realities of the virtual learning environment can only improve the quality of the educational experience for the online student (DiPietro & Sivy, 2011). Smith (2009) also reveals that while some online teachers receive training at the university level, most of the training they receive comes from the virtual school in which the teachers work, and that generally it is not sufficient, challenging, or ongoing. This narrative inquiry sought to identify the particular characteristics of an effective professional development program designed for teachers who arrive from the conventional school environment without the specialized skills required for the virtual setting. As a result, the problem is that without the proper training and preparation for the virtual classroom, the online pedagogy of the virtual school instructors may not adapted to the online setting, and consequently the quality of instruction students receive is compromised.

This particular professional training program was designed with the objective that the participants would modify their previous classroom practice and integrate educational practice which is best suited for the virtual setting by modeling this practice within the professional development program itself. Narrative analysis was employed to uncover common themes or plots in the data and subsequent analysis was carried out using a hermeneutic technique for noting underlying patterns across stories of the participants (Webster & Mertova, 2007). The narrative analysis identified common critical events which were most meaningful and effective for the participants in the professional development program, and which help identify issues, challenges and themes that emerge from the professional development program. These critical events were recorded and transcribed and given unique identifiers/tags along with a referencing system to allow for verification and to provide a means to identify recurring themes/variables that appear within the multiple narratives of the participants (L.Webster & Mertova, 2007). Yoder-Wise and Kowalski (2003) suggest that this approach helps identify recurring themes, identify consequences, reveal lessons learned, identify what succeeded and what did not, describe strengths and vulnerabilities and ultimately help build for future experiences, that is, professional development programs for online teachers. Narrative analysis does not apply the more traditional approaches toward validity and reliability common to standard qualitative research but factors in new measures such as access, honesty, verisimilitude, authenticity, familiarity, transferability, and economy (L.Webster & Mertova, 2007). As a result, narrative analysis is a departure from the objectivist definition of research validity and reliability (Clandinin, 2013; Webster & Mertova, 2007). The virtual high school serves hundreds of students from across the province, has been in existence since 1999 and has a number of unique characteristics including its delivery method which is a blended synchronous-asynchronous model. This narrative analysis highlights the perspectives of the research participants from the point of their inception into the professional training program to the current moment. An examination of a professional development program for this group of virtual schoolteachers has relevance for all those charged with the design and implementation of training programs for online teachers everywhere. Moreover, this study extends the understanding of the role that modeling practice has on the training of online teachers and the impact this type of professional development has on an online teacher's classroom practice.

2. PROFESSIONAL DEVELOPMENT: ISSUES & CHALLENGES

In an examination of the Bercow Report which was conducted in 2008 in the United Kingdom and which addresses the initial training of teachers, Mroz (2012) highlights many of the obstacles to the general improvement of teacher education. The first is that to effect change which is essentially systemic, there needs to be a need for a harmonizing of efforts by all involved in the process. This spectrum includes the politicians, bureaucrats, administrators, academics, and practitioners who are all involved to varying degrees in determining how teachers are prepared for the classroom. Secondly, Mroz argues that funding is required to improve teacher education, and at time when the global economy is struggling, monies are not going to be allocated for this problem.

There is considerable evidence that many professional development programs provided to teachers fail because they deliver knowledge and information which is not meaningfully situated or contextualized (Bell & Morris, 2009). Effective professional development programs have typically integrated authentic, real-world situations which incorporate collaborative work and which are sustained over a period of time (Blankenship & Kim, 2012; MacDonald, 2008; Zhang & Watts, 2008). Professional training which is specific to online teachers involves a defined set of challenges which range from technology integration to the modification of classroom pedagogy to fit the virtual environment which lends itself to the development and use of cognitive and social constructivism (Palloff & Pratt, 2011; Powell & Kalina, 2009). Moreover, the question of professional development for professionals in the domain of e-learning was explored inside the expanding dynamic of the exploding world of online instruction.

In a study conducted by Korth, Erickson, and Hall (2009), they indicate that a vast majority of teachers view themselves as teacher educators, that is, teachers who after a number of years of experience are poised to help other teachers in their progression as professional educators. These teacher educators consider that their field experiences which they are ready to share can be more purposeful and focused than what teachers typically receive from universities or in typical professional development situations (Korth et al., 2009). Implicit in this view teachers have of themselves as teacher educators is that professional development must be tied to classroom experience that is meaningful and authentic thereby supporting the views expressed by Bell & Morris (2009). Kostadinovic (2011) describes professional development in a context where it is stated-mandated and primarily driven by universities. It is expected that it be ongoing and formalized and inextricably linked to teacher certification though there is little reference in her study as to the efficacy of the professional development programs. However, she concludes by stating that teachers must remain current as the educational context is constantly evolving and that professional development is at the core of an effective educational system (Kostadinovic, 2011).

Penuel, Fishman, Yamaguchi and Gallagher (2007) conducted a study which explored the effectiveness of a professional development program for 454 Science teachers with the goal of identifying which features of the program were most effective in implementing change in the classroom practice and aligning the work with the prescribed curriculum. Penuel et al. argue that most of the research tied to professional development has not been generally useful since much of the data accumulated depended on teacher self-reporting and that there was also little objective measure of outcomes especially in the area of curriculum alignment. Similar to Kastadinovic, they point out that professional development design has generally been derived from policy-maker expectations and did not engage those who would be involved in the actual process. Penuel et al designed their study so that the focus was not simply on teacher satisfaction but on actual change in classroom practice as well as student outcomes. Referencing previous studies which identified effective professional development traits, they designed their program in order that teacher engagement be assured from the outset and that the process require active learning by the participants (Penuel, Fishman, Yamaguchi, & P.Gallagher, 2007). In addition, they recognized the need to extend the process over a duration of time and to establish a climate of collaboration and inquiry which in turn would help establish trust among the participants and a sense of mutual support (Suppovitz & Turner, 2000).

When teachers are involved in professional development which leads to certification, there also seems to be a higher level of success as measured by changes in classroom practice (Frye, 2000). Sato, Chung-Wei and Darling-Hammond (2008) conducted a three-year study during which they explored the effectiveness of a professional development program that was intended to improve teacher assessment skills, especially in the area of formative assessment. They found the program to have been successful because the teachers felt the program was tied to their classroom realities and the knowledge and skills they developed were both meaningful and practical. Similar to Penuel et al. (2007), the teachers in this study found that collaborative professional development with a high degree of collegiality not only built trust among the participants, it helped them develop a greater sense of self-confidence. In this program, Sato et al. found that active learning and inquiry were essential components.

In studies that describe effective professional development for educators, the recurring notions of collegiality and collaboration are highlighted as vital components; however, Stanley (2011) addresses both the pitfalls and promises of collaborative teacher groups. Collaboration is understood to be valuable since it offers the opportunity to tap into a collective experience and wisdom and simultaneously provides an opportunity for reflective practice and inquiry (Stanley, 2011). Professional development that incorporates collaboration stands in stark contrast to one-size-fits-all workshops and clinics in which teacher-participants are generally passive note-takers. Darling-Hammond, Wei, Andree, Richardson, and Orphanos (2009) found, however, that in general, teachers do not engage in collaborative professional development and that less than 14% thoughtfully collaborated on curriculum content. They point out how teachers are not trained or skilled in collaborative skills. Stanley (2011) argues that the isolated teacher can be replaced by the balkanized teacher group set fast against the outside world. She concludes by detailing six elements essential to successful teacher collaboration: (a) There must be both individual and group commitment to collaboration. (b) There needs to be an understanding of goals and recognition of the tension between knowledge acquisition and pedagogical skills. (c) Teacher participation must be active and engaged. (d) There necessarily must be within the group a high level of openness and integrity. (e) The teaching assignments of the participants must be connected in some fashion. (f) The participants must be ready for new ideas and approaches and feel supported in the process.

Beyond collaboration, effective professional development typically requires active learning and inquiry-related activities which engage the participant in acquiring greater content knowledge and pedagogical (Ali-Corlu & Sencer-Corlu, 2012; Penuel et al., 2007). Ali-Corlu and Sencer-Corlu (2012) describe a program in a Turkish university in which teachers were taught scientific inquiry-based skills because it was recognized that the students of these teachers would greatly benefit from classroom pedagogy that incorporated the very skills the teachers themselves were acquiring. This approach of modeling required that teachers plan, prepare, and present an experimental design and in doing so learn, the inquiry concept and then be able to teach it effectively. The program included progressively more complex problems that taxed the teachers and required them to push beyond their current levels of knowledge and ability. This action-research based project demonstrated significant changes in teacher practice but also illustrated the difficulties in training teachers' high-level skills. Corlu & Corlu (2012) conclude with a recurring observation that content mastery is, in and of itself, not sufficient to assure positive student outcomes and that there is a balance required between content mastery and pedagogical skills.

2.1 Professional Development and Online Educators

In an era of regular and ongoing educational reform, the importance of professional development is particularly acute (Palloff & Pratt, 2005). This issue is accompanied by the need for educational leaders to initiate growth and change, to view professional learning in terms which are both personal and engaging for the leader and the participants, and to move away from models of professional development which have failed to prepare teachers for a new educational reality (Baran, Correia, & Thompson, 2011; Fullan, 2001). Fullan (2011) points out the importance of the creation of an environment essential for meaningful and sustainable professional development/learning. This position is supported by Webster-Wright (2009) whose meta-analysis illustrates that professional development must integrate authentic learning and evaluation situations. Webster-Wright (2009) maintains that professionals learn in a fashion which not only shapes their practice but that they seek professional training which is inextricably linked to their personal realities. Burden (2010) builds on the view of learning as an ongoing process which incorporates the active participation and involvement of the professional. Moreover, he considers the significance of the experience, the use of reflection, the construction of knowledge, the contextualized nature of learning, and the social and collaborative nature of teacher learning. Burden's research draws on a large body of material on the subject of teachers and professional learning; however, there is a particular focus on Web 2.0. He employs this corpus to provide a theoretical framework for professional development which is relevant in the current times and which integrates tools and learning environments which resonate for educators. Pratt and Palloff (2011) view professional development for the online instructor in a manner which is similar to the professional learning of any educator; however, they highlight the differences of the online environment and the impact and influence of technology. For online instructors, they suggest that professional development must also be an organizational endeavor which integrates a systems-wide approach and that effectiveness in the virtual environment relies on coordinated team effort. In the context of this narrative inquiry which examines a professional development program for online instructors, the process is viewed both from the perspective of the teachers involved in the program as well as from the administrators' organizational perspective.

In a study conducted by Penuel, Fishman, Yamaguchi, and Gallagher (2007), they undertook a meta-analysis of research conducted in the last fifteen years on the topic of professional development for educators in general. This study specifically considers those models which have been proven effective as measured by the transfer of skills and knowledge acquired by educators in the process of professional development into the actual curriculum in which they teach. In the course of their study, they bring into question many of the previous studies which relied primarily on teacher feedback and self-analysis because of the inherent bias and lack of detachment noted in the studies. The authors surveyed over 1300 teachers and employed a quantitative methodology in order to determine which professional development process was most successful in changing teacher practice. They conclude by stating that any professional development program which is sustained and communal tends to have the most impact. Communal also includes online communities of practice which tend to reinforce the strengths of online learning and simulaneously illustrate the inherent challenges (Cook, 2007; Zhang & Watts, 2008). These studies underscore the complexities of professional development for educators and demonstrate that more research is required in this field in general and more specifically in the area of e-learning.

Smith (2009) examined a number of studies dealing with online teaching standards, the perceptions of online teachers, and national standards for online education. His conclusions are significant as he argues first that standards for online teachers are not truly reflective of the roles that online teachers must perform and secondly that most online teachers are themselves not even aware of any standards which apply to online teaching. In this study, Smith also points out that online education is offered using different platforms and delivery modes. These, in turn, require different training and offer different pedagogical options which implies that professional development for online teachers needs to be improved.

In a survey conducted by Rice and Dawley (2009) of 259 online teachers, they highlight many of the same deficiencies identified in earlier studies by D'Alba and Sandberg (2006). There is little empirical evidence of effectiveness and all too often professional development programs fail to consider the importance of contextualized training versus the acquisition of skills and knowledge which does reflect the realities of the teacher involved. Rice and Dawley cite the rapidly evolving nature of technology as one key issue in professional development programs for online teachers, but a significant proportion of online teachers involved in this survey indicated that they received either no training prior to teaching online, or they stated that their training was inadequate. Moreover the teachers involved in Rice and Dawley's survey described the topics involved in their professional development as those which covered technology usage, lesson design, facilitation strategies, and foundational knowledge. Ultimately, pragmatic issues drive the type of training online teachers receive, but as Rice and Dawley conclude more must be given over to what constitutes best educational practice in the virtual school setting.

What constitutes effective professional development for online teachers is not very easy to demonstrate as evidenced by the study conducted by Hathaway and Norton (2012). The initial premise put forth by the authors is that there are aspects of online teaching which are significantly different from conventional brick and mortar classroom instruction, and for this very reason, those teaching online require a robust, ongoing, and effective professional development program. As indicated by Archambault and Crippen (2009), the vast majority of online teachers have been recruited from the conventional classroom, and most are identified as highly effective teachers whose skills can and should transfer well into the virtual classroom. Hathaway and Norton examined two programs used to prepare classroom teachers for the online environment. In essence, one program was a light program which provided only the basics with an emphasis on the technology, while the second program covered a wide range of topics relevant to the online classroom. What the authors had anticipated was that those who had received indepth preparation would be more comfortable in the online classroom and they would report greater success when compared to those who had received only minimal training. The results surprised the authors as this correlation could not be drawn suggesting that classroom teachers who mastered their subject content and who could communicate effectively would transition comfortably into the virtual environment and that additional training was not as essential as suggested by others. Hathaway and Norton contextualized their findings by stating that much of the data came from the online teachers themselves in self-reporting and that their respective interpretations likely varied considerably.

When preparing educators to teach in the virtual classroom, modeling online instruction for prospective online teachers is a productive and effective means of introducing the technology, the tools at the teachers' disposal, the challenges and the potential that this educational environment provides (Bell & Morris, 2009; Cook, 2007). Beyond the value of acquiring the relevant competencies to teach online, prospective instructors engaged in effective professional development, according to Cook (2009), also have the opportunity to live the experience as learners and to understand the situation from the learners' perspective. In this way their knowledge and understanding is constructed collaboratively and in a manner which typifies the basic tenets of social constructivism.

2.2 Social Constructivism

In the context of this case narrative inquiry, Vygotsky's (1978) principles are particularly relevant as the professional development must be experienced as authentic and meaningful given that change occurs most effectively when it is the by-product of human interaction and exchange (Andrews, 2012).

Sutinen (2008) situates social constructivism as a theory of learning within the larger framework of educational theorists ranging from Dewey to Piaget and Vygotsky. Sutinen (2008) maintains that constructivism is based on the assumption that the individual's construction processes cannot be influenced from the outside. Furthermore, constructivist theories of learning often rely on a notion of development in which it is assumed that the individual's learning process will develop following an intuitive and native capacity which takes into consideration an individual's place in the world and that individual's interaction with everyone and everything. Moreover, Sutinen (2008) points how learning theories by Dewey and others are frequently embedded with social constructivist concepts and modalities that situate the learner in a context where there is constant and ongoing interaction. Consequently, and in the context of the professional development program, the narrative inquiry describes learning as an important collaborative and social process for the online teachers involved.

2.3 Study Group

The virtual school staff involved in the study was located in Shawville, Quebec. The staff included 8 teachers and two school administrators. The virtual school delivers a high school curriculum to students across Quebec using teachers who were selected from the regional school boards because of their subject mastery as well as their willingness to tackle the challenges of a synchronous-asynchronous blended delivery model. Initially, and as expected, their methodology reflected conventional brick and mortar styles. It became quickly apparent that this approach did not engage the students and did not optimize the potential of the virtual setting. The professional training program in which they embarked was intended to model what was to be expected of them in the online classes and to parallel the provincial curriculum which is grounded in social constructivist principles.

3. CONCLUSION

Research suggests that professional development should be a continuous process which allows teachers time to practice, to provide modeling of instruction, and to offer feedback (McMaster & Tschannen-Moran, 2009). Moreover in the field of e-learning, professional development functions as the path for developing faculty members to be effective online and to increase student outcomes (Keengwe, Kidd, & Kyei-Blankson, 2009). Currently there is an urgent need for effective professional development for educators in virtual schools; however, there is simultaneously a dearth of research on professional development models for the many forms e-learning may take.

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THE EFFECTIVENESS OF SDMS IN THE DEVELOPMENT OF E-LEARNING SYSTEMS IN SOUTH AFRICA

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ABSTRACT

E-learning systems, or learning management systems, as it is known in the field, sit at the heart of educational systems and are used to systematically deliver on-line content and facilitate the learning experience around that content. It becomes essential to ensure that Learning Management Systems of a high standard are being developed. In the field of Systems Development Methodologies (SDMs), much research has been done and the value of SDMs is proven and documented. To ensure that e-learning systems of outstanding quality are being developed, it is crucial that systems development methodologies are being used as they can have a significant impact on the development process.
The main focus of this study was to determine if systems development methodologies are being utilised in the development of electronic learning systems in South Africa and if these methodologies are being applied effectively. By utilising a survey as the main research method and statistically analysing the dataset, meaningful results were obtained. Some of the findings were that academic institutions are clearly using open-source LMSs more than proprietary LMSs. The LMS platform had a moderate effect on the success of the LMS. Open-source LMS users were very satisfied with their LMS platform and not inclined to consider a proprietary LMS for future projects. Proprietary LMS users may be inclined to consider an open-source LMS for future projects. It was found that a very strong relationship exists between respondents that indicated that they use RAD as SDM and the impact this SDM had on the quality and productivity of the development process. It was found that a very strong relationship exists between the perceived support that the SDM provides and the impact of the SDM on the quality and productivity of the development process. This in turn has a strong influence on the impact systems development methodologies have on the quality of learning management systems.

KEYWORDS

e-learning, learning management systems, systems development methodologies.

1. INTRODUCTION AND PROBLEM STATEMENT

With the dramatic increase in the popularity and use of e-learning and e-learning systems, it becomes a necessity to ensure that systems of a high quality are being developed. If e-learning is applied efficiently, it can go a long way towards helping learners to generate and obtain knowledge for themselves. Many cultures around the world still have no access to even basic education. E-learning can be one of the answers to this problem.

Even a cursory study into e-learning makes it clear that there is still plenty of confusion surrounding e-learning and the technology and applications involved with it. It becomes apparent there is still much to benefit, from further research into this field.

In another and not unrelated field of Systems Development Methodologies (SDMs), much more research has been done and the value of SDMs is proven and documented. However, there is still a lack of empirical evidence on the actual use and effectiveness of SDMs and even more so with its use and effectiveness in the development of e-learning systems.

SDMs have had a major impact on the development of software systems over the last 40 odd years and are an indispensable tool for developing systems in recent times. E-learning systems, being an emerging subset in software systems technology, could well profit from the benefits SDMs have to offer.

The aim of this study will be to research the use and effectiveness of SDMs in the development of e-learning systems.

2. LITERATURE STUDY

2.1 Terminology

For the purposes of this study e-learning can be seen as a medium for delivering and facilitating learning, through electronic means.

The term Learning Management System will also be used for the purposes of this study. An LMS is a software system that is used to systematically deliver content on-line and to facilitate the learning experience around that content.

The following definition of a systems development methodology will be used (Huisman, 1999):

- **Systems development approach**
  This can be defined as the philosophical view on which the methodology is built. Thus, the set of goals, guiding principles and beliefs, basic concepts and principles of the systems development process that drive interpretations and actions in systems development (Iivari *et al*., 1998; Iivari *et al*., 1999). Examples of systems development approaches are the structured approach, object-oriented approach, information modelling, etc.
- **Systems development process model**
  Wynekoop and Russo (1993) define a process model as a representation of the sequences of stages through which a system evolves. Some examples of process models are the linear life-cycle model, the spiral model and incremental model.
- **Systems development method**
  A method is a systematic approach to conducting at least one complete phase of systems development, consisting of a set of guidelines, activities, techniques and tools, based on a particular philosophy of systems development and the target system (Wynekoop & Russo, 1993). Examples include IE, SSADM, etc.
- **Systems development technique**
  A systems development technique consists of a well-defined sequence of actions, ensuring successful results if used correctly (Iivari *et al*., 2000; Brinkkemper, 1996), for example entity relationship diagrams and data flow diagrams..

2.2 The Use of Systems Development Methodologies

It is argued that the use of SDMs will aid in the development process by making it more effective, secure, predictable and easier to control, whilst improving productivity and quality (Fitzgerald *et al*., 2002). Whether systems development methodologies are being used in practice has been a point of interest for academics for an extended period of time.

Russo *et al*. (1995) found that only 6% of developers followed an SDM rigorously. Chatzglou and Macaully (1996) found that 47% of their population had never used a methodology. Avison and Fitzgerald (2003) also found this number to be low. Less than 50% of organisations follow SDMs strictly (Glass, 1999). Huisman and Iivari (2006) determined that when SDMs are being used in practice, it is not to the full extent. Fitzgerald *et al*. (2002) show that the use of formalised SDMs was significantly higher in larger organisations (more than 1 000 employees) and larger IS departments (more than 20 personnel). In recent studies conducted by Brits (2011) and Janse van Rensburg (2012) it was found that 74% of organisations in South Africa make use of SDMs. Conradie (2010) and Wagener (2012) also found this number to be above 75%.

2.3 The Effectiveness of Systems Development Methodologies

Empirical research on the effectiveness of SDMs is very limited, which seems to be due to the lack of standard criteria that measures SDM effectiveness (Conradie 2010). This section will confer the results on the effectiveness of SDMs that were found in the literature.

Although many SDMs have been successfully utilised over the years, there have been many software failures, which has questioned the relevance of SDMs. Even with the use of SDMs, projects are still being abandoned halfway, still overshooting the budget, and still not being delivered within an appropriate time frame (Truex *et al*., 2000; Gruner *et al*., 2007). However, great strides have been made in the last four decades; yet there is still much to be learned from studies into the effectiveness of SDMs.

There are several compelling reasons for using SDMs. Fitzgerald *et al*. (2002) state that systems development methodologies have been endorsed by the literature, as being capable of ensuing that the development process is more effective, secure, predictable and easier to control. Gruner *et al*. (2007) argue that it is challenging and precarious to develop software without the guidance or structured process that an SDM can provide. Huisman and Iiavari (2006) reasoned that SDMs introduce structure to the design process, thereby improving the effectiveness of software development and thus ensuing more consistent outcomes. The use of software methodologies is said to decrease the risk of failure of an information system (IS) project (Hull *et al*, 2002; Avison & Fitzgerald, 2003).

3. DATA COLLECTION AND ANALYSIS

In the field of information systems, surveys are a popular strategy to employ in the collection of empirical evidence. A questionnaire, as the measurement element, was developed in collaboration with a statistical consultation service. The constructs, identified from the conceptual research model, were operationalised by selecting measurement scale items (questions) and scale types. The questions were adapted from previous research studies, which proved to be reliable. The questionnaire was concise and relevant and contained mostly leading, importance and 5-point Likert scale questions. It was distributed electronically, as a macro-enabled Excel file, to personnel at institutions of higher education in South Africa that are responsible for developing and/or deploying e-learning systems. Software companies in South Africa, which develop e-learning solutions, were also targeted. The questionnaire had extensive built-in entry validation to ensure that the respondents fill in the correct values as well as coding to assist in data analysis.

Fifty responses were received from a possible one hundred and twenty-five responses. Therefore, the participation rate equalled 40% with 50 cases available for data analysis.

4. RESULTS OF THE RESEARH QUESTIONS

The relationship between industry and platform of the LMS (RQ1):

In academic institutions open-source LMSs are being used in almost 61% of the cases and in the private sector just above 52%. Many of the academic institutions indicated that they are in the process of moving towards an open-source learning management system but that they are currently still using a proprietary LMS.

The relationship between industry and number of students (RQ2):

Crosstab analysis was done to determine if the type of industry relates to the number of users of the specific LMS in question. The results of the crosstab analysis can be seen in Table 1 and it was statistically significant with $p < 0.01$ and a Cramer’s V of 0.568.

It is quite noticeable that 75% of the academic institutions’ LMSs are being utilised for 10 000 or more students, learners or employees. The private sector almost exclusively uses LMSs with more than a 1 000 users.

Table 1. Crosstab analysis: Research Question 2

Industry	**Number of students/learners/employees using the LMS**						
	1-99	**100-499**	**500-999**	**1000-4999**	**5000 - 9999**	**10 000 or more**	**Total**
Academic	7.1%	10.7%	0%	0%	7.1%	75%	100.0%
Private Sector	0%	15.8%	0%	21.1%	31.6%	31.6%	100.0%
Total	4.3%	12.8%	0%	8.5%	17%	57.4%	100.0%

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The relationship between industry and method of procurement of LMS (RQ3):

Crosstab analysis was to determine if the type of industry relates to the LMS platform being used. The results of the crosstab analysis can be seen in Table 2 and it was statistically significant with $p < 0.05$ and a Cramer's V of 0.447. There is very little in-house development being done when it comes to the procurement of LMSs with a combined (academic and private sector) total of 17.4% of the respondents indicating that they make use of in-house development. With 32.6% of the procurement of LMSs being done by adapting open-source LMSs, it is by far the preferred method of procuring an LMS. To elaborate on the abovementioned adaption of open-source LMS, it is worth noting that 39.3% of academic institutions use open-source systems "as is", while only 5.6% of the private sector use LMSs "as is". Only 21.4% of academic institutions adapt their LMSs compared to the 50% of the private sector. A combined total of 23.9% of the procurement of LMSs are being done by purchasing off the shelf products.

Table 2. Crosstab analysis: Research Question 3

Industry	Procurement of LMSs				
	Purchased	**In-house**	**Open-source (used as-is)**	**Adapted from open-source system**	**Total**
Academic	25%	14.3%	39.3%	21.4%	100.0%
Private Sector	22.2%	22.2%	5.6%	50%	100.0%
Total	23.9%	17.4%	26.1%	32.6%	100.0%

The relationship between the LMS platform and perceived success of the LMS (RQ4):

T-tests indicated that the LMS platform had a medium effect on the success of the LMS with an effect size $\left(f^2\right)$ of 0.34 and a statistical significance, $p > 0.05$.

The relationship between the LMS platform and the satisfaction with the platform (RQ5):

T-tests indicated that the platform of the LMS has a very high effect on the inclination of respondents to consider using an open-source LMS for future projects with an effect size $\left(f^2\right)$ of 1.71 and it is statistically significant with $p < 0.001$. Respondents that use an open-source LMS would be inclined to keep using an open-source LMS for future projects with a mean value of 4.4.[1] Respondents that use a proprietary LMS will be less inclined to consider an open-source LMS for future projects with a mean value of 2.75. T-tests also indicated that the platform of the LMS has a very high effect on the inclination of respondents to consider using a proprietary LMS for future projects with an effect size $\left(f^2\right)$ of 1.04 and it is statistically significant with $p < 0.001$. Respondents that use a proprietary LMS would be inclined to keep using a proprietary LMS for future projects with a mean value of 3.65. Respondents that use an open-source LMS will be less inclined to consider a proprietary LMS for future projects with a mean value of 2.4.

The relationship between the procurement method of the LMS and the satisfaction with the platform (RQ6):

T-tests indicated that the procurement method of the LMS has a very high effect on the inclination of respondents to consider using an **open-source** LMS for future projects. Respondents that use an open-source LMS would be inclined to consider using an open-source LMS (as is, i.e. not adapting it) for future projects with an effect size $\left(f^2\right)$ of 2.16 and it is statistically significant with $p < 0.001$. Respondents that use a proprietary LMS would be inclined to consider using an open-source LMS (as is, i.e. not adapting it) for future projects with an effect size $\left(f^2\right)$ of 2.11 and it is statistically significant with $p < 0.001$. Respondents that use an open-source LMS would also be inclined to consider adapting an open-source LMS for future projects with an effect size $\left(f^2\right)$ of 1.50 and it is statistically significant with $p < 0.001$. Respondents that

[1] All the means are indicated as a value out of a possible 5, as a five-point Likert scale was used.

use a proprietary LMS would also be inclined to consider adapting an open-source LMS for future projects with an effect size $\left(f^{2}\right)$ of 1.45 and it is statistically significant with $p < 0.001$.

It is clear that the respondents will consider using open-source LMSs for future projects, but they are less inclined to adapt such LMSs, than using them as is.

The relationship between the perceived success of the LMS and the satisfaction of the platform (RQ7):

There is a strong relationship that exists between the success of the LMS and the satisfaction of the platform used with a Spearman's rho of 0.589 and it is statistically significant with $p < 0.001$.

The relationship between the type of SDM used and the success of the LMS (RQ8):

T-tests indicated that the use of formal SDMs had a medium effect on the success of the LMS with an effect size $\left(f^{2}\right)$ of 0.34 and a statistical significance, $p < 0.05$.

The relationship between the type of SDM used and the impact of the SDM on the development process (RQ9):

This research question determines if there is a relationship between the type of formal standard SDM used and the impact of the SDM on the quality and productivity of the development process. There is a very strong relationship that exists between respondents that indicated that they use RAD as SDM and the impact this SDM had on the quality and productivity of the development process. Spearman's rho = 0.618. $p < 0.001$. There is a strong relationship that exists between respondents that indicated that they use IE as SDM and the impact this SDM had on the quality and productivity of the development process. Spearman's rho = 0.517. $p < 0.01$. The SDM with the strongest influence on the quality and productivity of the development process is RAD, which is an Agile methodology.

The relationship between the performance expectancy of the SDM and the impact of the SDM on the quality and productivity of the development process (RQ10):

There is a strong relationship that exists between the performance expectancy of the SDM and the impact of the SDM on the quality and productivity of the development process with a Spearman's rho of 0.563 and it is statistically significant with $p < 0.01$.

The relationship between the performance expectancy of the SDM and the perceived impact of the SDM on the quality of the LMS (RQ11):

There is a strong relationship that exists between the performance expectancy of the SDM and the perceived impact of the SDM on the quality of the LMS with a Spearman's rho of 0.547 and it is statistically significant with $p < 0.01$.

The relationship between the perceived support that the SDM provides and the impact of the SDM on the quality and productivity of the development process (RQ12):

There is a very strong relationship that exists between the perceived support that the SDM provides and the impact of the SDM on the quality and productivity of the development process with a Spearman's rho of 0.744 and it is statistically significant with $p < 0.001$.

The relationship between the perceived support that the SDM provides and the perceived impact of the SDM on the quality of the LMS (RQ13):

There is a strong relationship that exists between the perceived support that the SDM provides and the perceived impact of the SDM on the quality of the LMS with a Spearman's rho of 0.541 and it is statistically significant with $p < 0.01$.

The relationship between the impact of the SDM on the quality and productivity of the development process and the success of the LMS (RQ14):

There is a weak relationship that exists between the impact of the SDM on the quality and productivity of the development process and the success of the LMS with a Spearman's rho of 0.177 and it is not statistically significant with $p > 0.05$.

The relationship between the impact of the SDM on the quality and productivity of the development process and the perceived impact of the SDM on the quality of the LMS (RQ15):

There is a strong relationship that exists between the impact of the SDM on the quality and productivity of the development process and the perceived impact of the SDM on the quality of the LMS with a Spearman's rho of 0.543 and it is statistically significant with $p < 0.01$.

The relationship between the perceived impact of the SDM on the quality of the LMS and the success of the LMS (RQ16):

There is a moderate relationship that exists between the perceived impact of the SDM on the quality of the LMS and the success of the LMS with a Spearman's rho of 0.376 and it is statistically significant with $p < 0.05$.

The need to design an SDM specific to LMS and the SDM that was used to design the current LMS (RQ17):

There is a strong negative relationship that exists between respondents that indicated that they use another (not listed) SDM and on opinion that there is room for a newly designed SDM specifically for developing LMSs with a Spearman's rho = -0.402 and a statistical significance, $p < 0.05$. There is a strong relationship that exists between respondents that indicated that they use another (not listed) SDM and on the opinion that an existing SDM can be adequately adopted to suit the needs of e-learning with a Spearman's rho = 0.437 and a statistical significance, $p < 0.01$. There is a moderate negative relationship that exists between the respondent that indicated that they use IE (Information Engineering) as SDM and the opinion that an existing SDM can be adequately adopted to suit the needs of e-learning with a Spearman's rho = -0.399 and a statistical significance, $p < 0.05$.

Summary of the results

A summary of the statistical analyses that were performed, and the relationships that were evaluated, can be seen in table 3.

Table 3. Research questions as tested (Note: p = Level of Significance. ***= <0.001, **= <0.01, *= <0.05, '=<0.1; n/a=this type of test could not/was not performed)

Research Question	Path tested	Spearman's rho (ρ) / Cramer's V (φ)	Effect Size (f^2)	Relationship / Correlation / Level of Association
RQ1	Industry → Platform_Used	φ_c = 0.709***	n/a	Very strong
RQ2	Industry → Number_Users	φ_c = 0.568**	n/a	Very strong
RQ3	Industry → Procurement_LMS	φ_c = 0.447*	n/a	Very strong
RQ4	Platform_Used → Success LMS	n/a	0.34	Medium effect
RQ5	Platform_Used → Satisfaction_LMS_Platform	n/a	1.71*** 1.04***	Very high effect
RQ6	Procurement_LMS → Satisfaction_LMS_Platform	n/a	2.11*** 2.16*** 1.50*** 1.45***	Very high effect
RQ7	Success LMS → Satisfaction_LMS_Platform	ρ = 0.589***	n/a	Strong
RQ8	Formal_SDM_Use → Success_LMS	n/a	0.34*	Moderate

Research Question	Path tested	Spearman's rho (ρ) / Cramer's V (φ)	Effect Size (f^2)	Relationship / Correlation / Level of Association
RQ9	Extent_Standard_SDM (RAD) → Impact_SDM_Quality_Productivity	ρ = 0.618***	n/a	Very strong
RQ10	Performance Expectancy SDM → Impact_SDM_Quality_Productivity	ρ = 0.563**	n/a	Strong
RQ11	Performance Expectancy SDM → Impact_Quality_LMS	ρ = 0.547**	n/a	Strong
RQ12	Perceived Support SDM → Impact_SDM_Quality_Productivity	ρ = 0.744***	n/a	Very strong
RQ13	Perceived Support SDM → Impact_Quality_LMS	ρ = 0.541**	n/a	Very strong
RQ14	Impact_SDM_Quality_Productivity → Success LMS	ρ = 0.177'	n/a	Weak
RQ15	Impact_SDM_Quality_Productivity → Impact_Quality_LMS	ρ = 0.543**	n/a	Strong
RQ16	Impact_Quality_LMS → Success LMS	ρ = 0.376*	n/a	Moderate
RQ17	Need_SDM_LMS → Extent_Standard_SDM (Other)	ρ = 0.437**	n/a	Strong

5. CONCLUSION

The inferential statistics that are presented in this paper reveal some interesting facts about the relationships between certain constructs related to learning management systems and systems development methodologies in South Africa.

Crosstab analysis indicated that open-source learning management systems are preferred to proprietary LMSs, especially in the academic sector. It also revealed that the majority of LMSs in South Africa are being used for 10 000 or more users. Academic institutions also tend to use open-source LMSs as is and the private sector adapts open-source LMSs to a large extent.

There is a strong relationship that exists between the perceived success of the LMS and the satisfaction of the platform used. It makes sense that respondents will be satisfied with their LMS platform if the LMS is successful. In general, respondents are very satisfied with their current LMS platform.

Open-source LMS users are not inclined to consider a proprietary LMS for future projects. Proprietary LMS users are more inclined to consider an open-source LMS for future projects. Both proprietary and open-source LMS users will be less inclined to adapt an open-source LMS, than using it as is.

A very strong relationship were found between the perceived support that the SDM provides and the impact of the SDM on the quality and productivity of the development process. There is a very strong relationship that exists between respondents that indicated that they use RAD as SDM and the impact this SDM had on the quality and productivity of the development process. This correlates with what the literature revealed on the use of Agile methodologies in the post-methodology era.

There is also a strong relationship that exists between the performance that users expect SDMs can provide and the impact that the specific SDMs have on the quality and productivity of the development process. A very strong relationship exists between the support that the SDM provides in the development process and the actual impact that the SDM has on the quality and productivity of the development process.

Both the perceived support that the SDM provides and the impact of the SDM on the quality and productivity of the development process have a strong influence on the impact the SDM has on the quality of the LMS.

The study made a contribution to the discipline of information systems, and more specifically, learning management systems, by providing insights with regard to the factors effecting the use and effectiveness of SDMs in developing LMSs. As far as could be ascertained, this study generated the first empirical data on the procurement and development of LMSs in South Africa. A holistic picture was drawn on what the South African e-learning market looks like and it was determined that the extent of use of open-source LMSs exceeds what was initially believed.

Almost 75% of the respondents indicated that there may be room for a newly designed SDM specifically for the development of LMSs and tools for LMSs. This could well be a great opportunity for future research in this field. This study may also serve as a stimulus for future research in the field of learning management systems and more specifically the development of LMSs by using systems development methodologies to enhance the chances of success for those systems.

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ONLINE LEARNING BEHAVIORS FOR RADIOLOGY INTERNS BASED ON ASSOCIATION RULES AND CLUSTERING TECHNIQUE

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ABSTRACT

In a hospital, clinical teachers must also care for patients, so there is less time for the teaching of clinical courses, or for discussing clinical cases with interns. However, electronic learning (e-learning) can complement clinical skills education for interns in a blended-learning process. Students discuss and interact with classmates in an e-learning collaborative environment. E-learning can assist clinical training and provides a collaborative environment, but every student has individual learning preferences on the e-learning platform. A typical platform, such as a learning management system (LMS) does not provide individual learning activities for every student. This paper clusters students into two groups: active and inactive groups. In each group, students' learning behavior patterns, i.e., the association rules for activities, are derived from the transaction data for the LMS. The cluster to which a student belongs defines the online learning behaviors, from the activity association rules. The method then provides individual preferred activities. Teachers instruct students in accordance with their aptitude, as derived from the learning behavior pattern. The cluster analysis shows that students in active group often view teaching videos after completing feedback. Students in the inactive group often view teaching materials after adding posts on a forum.

KEYWORDS

Internship, clinical skill education, e-learning, blended learning, clustering, association rules

1. INTRODUCTION

In a hospital, clinical teachers must devote time to patients, so they have less time to teach clinical courses, or to discuss clinical cases with interns (Prideaux et al., 2000, Ramani and Leinster, 2008). However, e-learning can be a complement to clinical skill education for interns (Ruiz et al., 2006). Most medical students feel that e-learning has a positive impact on the acquisition of clinical skill and knowledge. It is an integrated, blended approach (Gormley et al., 2009). Students who use an e-learning platform as a complement to in-classroom education obtain higher scores in the final examination (Seluakumaran et al., 2011). Blended learning, which is clinical learning combined with e-learning, results in a greater acquisition of knowledge in radiology internship (Mahnken et al., 2011). An e-learning course in radiology gives greater knowledge acquisition than a standard lecture-based course and is a cost-effective alternative to standard lecture-based teaching (Hadley et al., 2010).

Medical education in radiology includes undergraduate, postgraduate and continuing education. The existing e-learning platforms for radiology are on-line neuroradiology education resources (NeuroRAD) (Sparacia et al., 2007), the American Association of Physics in Medicine (AAPM) and the Radiological Society of North America (RSNA) (Brambilla et al., 2011). These platforms were developed for physicists and radiologists in continuing education, but few platforms have been developed for undergraduate radiology internship. Radiology clinical training includes image diagnosis, nuclear medicine, radiation oncology, quality assurance and safety examination, which require discussion and interaction with a teacher and classmates. In an e-learning collaborative environment, radiology interns can interact with their classmates at anytime, to construct their own knowledge base(Brambilla et al., 2011). Clinical teachers provide the radiological content, such as image banks and special clinical cases (Perriss et al., 2006). Radiology interns in

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different areas discuss their cases with others by posting on a forum. This study establishes an e-learning platform to assist clinical skill training.

E-learning can assist clinical training and provides a collaborative environment, but every student has individual learning preferences on the e-learning platform. A typical platform, such as the learning management system (LMS), does not provide individual learning activities for every student. In order to provide an individual learning environment, data mining technology is applied to educational systems (Romero and Ventura, 2007). This paper clusters students into two groups, based on their activity preferences: active and inactive groups. Students in the active group, often view the course, complete feedback, add posts, update posts and view discussions on the forum. All of the activity association rules for the two groups were retrieved, in order to determine students' learning behavior patterns, for each cluster. For example, active group students often view teaching videos for the lessons, after viewing the course and completing feedback. They also prefer to write messages to other classmates to communicate emotions.

The remainder of this paper is organized as follows. Section 2 discusses related studies. Section 3 describes the proposed method. Section 4 presents the experimental results. Section 5 summarizes the findings, states the limitations of this study.

2. RELATED STUDIES

Two data mining techniques are used: clustering technique and association rules. Some data mining applications for e-learning are also described.

2.1 Clustering Technique

Clustering techniques, which are usually used to segment markets (Punj and Stewart, 1983), seek to maximize the variance between groups and to minimize the variance within groups. A number of clustering algorithms have been developed, such as K-means, hierarchical and fuzzy c-means algorithms (Omran et al., 2007). K-means clustering (MacQueen, 1967) is a widely used similarity grouping method that partitions a dataset into k groups. The K-means algorithm assigns instances to clusters, based on the minimum distance principle. An instance is assigned to a cluster based on the minimum distance to the center of the cluster, over all of the k clusters.

2.2 Association Rules

Association rule mining determines the associations between two sets of products in a transaction database. Agrawal et al. (1993) formalized the problem of determining association rules that satisfy the minimum support and the minimum confidence requirements. For example, if a set of purchase transactions includes a set of product items I, an association rule is an implication of the form, $X \Rightarrow Y$, where $X \subset I$, $Y \subset I$, and $X \cap Y = \Phi$. X is the antecedent (body) and Y is the consequence (head) of the rule. Two measures, support and confidence, are used to determine the quality of an association rule. The support of a rule is the percentage of transactions that contain both X and Y and the confidence of a rule is, the fraction of all transactions that contain X that also contain Y.

2.3 Data Mining Applications for E-learning

Data mining technologies include on-line analytical processing (OLAP), clustering, association rules and classification and visualization (Zaíane, 2002, Talavera and Gaudioso, 2004, Zorrilla et al., 2005, Mostow and Beck, 2006, Romero and Ventura, 2007, Romero et al., 2008). For example, Zorrilla et al. (2005) built a web log data cube for OLAP operation, to analyze the log to obtain the information that allows teachers to evaluate the learning process. Talavera and Gaudioso (2004) clustered users into groups, to determine their behavior patterns and evaluations. Mostow and Beck (2006) developed a listening tool that uses visualization technology to help children to decode words and comprehend stories. Zaíane (2002) used association rules that use a learner's access history to recommend on-line learning activities, or shortcuts on a course website. Romero et al. (2008) used clustering, association rules and classification technologies to discover knowledge from a learning content management system.

3. METHODOLOGY

This section proposes a method to understand learning behavior patterns for interns, which is shown in Figure1.The activity usage count for each student on LMS was calculated. The missing values were filled using proper data preprocessing. Because some activities are used by few or no students, feature selection was applied to some activities. These activities were not taken into account. The continuous values for the activity usage count were then transformed into discrete preference values, to form a student-activity preference matrix.

The K-means clustering method was then used to cluster students into activity preference groups, based on the similarity between students' activity preferences, which were measured using Pearson's correlation coefficient, as shown in Eq.(1). The $\overline{r_{S_i}}$ and $\overline{r_{S_j}}$ denote the average rating score of all activities used by students S_i and S_j respectively. The variable I denotes the mix of the set of activities. The $r_{S_i,A}$ and $r_{S_j,A}$ denote the rating score that students S_i and S_j used activity A.

$$\mathrm{corr}(S_i, S_j) = \frac{\sum_{A\in I}\left(r_{S_i,A}-\overline{r_{S_i}}\right)\left(r_{S_j,A}-\overline{r_{S_j}}\right)}{\sqrt{\sum_{A\in I}\left(r_{S_i,A}-\overline{r_{S_i}}\right)^2 \sum_{A\in I}\left(r_{S_j,A}-\overline{r_{S_j}}\right)^2}} \tag{1}$$

In each group, students' online learning behavior pattern, the association rules, were derived from the transaction data of the learning management system (LMS). The cluster to which a student belongs defines the online learning behavior pattern, based on the association rules in that cluster. The method shows the preferred activities for every student.

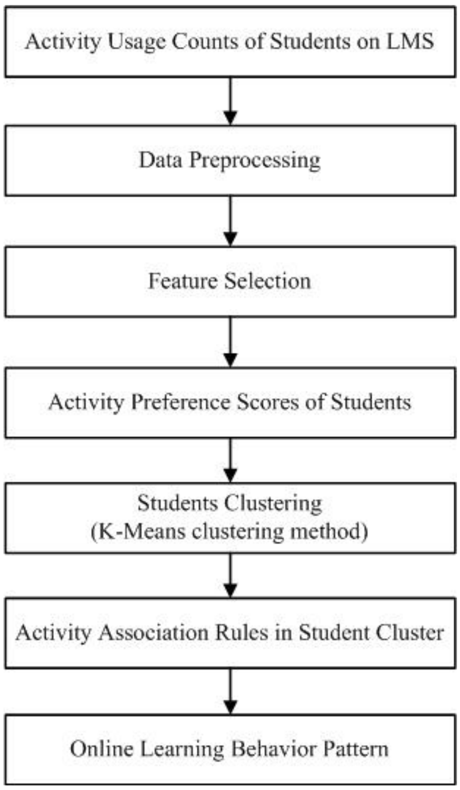

Figure1. An overview of the proposed method

3.1 Data Preprocessing

The students and activities transaction data from the learning management system (LMS) were firstly pre-processed. The linear method was used to fill the missing values. Feature selection was then applied. There are many learning activities on the learning management system, but some activities are never or seldom used. The number of the selected activities is 18. They include viewing the course, folder, discussion, resource, video, completing feedback, adding and updating posts on a forum, writing messages and updating user profiles.

3.2 Activity Preference Scores of Students

The usage counts for the selected activities are continuous values. Eq. (2) (Lin et al., 2003) is used to transform the continuous values to discrete values, i.e., -1, 0, or 1.

$$Z = \frac{X - \bar{x}}{\sigma_x} \tag{2}$$

where X is the activity usage count, $\bar{x}$ and σ_x are, respectively, the mean value and the standard deviation of the activity usage count and Z is a semantic variable.

All of the continuous usage count values were normalized to discrete preference scores (PS) and 0.3 is selected to cluster students into suitable groups by using Eq. (2) with $Z < -0.3$, $-0.3 \leqq Z \leqq 0.3$, and $Z > 0.3$, to respectively represent inactive, neutral and active preferences. The preference score (PS) is the degree of preference that a student demonstrates for an activity, which is defined as in Eq. (3). The preference score is 1 if the usage count, $X > \bar{x} + 0.3\sigma_x$, and the preference score is -1, if the usage count, $X < \bar{x} - 0.3\sigma_x$. 0 represents a neutral preference.

$$\text{Preferece Score (PS)} = \begin{cases} 1, & \text{when } X > \bar{x} + 0.3\sigma_x \\ -1, & \text{when } X < \bar{x} - 0.3\sigma_x \\ 0, & \text{otherwise} \end{cases} \tag{3}$$

The student-activity preference score matrix is shown in the following Table 1.

Table 1. Student–activity preference score matrix

Student ID	View courses	Complete feedback	Add post on forum	Update post on forum	View discussion on forum	
1	-1	0	1	0	1	…
2	0	-1	0	-1	1	…
3	1	0	-1	1	0	…
4	0	1	0	1	-1	…
⋮	⋮	⋮	⋮	⋮	⋮	…

4. EXPERIMENTAL RESULTS

4.1 Experiment Setup and Dataset

A dataset obtained from the learning management system (LMS) of a hospital was used for the experiment. The hospital is a medical center in northern Taiwan. This study was approved by the hospital ethics committee. Clinical teachers added learning resources (course, teaching material videos, or questionnaires) and activities (forum, chat room). Students viewed the courses, talked in chat rooms, discussed on forums and completed feedback on the LMS. The details are shown in Figure2.

The experiment dataset was extracted from the learning management system of the hospital, for the first semester of 2013. There are 10,637 items of student activity transaction data on the LMS. The dependent variable, support and confidence thresholds for the association rules were set to 0.5, 0.2 and 0.6. These thresholds were set based on our observation on the online learning behaviors of the students. The most popular activities are viewing the course, completing feedback, adding and updating posts and viewing discussions on a forum.

Figure 2. Knowledge sharing (left) and a discussion on a forum (right) on the e-learning platform

4.2 Student Cluster Identification

It is firstly necessary to identify the characteristics of each student cluster, i.e. the activity preferences for each student cluster. The average usage count for activity X in a cluster is compared to the average usage count $\bar{x}$ plus/minus the standard deviation, σ_x, for all students, to obtain the cluster preference score (PS),using Eq. (2). The preference score for an activity in the cluster ID is $PS(X^{\text{Cluster ID}}_{\text{Activity}})$. For example, $PS(X^0_{\text{View course}}) = -1$ and $PS(X^1_{\text{View course}}) = 1$. The activity preference scores for two clusters are shown in Table 2. The preference scores for activities such as viewing the course, completing feedback, adding posts, updating posts and viewing discussions on a forum in cluster 0 are $PS(X^0_{\text{View course}})$, $PS(X^0_{\text{Complete feedback}})$, $PS(X^0_{\text{Add post}})$, $PS(X^0_{\text{Update post}})$, $PS(X^0_{\text{View discussion}})$, which is (-1, -1, -1, -1, -1) and the preference scores for these activities in cluster 1 are $PS(X^1_{\text{View course}})$, $PS(X^1_{\text{Complete feedback}})$, $PS(X^1_{\text{Add post}})$, $PS(X^1_{\text{Update post}})$, $PS(X^1_{\text{View discussion}})$, which is (1, 1, 1, 1, 1).

Table 2. Activity preference scores for students in the two clusters

Cluster ID	Activity		Cluster	All			Preference Score (PS)
			X	$\bar{x}$	$\bar{x}$ - 0.3 σ_x	$\bar{x}$ + 0.3 σ_x	
0	course	recent	3.0	3.0	2.4	3.6	0
		view	269.3	399.0	319.8	478.2	-1
	feedback	complete	7.0	9.0	7.8	10.2	-1
	folder	view	12.0	10.0	7.9	12.1	0
	forum	add discussion	2.0	2.0	2.0	2.0	0
		add post	38.3	53.0	44.3	61.7	-1
		delete post	1.0	1.0	1.0	1.0	0
		update post	1.0	3.0	2.4	3.6	-1
		view discussion	294.3	402.0	332.7	471.3	-1
1	course	recent	2.5	3.0	2.4	3.6	0
		view	519.3	399.0	319.8	478.2	1
	feedback	complete	14.7	9.0	7.8	10.2	1
	folder	view	13.3	10.0	7.9	12.1	1
	forum	add discussion	3.0	2.0	2.0	2.0	1
		add post	78.5	53.0	44.3	61.7	1
		delete post	1.5	1.0	1.0	1.0	1
		update post	5.5	3.0	2.4	3.6	1
		view discussion	531.3	402.0	332.7	471.3	1

The usage counts for these activities for cluster 1 are twice those for cluster 0. Cluster 0 is an inactive group and cluster 1 is an active group. Students in the inactive group (cluster 0) seldom view the course, complete feedback, add posts, update posts, or view discussions on a forum. However, the active group (cluster 1) students have the opposite learning behaviors. Table 2 shows that the usage counts for adding posts, updating posts and adding discussions for cluster 1 are all larger than those for cluster 0. Students in cluster 1 show confidence in self-expression. The usage counts for recent course, viewing folders and deleting posts for cluster 0 are all close to those for cluster 1. “Recent course” means that students check the latest course status on the LMS.“Viewing folders” means that students download the necessary files, e.g., teaching plans and material, which are placed in folders on the LMS. “Deleting posts” means that students delete their post after adding a post on a forum. In summary, students in both groups download the necessary teaching material files, check the latest course information and delete their posts on a forum.

4.3 Activity Association Rules for Student Clusters

Table 3 shows the association rules between activities for cluster 0, i.e., from activity (X) to activity (Y). Students fill out the questionnaire, add discussions on a forum and then view discussions and search for the clinical questions on the platform. After adding a discussion on the forum, they view resources to find the answer to a clinical question. The resources are the teaching material files, which are provided by the clinical teacher. It is interesting that students in cluster 0 often remember to logout from the system and they pay more attention to the security of personal information than students in cluster 1.

Table 3. Association rules for activities for cluster 0

Cluster ID	Activity (X)		→	Activity (Y)	
0	course	recent	→	user	update
		view	→	forum	view forum
				resource	view
				user	login, logout, update, view all
	feedback	complete	→	forum	view forum
				resource	view
				user	login, logout, update, view all
	folder	view	→	user	logout, update
	forum	add discussion	→	forum	view forum
				resource	view
				user	login, logout, update, view all
		add post	→	forum	view forum
				resource	view
				user	login, logout, update, view all
		delete post	→	user	logout, update
		view discussion	→	forum	view forum
				resource	view
				user	login, logout, update, view all

Table 4 shows the association rules between activities for cluster 1, i.e., from activity (X) to activity (Y). Students in cluster 1often view a uniform resource locator (URL) and resource after viewing the course and completing feedback. The URL is a web link to teaching videos on YouTube. Students in cluster 1 review the lesson on the platform after it is taught. In addition, students in cluster 1 keep in touch with teachers or classmates by writing messages. Students in cluster 1 also often surf many websites at the same time and are more often compulsorily logged out of the after 5 minutes of no activity.

Table 3 and Table 4 show that students in both groups view other classmate’s recent profiles, which include information on the last login to the system. Students wish to know whether classmates view their recent posts and discussions on a forum, after they add posts and discussions on a forum. Students often check classmates’ latest login time to the system. They also often update their personal photos on the LMS. These are similar social behaviors to those seen on Facebook. It is found that students care about the peer status in the collaborative environment. Peer interaction is important during an internship. Students construct their own knowledge bases and learn from each other (Wilson and Stacey, 2004). In addition, students often observe other students learning status and wish to attract their attention. When they add a new topic for discussion on a forum, they view the posts that other classmates add or update. At the same time, they regularly update their photos and personal information on their own home pages. They attract the attention of peers for personal and social reasons.

Table 4. Association rules for activities for cluster 1

Cluster ID	Activity (X)		→	Activity (Y)	
1	course	recent	→	user	login, update
	course	view	→	message	write
			→	resource	view
				url	view
				user	login, update, view all
	feedback	complete	→	message	write
			→	resource	view
				url	view
				user	login, update, view all
	folder	view	→	user	login, update, view all
	forum	add discussion	→	user	login, update, view all
		add post	→	user	login, update, view all
		delete post	→	user	login, update
		update post	→	user	login, update, view all
		view discussion	→	user	login, update, view all

5. CONCLUSION

After cluster analysis, the average usage counts for viewing the course, completing feedback, adding posts, updating posts and viewing discussions on a forum for the active group are twice those for the inactive group. Therefore, students in the active group often view forums and resources after viewing the course, completing feedback, adding posts and viewing discussions on a forum. The student learning behavior patterns for each cluster can be derived, based on the association rules between activities for the cluster. Next year, when there are new interns, teachers can derive their clusters and association rules, to determine students' behavior, and using their behaviors and the association rules, give proper guidance and resources, to allow students to be taught in accordance with their aptitude. However, this study has some limitations. Some students were not familiar with the e-learning platform. In the future, the e-learning platform will be introduced before the internship.

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THE USE OF SDMS IN DEVELOPING E-LEARNING SYSTEMS IN SOUTH AFRICA

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ABSTRACT

The main focus of this study is to determine if systems development methodologies (SDMs) are being utilised in the development of electronic learning systems in South Africa. Electronic learning, or e-learning, is being employed to educate millions of learners, students and employees around the world and it is a critical component of modern educational systems. To ensure that e-learning systems of outstanding quality are being developed, it is therefore crucial that systems development methodologies are being used as they can have a significant impact on the development process. By utilising a survey as the main research method meaningful results were obtained. This study gave some insights into how learning management system procurement and development is being done in South Africa and revealed that the use of open-source systems currently exceeds the use of proprietary systems. The results of the research showed that systems development methodologies (e.g. Object-Oriented Analysis and Rapid Application Development) are being used in the development of e-learning systems.

KEYWORDS

e-learning, learning management systems, systems development methodologies.

1. PROBLEM STATEMENT AND RESEARCH AIM

Advances in information and communication technologies (ICT) have made huge volumes of information available to millions of people around the world. Some reports suggest that the U.S. workforce spends well in excess of $100 billion a year on job training (Clark & Meyer, 2008).

Garrison (2011) believes it is of the utmost importance that higher educational institutions need to understand and embrace the increasing importance of technology in an educational environment. It is obvious that our way of learning will have to adapt to this inundation of information.

According to Holmes and Gardner (2006) e-learning has properties that can overcome certain limitations of traditional learning, specifically limitations regarding the set times and locations for learning.

As e-learning is becoming ever more popular, it has almost become synonymous with education. It is being used in universities for educational purposes, by corporations to train their staff, in primary and secondary schools to teach learners, etc. Almost all forms of training and education done nowadays, have an e-learning component.

With the dramatic increase in the popularity and use of e-learning and e-learning systems it becomes a necessity to ensure that systems of a high quality are being developed.

In another and not unrelated field of Systems Development Methodologies (SDMs), much more research has been done and the value of SDMs is proven and documented. However, there is still a lack of empirical evidence on the actual use and effectiveness of SDMs and even more so with its use and effectiveness in the development of e-learning systems.

E-learning systems, being an emerging subset in software systems technology, could well profit from the benefits SDMs have to offer.

The aim of this study was to research the use of SDMs in the development of e-learning systems in South Africa, specifically to determine if open-source learning management systems are gaining ground on their proprietary counterparts and also to determine relationships between the type of industry and the learning management platform. The study makes a contribution to the discipline of information systems, and more specifically, learning management systems, by providing insights with regard to the use of SDMs in developing LMSs. This study has shed some light on what the South African e-learning market looks like. The researchers obtained a holistic picture of how e-learning systems (or more specifically, learning management systems) are being procured or developed in South Africa.

2. LITERATURE STUDY: E-LEARNING

This section gives a background on what is implied by the terms e-learning and e-learning systems and confers the difference between open-source and proprietary e-learning systems.

2.1 Definition of e-learning

Over the last decade or so, there has been some contention over the exact definition of e-learning and the terminology associated with e-learning. Some authors see e-learning as an overarching activity that involves any type of learning that is supported by ICT. This overarching term has been referred to as educational technology, communication and information technologies, technology-enhanced learning or web-based training.

There are many disparate definitions of e-learning but for the purposes of this study e-learning can be seen as a medium for delivering and facilitating learning, through electronic means.

2.2 E-learning Systems

A software system helps manage all the different technologies, concepts and aspects pertaining to a specific problem.

The Joint Information Systems Committee defines the term Virtual Learning Environment (VLE) as the components in which learners and tutors participate in on-line interactions of various kinds, including on-line learning (As quoted in Weller, 2007). VLEs can be described, in layman's terms, as software systems that are specifically developed to facilitate teaching and learning in an educational environment. VLEs is mentioned as a precursor, for what we know today as Learning Management Systems (LMSs). Paulsen (2002) defines an LMS as a broad term that is used for a wide range of systems that organise and provide access to on-line learning services for students, teachers and administrators. The definition Weller (2007) provides, best explains an LMS as a software system that combines a number of different tools that are used to systematically deliver content on-line and to facilitate the learning experience around that content.

For the purposes of this study, an LMS is a software system that is used to systematically deliver content on-line and to facilitate the learning experience around that content.

When procuring an e-learning system one can divide the options into two main groups, namely: proprietary or open-source. Open-source software is getting increasingly popular due to the economical and modular benefits it can offer. There is a number of open-source LMS software available but the two that have the greatest market share are Sakai and Moodle.

In contrast to open-source LMS software, proprietary software is produced and owned by a software company or software producer. Users of such software pay licensing fees and do not have access to the source code. Blackboard is one of the main competitors in the proprietary LMS market.

3. LITERATURE STUDY: SYSTEMS DEVELOPMENT METHODOLOGIES

The aim of this section is to give a review of systems development methodologies. Firstly, a brief overview on the background of SDMs will be given, then a clarification of the definition of SDMs will be made.

3.1 Background

Prior to the 1970's computer applications were implemented without the use of any formal systems development methodologies. The success or failure of such systems depended largely on the skill and experience of individual programmers. History shows us that systems development methodologies came into existence to address the shortcomings in existing techniques and to improve on the productivity and quality of software (Avison & Fitzgerald, 2002; Iivari *et al*., 2000).

Huisman and Iivari (2006) argued that using a systems develop methodology is more effective than not using one. SDMs introduce a certain structure to the development process, which in turn improves the effectiveness of the design process and facilitates more consistent outcomes.

Some of the better-known SDMs include Structured Systems Analysis and Design methodology (SSADM), Coad-Yourdon's Object-Oriented Analysis Design methodology (OOADM), Information Engineering (IE) and later on, Agile methodologies.

3.2 Definition

There has been much contention over the precise definition of the term, Systems Development Methodology. Wynekoop and Russo (1997) and Avison and Fitzgerald (2006) argue that there is no universally accepted and exact definition of what is implied by SDMs. This makes defining SDMs challenging.

Some examples of the disparate definitions follow. A systems development methodology is a systematic procedure for completing either a system or one of several stages of the systems development life cycle. It consists of goals, principles and specific methods and tools, which are selected on the basis of an underlying rationale or system development philosophy (Iivari *et al*., 1999). Wynekoop and Russo (1995) defined a methodology as an orderly approach to carry out at least one stage of the systems development life-cycle, by using relevant tools, techniques, or guidelines, based on an underlying philosophy. Avison and Fitzgerald (2006) defined an SDM as a way to accomplish the development (or part of the development) of software, established on a set of rationales and an underlying philosophy. This includes a definition of phases, tasks, tools, guidelines and documentation.

The following definition of a systems development methodology was developed (Huisman, 1999):

- **Systems development approach**

  This can be defined as the philosophical view on which the methodology is built. Thus, the set of goals, guiding principles and beliefs, basic concepts and principles of the systems development process that drive interpretations and actions in systems development (Iivari et al., 1998; Iivari et al., 1999). Examples of systems development approaches are the structured approach, object-oriented approach, information modelling, etc.
- **Systems development process model**

  Wynekoop and Russo (1993) define a process model as a representation of the sequences of stages through which a system evolves. Some examples of process models are the linear life-cycle model, the spiral model and incremental model.
- **Systems development method**

  A method is a systematic approach to conducting at least one complete phase of systems development, consisting of a set of guidelines, activities, techniques and tools, based on a particular philosophy of systems development and the target system (Wynekoop & Russo, 1993). Examples include IE, SSADM, etc.
- **Systems development technique**

  A systems development technique consists of a well-defined sequence of actions, ensuring successful results if used correctly (Iivari *et al*., 2000; Brinkkemper, 1996), for example entity relationship diagrams and data flow diagrams.

This definition of SDMs implies that there is a development approach that guides the development. All the facets that need to be included in the development are underpinned in this approach. The process model, in turn, defines the order in which the development steps are carried out and is dependent on the development approach. The development method is what has to be done in order to develop the system, given the approach. The techniques are instruments used in accomplishing the steps of the development. All this adds up to what is called a systems development methodology. This encompassing definition will also be used for this study.

4. DATA COLLECTION AND ANALYSIS

In the field of information systems, surveys are a popular strategy to employ in the collection of empirical evidence. A questionnaire, as the measurement element, was developed in collaboration with a statistical consultation service. The constructs, identified from the conceptual research model, were operationalised by selecting measurement scale items (questions) and scale types. The questions were adapted from previous research studies, which proved to be reliable. The questionnaire was concise and relevant and contained mostly leading, importance and 5-point Likert scale questions. It was distributed electronically, as a macro-enabled Excel file, to personnel at institutions of higher education in South Africa that are responsible for developing and/or deploying e-learning systems. Software companies in South Africa, which develop e-learning solutions, were also targeted. The questionnaire had extensive built-in entry validation to ensure that the respondents fill in the correct values as well as coding to assist in data analysis.

Fifty responses were received from a possible one hundred and twenty-five responses. Therefore, the participation rate equalled 40% with 50 cases available for data analysis.

5. RESULTS

This section gives a summary of the background information of all the respondents that completed the survey.

Industry the respondents work in

Just fewer than 60% of the respondents stated that the type of industry they work in can be described as "Academic". The rest (40.43%) were in the "Private Sector".

Number of learners, students or employees

Almost 58% of the LMSs are being used to train or educate 10 000 or more people.

LMS Platform

Almost 60% of respondents use an open-source LMS environment and not proprietary.

Procurement method of LMS

Respondents were asked whether they purchased, developed in-house, outsourced, use an open-source (as-is) or adapted from an open-source LMS. Just fewer than 32% of the respondents indicated that they adapted their current LMS from an open-source based LMS. See Table 1.

Table 1. Procurement method of LMS

Procurement method	Percentage
Purchased	23.40%
Developed in-house	17.02%
Outsourced	2.13%
Open-source (used as-is), specify which:	25.53%
Adapted from open-source system, specify which:	31.91%

Perceived success of the LMS

Respondents were asked to what extent they agree on statements regarding their current LMS. An overwhelming 84.91%[1] of the respondents answered in the affirmative, by marking either "Agree" or "Totally Agree", on the different options of this question. See Table 2.

[1] This percentage was calculated by adding the Agree and Totally Agree columns and averaging it for all the variables across the complete question.

Table 2. Perceived success of LMS

Statement	Percentage				
	Totally Disagree	Disagree	Neutral	Agree	Totally Agree
The system is functional	0.00%	0.00%	4.26%	53.19%	42.55%
The system is reliable	0.00%	6.38%	6.38%	42.55%	44.68%
The system is maintainable	0.00%	4.26%	4.26%	42.55%	48.94%
The system is portable	0.00%	2.13%	25.53%	42.55%	29.79%
The system is efficient	0.00%	6.38%	8.51%	42.55%	42.55%
The system is usable	0.00%	0.00%	8.51%	42.55%	48.94%
The developed system meets user needs	2.13%	2.13%	10.64%	53.19%	31.91%
The documentation of the developed system is good	6.38%	14.89%	12.77%	36.17%	29.79%
Overall, the developed system is of high quality	2.13%	2.13%	12.77%	38.30%	44.68%
Overall, the users are satisfied with the developed system	0.00%	2.13%	12.77%	53.19%	31.91%
Overall, the developed system is a success	0.00%	4.26%	4.26%	55.32%	36.17%

Satisfaction with the LMS platform

To statements regarding the e-learning platform, 44.68% of the respondents agreed that they were satisfied with their current platform and 29.79% totally agree to being satisfied with their platform. Almost 62% of the respondents would consider using an open-source LMS environment for future projects and 46.81% “Disagree” or “Totally Disagree” about considering in-house development for future LMS projects. See Table 3.

Table 3. LMS platform satisfaction and procurement for future LMS projects

Statement	Percentage				
	Totally Disagree	Disagree	Neutral	Agree	Totally Agree
I'm totally satisfied with our current platform	4.26%	6.38%	14.89%	44.68%	29.79%
I would consider using an open-source e-learning system for future projects	6.38%	12.77%	19.15%	27.66%	34.04%
I would consider purchasing a proprietary e-learning system for future projects	12.77%	23.40%	29.79%	23.40%	10.64%
I would consider the in-house development of an e-learning system for future projects	27.66%	19.15%	19.15%	17.02%	17.02%

The use of formal SDMs

Respondents were asked to indicate whether they used *formal* systems development methodologies to aid in systems development. Almost 80% indicated that they use formal SDMs in development.

To what extent were standard SDMs used

On the question that asked respondents to indicate which SDMs they use and to what extent, Object-Oriented Analysis (OOA) and Rapid Application Development (RAD) were most frequently selected, with 47.06% and 38.24% of the respondents respectively, using it to a large extent. See Table 4.

Table 4. SDMs used in LMS development

SDM Used	Percentage			
	Not At All	To Small Extent	To Large Extent	To Full Extent
STRADIS (Structured Analysis, Design & Implementation of Information Systems)	47.06%	23.53%	23.53%	5.88%
OOA (Object-oriented Analysis)	14.71%	35.29%	47.06%	2.94%
RUP (Rational Unified Process)	70.59%	23.53%	5.88%	0.00%
XP (Extreme Programming)	52.94%	29.41%	14.71%	2.94%
RAD (Rapid Application Development)	35.29%	23.53%	38.24%	2.94%
ETHICS (Effective Technical & Human Implementation of Computer-based Systems)	85.29%	8.82%	2.94%	2.94%
IE (Information Engineering)	47.06%	38.24%	11.76%	2.94%
SSM (Soft Systems Methodology)	76.47%	17.65%	5.88%	0.00%
Other, specify:	76.47%	2.94%	17.65%	2.94%

Stringent use of SDMs

Almost 60% of the respondents indicated that they adapted the SDM they used, depending on the specific project requirements.

Performance expectancy and perceived support of the SDM

The respondents were generally positive on the use, functionality and benefits of SDMs – as can be seen in table 5.

Table 5. Performance expectancy of the SDM and perceived SDM support

Statement	**Percentage**				
	Totally Disagree	**Disagree**	**Neutral**	**Agree**	**Totally Agree**
Using an SDM is recommended in my work	0.00%	0.00%	20.59%	58.82%	20.59%
The result of using an SDM is clear to me	2.94%	2.94%	20.59%	41.18%	32.35%
I would be able to communicate to others the consequences of using an SDM	2.94%	11.76%	17.65%	55.88%	11.76%
I would be able to explain why using an SDM may or may not be beneficial	8.82%	0.00%	20.59%	52.94%	17.65%
The application of the SDM is clear to me	8.82%	8.82%	14.71%	52.94%	14.71%
The benefits of using the SDM is apparent	5.88%	2.94%	5.88%	58.82%	26.47%
Overall, I believe the SDM is user-friendly and easy to apply	2.94%	5.88%	26.47%	61.76%	2.94%
The SDM enable me to complete tasks quicker	2.94%	2.94%	35.29%	44.12%	14.71%
The quality of my work is improved by using the SDM	2.94%	0.00%	20.59%	52.94%	23.53%
It is easier to accomplish my work by using the SDM	2.94%	2.94%	29.41%	47.06%	17.65%
The effectiveness of my work in systems development was enhanced using an SDM	2.94%	2.94%	41.18%	38.24%	14.71%
I had greater control over my development work when using an SDM	2.94%	0.00%	20.59%	61.76%	14.71%
The SDM is compatible with my development work	2.94%	2.94%	26.47%	58.82%	8.82%
The SDM fits well in the way I like to work	5.88%	0.00%	26.47%	52.94%	14.71%
I was permitted to use the SDM on a trial basis to see what it can do	11.76%	5.88%	26.47%	50.00%	5.88%

Perceived impact of the SDM on the LMS

The respondents were asked to indicate whether they agree with statements regarding the effect SDMs had on their e-learning system in terms of functionality, reliability, maintainability, efficiency, quality, usability and user satisfaction. Notably, about 56% of the respondents agreed and about 12% totally agreed that the e-learning system was more reliable as result of using an SDM in development. On average, 58%[2] of the respondents indicated that they "Agree" or "Totally Agree" that their developed e-learning system was more functional, reliable, maintainable, efficient, of better quality, more usable and that users are more satisfied with the e-learning system, as result of using SDMs to develop the system. See Table 6.

Table 6. Impact of SDM on LMS

Statement	**Percentage**				
	Totally Disagree	**Disagree**	**Neutral**	**Agree**	**Totally Agree**
The e-learning system is more functional as result of using the SDM	0.00%	0.00%	44.12%	41.18%	14.71%
The e-learning system is more reliable as result of using the SDM	0.00%	0.00%	32.35%	55.88%	11.76%
The e-learning system is more maintainable as result of using the SDM	0.00%	0.00%	32.35%	41.18%	26.47%
The e-learning system is more efficient as result of using the SDM	0.00%	0.00%	47.06%	38.24%	14.71%

[2] This percentage was calculated by adding the Agree and Totally Agree columns and averaging it for all the variables across the complete question.

The e-learning system is of better quality as result of using the SDM	0.00%	2.94%	35.29%	50.00%	11.76%
The e-learning system is more useable as result of using the SDM	0.00%	0.00%	47.06%	35.29%	17.65%
The users of the e-learning system is more satisfied as result of using the SDM	0.00%	2.94%	50.00%	35.29%	11.76%

Reasons for not using SDMs

The next question tried to ascertain the reasons for not using SDMs. The results can be seen in table 7. More than 60% of the respondents confirmed (Agree and Totally Agree) that there was a lack of staff experienced in implementing SDMs in their development work.

Table 7. Reasons for the non-use of SDMs

Statement	Percentage				
	Totally Disagree	Disagree	Neutral	Agree	Totally Agree
My organisation/IS department doesn't require the use of SDMs	26.47%	50.00%	0.00%	14.71%	8.82%
SDMs are complex or difficult to use	14.71%	55.88%	23.53%	5.88%	0.00%
Our current processes for development are adequate	2.94%	29.41%	23.53%	44.12%	0.00%
The benefits of using SDMs are not extensive enough	8.82%	64.71%	23.53%	2.94%	0.00%
The initial cost of procuring an SDM are high	14.71%	41.18%	32.35%	11.76%	0.00%
There is a lack of staff experienced in SDMs to implement such a strategy	5.88%	23.53%	8.82%	58.82%	2.94%
There is a lack of management support for the use of SDMs	5.88%	14.71%	41.18%	23.53%	14.71%

The need for an LMS-specific SDM

With the last question of the questionnaire the researchers wanted to ascertain, by means of certain statements, if there was room for a newly developed SDM designed specifically for e-learning systems. Almost 75% of the respondents agreed that there was room for a newly designed SDM for developing LMSs.

6. CONCLUSION

The descriptive statistics that are presented in this paper reveal some interesting facts about learning management systems in South Africa and the use of systems development methodologies when developing LMSs.

Both academic institutions and the private sector were approached to participate in this study. The respondents that returned the questionnaire were mostly developers, project leaders and people involved in the deployment of LMSs or involved with user support. More than half of the respondents indicated that their LMSs are being used for 10 000 or more learners and that they use an open-source LMS. Almost a third of all the respondents adapt their open-source LMS to suit their needs. Overall, the respondents perceived their LMS to be successful with almost half of them indicating that they agreed completely that their LMSs are efficient. A great number of respondents answered in the affirmative that they would consider an open-source LMS for future projects.

Almost 80% of the respondents indicated that they made use of formal SDMs. This is in line with recent studies done in South Africa. It appears that development teams involved with LMS projects are relatively small with more than half of the respondents indicating project teams of five members or less. Many of the standard SDMs are not being used to their full extent but the two standout SDMs were Object-Oriented Analysis and Rapid Application Development, which is an agile methodology. Almost none of the respondents use an SDM rigorously and more than half adapt them based on the specific needs of the project. This is in line with what is known about the contingent use of SDMs.

More than three quarters of the respondents were positive on the support and benefits that SDMs provide and almost as many answered in the affirmative that SDMs could have a positive impact on the development process. Many of the respondents were positive that SDMs could be advantageous in the development of LMSs in terms of the reliability, maintainability, efficiency and the quality of the LMS. Almost three quarters of the respondents indicated that they would adapt SDMs for future projects as needed for the specific project. Respondents indicated a substantial lack of personnel experienced in the use of SDMs as the major reason for the non-use of SDMs in development projects. They agreed on statements regarding the benefits SDMs have to offer as well as SDMs being recommended in their development work.

Almost three quarters of the respondents felt that there may be room for a newly designed SDM that could enhance their LMS development work.

This study may serve as a stimulus for future research in the field of learning management systems and more specifically the development of LMSs by using systems development methodologies to enhance the chances of success for those systems. A holistic picture was drawn on what the South African e-learning market looks like and it was determined that the extent of use of open-source LMSs exceeds what was initially believed. It was substantiated that SDMs are being used in the development of LMSs. The study also unlocks various future research possibilities in the emerging field of LMS development.

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ASSESSMENT OF THE USE OF ONLINE COMUNITIES TO INTEGRATE EDUCATIONAL PROCESSES DEVELOPMENT TEAMS: AN EXPERIENCE IN POPULAR HEALTH EDUCATION IN BRAZIL

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ABSTRACT

This paper is intended to share the results of the assessment of the use of the Online Work Community (OWC), developed in the Moodle technology that was used as an instrument to facilitate the educational and operational processes, intended to share problems and proposals for solution among the 470 members of the development teams, made up of educators, experts, technicians, managers and supporters, connected to the Popular Health Education Qualification Program, aimed at the qualification of the Basic Healthcare (*Atenção Básica à Saúde* - EdPop-SUS), through the examination of the issues concerning educational practices related to health in the disadvantaged communities of the Federal District and 8 other Brazilian states. The Program, based on critical pedagogy (FREIRE, 1997), sets forth three stages of a familiarization course aimed at 17 thousand healthcare professionals, and another one for a deeper level of understanding, for 8 thousand alumni of the first course. The assessment methodology is based on the Dialogue Assessment (ROMÃO, 2005), in which the assessment took two paths for analysis, a quantitative one and a qualitative one. The first one occurred by means of a survey of the perceptions of the participants, recorded in two online self-applied questionnaires, with open and closed questions that focused on the access, guidance/navigation and functionalities. The other one through the observation of the posts and interventions in the different online spaces of the OWC. The quantitative analysis ratified attendance as a still important characteristic in the Popular Education field, due to the difficulties pointed out by the participants regarding access (31%) and navigation and guidance (42%). The qualitative analysis, having as Speech Analysis as basis, revealed the wealth of the construction process by means of the shared statements and productions, totaling 159 products connected to culture and art. In addition, it evidenced the problems faced, the "political" category being the most significant one for the participants. Thus, the assessment concluded that the OWC allowed social integration between educators and team members, contributing to the implementation of the National Popular Health Education Policy, a government action that brings care, absence of centeredness, dialogue and respect to the community cultural diversity as premises for its implementation.

KEYWORDS

Popular Health Education, Online Communities, Community Healthcare Agents, Unified Healthcare System (*Sistema Único de Saúde* – SUS).

1. INTRODUCTION

Professional education currently works with elements connected to the civilization milestone of modernity that encompasses reflection, culture and subjectiveness. Within such context, the starting point for learning is the understanding of education as a social interaction experience by language and action (Vygotsky, 2003), intended for the creation of a learning, speech and practice community, in order to produce results, understanding for critical action, exercising learning through cooperation and autonomy, ensuring the centrality of the individual in the construction of knowledge and allowing cognitive and affective results, and those aimed at actions (COELHO, 1999).

Regardless of whether the modality of education is class-attendance or at a distance, the perpetuity of such integration is sought, by means of Technologies considered to be mediators of human wealth; environments able to promote the meeting of people by transcending time and space: the so-called Online Environments. Beyond communication, within an educational context, such environments are expected to contribute to the intuitive search and shared construction of knowledge that is no longer individual, to gain a collective dimension. Thus, even if they are in different physical spaces, the social relationships gain power insofar as, in such environments, active expression and participation are valued.

In relation to the concept of health, it currently transcends the purely biomedical understanding of absence of illness, to give preference to quality of life, incorporating the notion of promotion of health. This new paradigm presupposes social participation as a crucial element to reach equity, universality of assistance and integrality of healthcare, principles that are the goals of the Brazilian healthcare system – the Unified Healthcare System (*Sistema Único de Saúde* - SUS).

The structuring of public policies aimed at healthcare in communities goes through popular education strategies involving the Basic Healthcare professionals and the population itself, so that they see themselves as health promoters and, in case of the professionals, as healthcare agents in charge of the mediations in the health scope, within a concept of State. Logically, social actions related to health assume an educational axis, for it is only through it that new authority paradigms can be turned into new ways of seeing, understanding and working with health. Such new participative concept of healthcare may be appropriate in a country of continental dimensions.

Popular Health Education (EPS) allows the approximation and dialogue among the popular knowledge, the scientific medical knowledge, the healthcare professionals and institutions. The EPS constitutes a movement expressed by the healthcare practices, production of shared knowledge and constitution of subjects and political players in the health field (BONETTI, PEDROSA, SIQUEIRA, 2011).

The main professionals connected to the EPS are the Community Healthcare Agent (Agente Comunitário de Saúde -ACS) and the Health Surveillance Agent (Agente de Vigilância de Endemias - AVE), people who were born, live and work in the communities, understanding their realities and healthcare needs. Such work, however, has been faced with outdated and authoritarian guidelines that set forth a mere fight against disease instead of working on its causes, together with the populations, incorporating the local realities involving cultural and environment dimensions.

In October, 2011 the National Basic Healthcare Policy (PNAB/2011) stressed that Basic Healthcare occurs by means of care practices and democratic and participative management, also ratifying the educational activities as duties of such agents, so as to promote health and prevent disease. Two years later, Ordinance 2,761/2013 instituted the Popular Healthcare Education Policy (Política Nacional de Educação Popular em Saúde - PNEPS-SUS) that, among other elements, proposes a political and educational practice to guide the actions aimed at the [...] promotion, protection and recovery of health, based on the dialogue among the several kinds of knowledge, valuing popular knowledge, ancestrality and incentive to individual and collective production of knowledge..." (BRAZIL, 2013).

As the main strategy to contribute to the consolidation of PNEPS-SUS, in October, 2013 the Popular Healthcare Education Qualification Program (EdPop-SUS) was launched, a fruit of the partnership between the Strategic and Participative Management Department of the Brazilian Ministry of Health, the National Public Healthcare School (Ensp) and the Joaquim Venâncio Polytechnic Health School (EPSJV), the latter units being members of the Oswaldo Cruz Foundation (Fiocruz), a federal institution connected to the Ministry of Health, headquartered in the city of Rio de Janeiro and with 6 other regional centers in Brazil.

EdPop-SUS was developed to qualify the educational practices in the basic healthcare field by means of the formation of ACS and AVEs that, mentioned in the Brazilian Healthcare System principles, develop educational practices of social mobilization, health promotion and equity, its political and educational reference being the Popular Health Education (invitation to bid, 2014). It is structured in an awareness course made up of three 53-hour stages for 17 thousand agents and another stage, for a more in-depth understanding, for 8 thousand agents, qualified of the first offer. The EdPop-SUS is a great challenge in the Brazilian public health field, seeing as in addition to the social inclusion of such players, it also sets forth the digital inclusion of 17 thousand agents that have been historically deprived of access to consumer goods, including digital access technologies.

Due to the fact that it involves the Federal District, in addition to 8 other Brazilian states, the Popular Health Education Qualification Program relies on the decentralized participation of a multi-professional staff of approximately 470 professionals, each of them dealing with the regional specificities typical of a continental country. Due to that, in addition to the educational dimension inherent to all collective construction process, such action has, as the crucial element of the shared management of processes, an Online Community containing spaces intended for the sharing of ideas and experiences, the Online Work Community – OWC. The interaction among the teams occurred by means of discussion forums in which the work teams exchanged experiences, impressions and doubts about the development and implementation of the course.

This paper is intended to show the results of the assessment made with the faculty and work teams about the experience with the OWC, connected to the Popular Health Education Program (www6.ensp.fiocruz.br/edpopsus) in progress, pertaining to the first stage of the awareness course.

2. THE ONLINE WORK COMMUNITY (OWC) ASSESSMENT AND ITS ANALYSIS

The political and educational guideline of the Popular Health Education Awareness Course, based on socio-constructivist grounds, considers that learning is a complex process that occurs within a social context by means of the interaction among cultural agents that go through new experiences, which are compared with other experiences already lived, thud favoring the development of new mental schemes expressed in individual and collective knowledge (BARILLI and PESSÔA, 2013). Add to that the critical pedagogy guideline that understands education as being the practice of freedom that, by means of the critical understanding of reality, renders the subject politically able to free him or herself from forms of oppression (SANTIAGO, 2012), considering that knowledge belongs to a greater act, that of knowing, thus being the epistemological element of the action of learning (FREIRE, 1997).

Due to the innovative nature of the EdPop-SUS, the development and implementation activities were considered to be learning experiences for the 470 members of the teams. For such, in addition to the OLC, an Online Work Community (OWC) as made avialable, intended for the follow-up, from a management and interaction and support opportunity viewpoint, but The OLC is not the purpose of this paper, which is dedicated to the assessment of the Online Work Community (OWC).

The OWC is an online environment supported by the Moodle technology, developed so as to promote integration between the work teams connected to the EdPopSUS and to facilitate the decentralized and shared management of the teaching and operational processes.

We must stress the importance of being able to provide an environment for human communication/interaction, research and collective construction.

The OWC's structure expresses the work processes related to the development and implementation of the course, composed by: a) <u>Online Mediators' Room</u> – a space where the mediators receive educational support from professional education experts, in addition to popular educators and learning instructors; b) <u>Coordinators and teams forum</u> – intended for the sharing of solutions and strategies implemented in the state centers; c) <u>Exchange forum</u> – This forum is for general use, intended for the sharing of News and documents, needs, doubts regarding the work process and; d) <u>Doubts regarding the Online Work Community</u> - support to the doubts regarding the navigation and use of the OWC's tools. The support, in this space, is distributed by each participant state.

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In addition to the process development teams, the Program also relies on the participation of the faculty (185 participants), which comprises three different profiles: 1) The *Mediator* – teachers responsible for the learning relationship with the student; 2) *Popular Educator* – professionals of any level of qualification, but who have solid experience in popular healthcare education practices with disadvantaged communities. Their duty is to provide support to the mediator in the teaching work, by means of their experience and popular educators; and 3) *Learning Instructor* – working as theoretical, methodological and educational reference for the faculty (mediators and popular educators).

In order to be coherent with the educational guidelines adopted, the assessment of the OWC followed the "Dialogue Assessment" approach, that affirm that the purpose of which is to allow the different players involved, whose fields of judgment are often different, to be apt to take a stance in order to build, individually or collectively, a judgment that could be translated into action. Thus, having previously established criteria and methods as basis, the assessment subsidies the decision-making process that will support future actions (ROMÃO, 2005).

Within such logic, from a methodological point of view, the assessment followed a quantitative and qualitative guidance, the latter supported by the methods of content analysis and discourse analysis. Thus, the OWC assessment followed two paths, one with a quantitative emphasis and another with a qualitative one. The first one was through two online self-applied questionnaires, with closed questions, developed in the *Online Assessment System*, made available at the institutional web address (pesquisa.ead.fiocruz.br), touching upon the easiness of access, guidance/navigation, tools and functionalities. Due to its not being required, the first one, intended for the faculty, was replied to by only 127 people. The second questionnaire, aimed at the other members of the work teams, was replied by 43 people.

The quantitative analysis was based on the results of the questionnaires, number of interactions and products shared in the different online spaces of the OWC.

The second methodological path, of a qualitative nature, occurred by means of the observation of the "speech" of the participants, expressed in the posts and interventions in the different online spaces of the OWC. The assessment was therefore focused on the content of the interventions, seeking to group them into the following significant categories: experiences lived, problems faced, cultural expressions,

The qualitative method of assessment adopted was the Speech Analysis, following the principle set forth by Rocha and Deusdará (2005), that *the text of the informants' replies forms a surface to be explored, from which "psychological qualities" emerged in relation to the object* (p.331), herein considered to be the dialogues posted on the OWC.

3. RESULTS

The access to, as well as the guidance and navigation in the OWC, were considered difficult, perhaps due to the participants' profiles, since in the Popular Education attendance is one of the main characteristics (Figures 1 and 2), followed by the difficulty in accessing Internet in some of the communities located in the countryside of Brazil, where the mediators live and work.

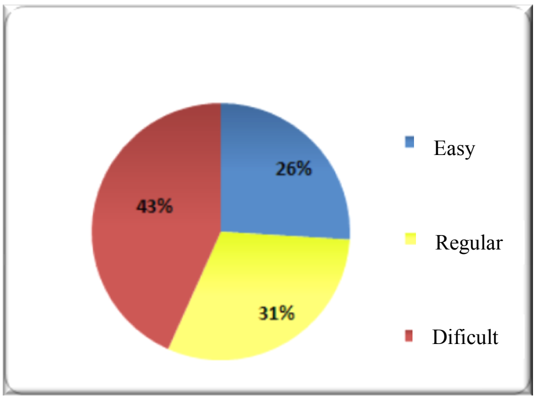


Figure 1. Access to the OWC

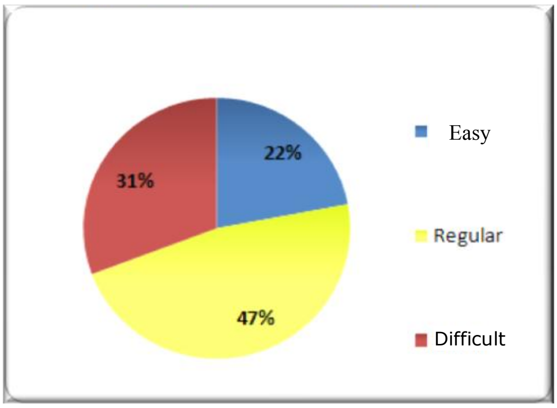


Figure 2. Guidance and navigation in the OWC

Even though considered to be simple activities, demands regarding difficulty in changing passwords, posting of images and sending of messages were recurrent.

In spite of the difficulties evidenced by the results show, we must highlight the fact that in this first stage of the Course it was not possible to hold the (practical) training on the OWC, due to the unavailability of places with computers upon the initial qualification of the faculty, which could explain the participants' difficulty in using the functionalities of their virtual spaces. Even so, table 1, shows the wealth of productions shared in the OWC.

Table 1. Survey of productions shares on the OWC, distributed by participant

Products	**CE**	**PE**	**BA**	**DF**	**SE**	**RJ**	**SP**	**RS**	**PI**	**TOTAL**
Poetry	2		6	3			2		1	14
Pictures	33		22	1	4	1	21			82
Videos							6			6
Texts	3			1						4
Assessments	1	2	4	1	1	1	43			53
TOTAL	39	2	32	6	5	2	72	0	1	**159**

States of Brazil: CE = Ceará. PE = Pernambuco, BA= Bahia, DF= Federal District, SE=Sergipe, RJ=Rio de Janeiro, SP=São Paulo, RS=Rio Grande do Sul, PI=Piauí.

The qualitative analysis sought to prioritize the expressions of experiences lived, perceptions, doubts and confessions, and wow it contributed to the development and success of the Program and personal growth of the participants.

Even though the use of all spaces had been instructed, there was a certain confusion in the posting. We can mention as an example the news forum, which was used to share reports on experiences lived during the course, in addition to requests for support regarding the procedures and use of the OWC.

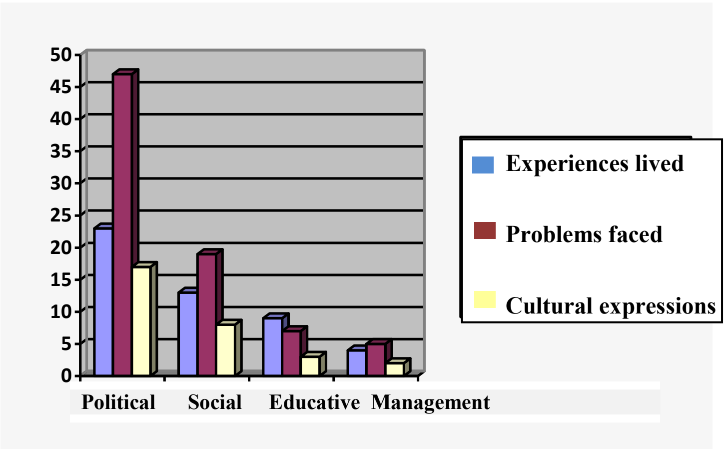
We noted that Learning Instructors (LIs), Popular Educators (EPs) and Mediators prioritized the posting of information on what was done (experiences) in the class-attendance moments, field work and impressions, as a way of sharing their experiences, which fact ratifies the hands-on learning of popular education. One of the most interesting contributions reported in the OWC was the mediators' efforts to create electronic addresses (e-mail) for the students, in order to allow them to access the OLC. The expectations and concerns related to this activity were often shared in the OWC, in the Mediators' Room space.

For the analysis of the speech of the subjects, in the OWC online spaces, also according to Rocha and Deusdara (2005), the researcher makes a *floating reading*, which is the basis for him or her to formulate his or her hypotheses, to be validated or not in the subsequent stages. After that, the researcher extracts criteria to classify the results obtained into *categories of signification* (p.313). On the other hand, for the same writers the Speech Analysis Works on the meaning, and not only the content, seeking to bridge the distance between the research question and the question aimed at the participant, integrating textual organization (contents) and social context. The text is, thus, seen as the materialization of the speech (p.321).

Thus, the analysis tool 157 posts in the OWC interaction spaces into account, of which the floating Reading as made, based on which 3 dimensions were formulated: experiences lived (97 posts), problems faced (more recurrent, with 112 posts) and cultural expressions (52 posts). Based on the dimensions surveyed, signification categories emerged, shown in Table 2. The "Political" category proved to be the most significant one for the participants, as shown by Graphic 1.

Table 2. Signification categories identified based on the posts to the OWC

DIMENSIONS	CATEGORIES	POSTS AT THE OWC
EXPERIÊNCES LIVED	POLÍTICAL	Let's not be afraid to create... let's dare! Going over the institutional walls doesn't mean only opening the range of multiple possibilities of creation of knowledge.
	SOCIAL	As a learning subject... I acquire voice and speech… here among you… I am concrete existence… turned into living contents.
	EDUCATIIONAL	The search for acknowledgment of the forms of resistance of the community, as well as potentials, organization and popular mobilization, considering the development of a critical and reflective thinking on the concrete reality lived by the healthcare professionals in their daily work lives and their territory, connecting popular education to life.
	MANAGEMENT	Knowledge of reality – knowing a bit of the local healthcare network, the history of the neighborhoods, of the people who live there, respecting the colleague, exchanging experiences, respecting the popular knowledge, listening to the community.
PROBLEMS FACED	POLÍTICAL	The public policies confine the healthcare work with the communities to epidemiological surveys (filling out of forms). The data is more importante than people.
	SOCIAL	Inability to handle social problems affecting the community's healthcare levels: violence, alcoholism, drugs.
	EDUCATIONAL	Adaptation of the teaching models to the Popular Education reality
	MANAGEMENT	Social inclusion also comprises digital inclusion.
CULTURAL EXPRESSIONS	POLÍTICAL	For the implementation of a policy with the PENEPS-SUS..."change is necessary", for the forms of healthcare education... there must be "new reflections" and for the professionals and the community to realize that.
	SOCIAL	Cultural expression as an element of community integration (the *vaquejada* holiday, *bumba meu boi*, rhyming, verse, poetry and *cordel*,
	EDUCATIONAL	Cultural expression in the healthcare educational practices - speaking the "language" of the population in the communities.
	MANAGEMENT	The expressions, discoveries of potential, a new look of the community.



Graph 1. Posts on to the OWC pertaining to the signification categories

4. CONCLUSIONS

One of the challenges faced by the PNEPS-SUS is the social insertion of the Brazilian disadvantaged communities. The path taken was the improvement of the basic healthcare levels through the qualification of the educational practices in the health segment, carried out by the healthcare agents that work in such communities. The barriers of access to production goods for the majority of the Brazilian communities has historically confirmed, in Popular Education, class attendance in the courses as a path for exchange and fight, materialized as popular movements that prioritize art and culture, a context that can explain the wealth of the products shared in the OWC in spite of the difficulties in using it, pointed out by the participants. Note that mediators could only post products due to its direct contact with students in person meetings.

The hands-on nature of Popular Education, which stood out in the posts to the OWC, revealed the speech of the educators and teams, pointing out the potential and challenges of the territory and the need for change, both of the professional’s outlook on his or her own work process and of the ways of teaching and working with health in the communities that are, still today, very centered around authoritarian models that defend medical authority.

The qualitative analysis revealed the “Problems Faced” dimension to be the most frequent and, based on that, the “Political” category to be the most significant one for the participants, contributing to the systematization of the participants’ speech in relation to the feeling of increased precariousness of the work of the community healthcare agents and health surveillance agents, which before the PNEPS-SUS was limited to the filling out of epidemiological questionnaires, leading to the interpretation that the numeric data are more important than people.

Such result confirms the importance of the PNEPS-SUS as a policy that, in addition to acknowledging the importance of such professionals for rendering the concept of health promotion concrete and spreading it by means of dialogue (FREIRE, 1997), a step-up from the purely biological concept that works with the disease, also focuses on *dialogue, care, discussion, shared construction of knowledge, emancipation and commitment to the construction of a democratic and popular project* (AGADIR and WIMMER, 2013, p. 16). In addition to the political dimension, the work also contributed to the systematization of the educational dimensions, in the individual and collective understanding of the role of each professional and health promoting agent, and thus assigning a new meaning to the practice thereof; of management, insofar as both educators and teams join efforts to reach consensual goals, and finally healthcare as it related to the singularity of each subject, or how individual experiences his or her illness, considering such act to be the result of a process of reflection on the reality that triggers the will to change, to do something, producing new meanings.

Such training contributed to the creation of spaces for the support to online access in the states, in order to ensure the access by students and educators.

For the second stage of the awareness course, the educators will be expected to be able to use the Online Community and its functionalities, identifying the OWC as the center of exchange among peers and especially of educational support, aiming at contributing with the qualification in Basic Healthcare by means of the shared construction of a new outlook on the educational practices in the communities.

The OWC, as a means for human integration, contributed both for promoting meetings and for recording the wealth of human production within a concept of sharing and collective production. The use of Online Environments in educational processes already finds, in the literature, solid references to its role as an instrument of support to shared construction. This paper, however, sought to evidence the use thereof as an instrument that collaborates to the implementation of public policies, having Popular Education as a theoretical and practical guideline, within the Brazilian healthcare segment, which by itself evidences its innovative nature.

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STEREO ORTHOGONAL AXONOMETRIC PERSPECTIVE FOR THE TEACHING OF DESCRIPTIVE GEOMETRY

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ABSTRACT

The representation of figures in mongean projection (double system planned orthographic projection used in the studies of Descriptive Geometry), specially when placed in a particular situation in relation to the projection plans, possesses the quality that, through them, the actual dimensions of represented spatial objects can be found directly and without additional geometric constructions. However, these representations using orthogonal views present a disadvantage that had been observed in which the representation is not always compared to the sight of the actual object. In some complex problems, even with great effort of concentration and imagination, the idea of the represented spatial figure cannot be reached.

For current students and future engineers and architects, spatial visualization in perspective and depth is of most importance. The binocular or stereo perspective is necessary for the improvement of students' spatial reasoning. For this, stereo visualization programs used in computer graphics can be used. They differ from the method of the cylindrical orthogonal axonometric perspective, often taught in the courses of Descriptive Geometry. Thus, it is proposed in this work, the use of computational method anaglyphic, in which the binocular axonometric perspective is obtained from the mongean projections of the object. The developed program is indicated for the teaching/learning Descriptive Geometry.

KEYWORDS

Computer graphics; descriptive geometry; axonometric stereoscopic visualization; geogebra software

1. INTRODUCTION

The great evolution of computing and electronics allowed the use of new technological resources for the teaching/learning of disciplines on graphics area, such as Descriptive Geometry, Technical Drawing, Space Geometry, etc. This way, we can find some studies in the literature that have been developed in the search for computational solutions to enhance the teaching of such subjects.[18] proposes an intelligent computing environment accessed via Internet, which operates according to the profile of each student. The system presents a database of exercises that must be registered by teachers. The environment has not been tested yet. Also, we found studies that indicate the potential for stereoscopic computer graphic systems for the development of spatial visualization skills [13] and virtual reality techniques to be employed. It is suggested to use a stereoscopic display system using polarized projections, in which students would attend classes using passive polarized glasses. However, the system was not implemented. Another work of the area has a graphical tutorial system, available on the Internet for teaching Descriptive Geometry. The system consists of written content, accompanied by illustrative animations. The system, however, is not intended to be used in classroom, and does not explore stereoscopic capabilities or real-time interactivity [8]. In a more recent study, the author has been making use of augmented reality techniques [2], [4] for visualizing and learning of conical surfaces [9]. [16] implemented the Hipercal3D software, which utilizes virtual reality through language VRML, for the viewing and manipulation of objects generated with interactivity using three-dimensional visualization perspective and solid modeling for descriptive geometry, but it does not use features of stereoscopy. [7] implemented the VirtualGD software, also using the VRML language [19], [20] to create a lively and interactive virtual environment, with manipulation of objects in real time, showing the key elements and processes used in Descriptive Geometry. In another subsequent work [6], the authors present the use of stereoscopy techniques implemented to VirtualGD. The Descriptive Geometry software [17], developed at the University of Lisbon, can be freely downloaded from the website. The program is interactive and has offices in both epure and space representation. The system interface is somewhat overwhelmed by too much information windows and it is not very suitable for beginning students. Since the program AEIOU Descriptive Geometry [1] has many graphics and a clear and friendly interface, it is a commercial software. Both programs do not offer resources of stereoscopy. The use of stereoscopic techniques has great potential for the improvement of spatial visualization ability, particularly for individuals with greater difficulties, because they allow the understanding of spatial (three-dimensional) situations presented in exercises, making its development possible. Stereoscopy is related to the ability of depth perception. A long time ago, it began to be used in order to facilitate the visualization of complex spatial situations and, particularly, in the study of Descriptive Geometry [11]. The first experiments used simple techniques like drawings anaglyphics [12]. Nowadays, with the technological development, more sophisticated devices are available, which opened new possibilities for the use of these techniques. For students, the spatial visualization in perspective and depth is of the most importance and for both the perspective using stereoscopy view is necessary.

In this work, we developed a program, using the GeoGebra educational software [5], in which the binocular axonometric perspective of a given object is created from the mongean projections. We observed that the most articles published in technical and scientific events in the area are still at the level of academic research and are not therefore available for use or do not explore stereoscopic vision. On the other hand, we find some commercial products available, but not always perfectly suited to our educational needs.

We first present the usual matrix method used by computer graphics programs, [3], [15], [21] and that is implemented in C language using the OpenGL graphics library, [10], [14] and later we will introduce the proposed method, which uses orthogonal axonometric perspective and the GeoGebra software [5].

2. STEREO ANAGLYPHIC PROJECTION

Stereoscopic vision consists of depth scene perception by the human visual system. For this purpose, it is necessary to capture the image of the object by the two eyes so the brain can estimate the distance between them, it means, between the eyes and the object. We will be using the anaglyphic method, in which the image of the left eye is colored with cyan and the right eye is colored with red.

2.1 The Traditional Matrix Method

The following section presents the method commonly used in computer graphics stereoscopic vision and implemented in C language, with the purpose of comparing the figures generated from those obtained by the proposed method, presented in section 2.2.

2.1.1 Visualization in Perspective using the Matrix Method in Homogeneous Coordinates

Consider the case in which the object is described by points $P = (x,y,z)$ having its coordinates given in relation to the orthonormal frame in the world and we want to design it (Figure 1) in a projection plan pp located between P and the eye of the beholder $e=(e_1,e_2,e_3)$. It is necessary to provide a point $a=(a_1,a_2,a_3)$ to set the direction to where one should look and as the observer's head orientation vector $\vec{u}_p = (u_{p1}, u_{p2}, u_{p3})$.

Thus the intersection of a point $P=(x,y,z)$ of space with the projection plan pp in relation to the observer’s eye ***e*** is calculated by two coordinate transformations:

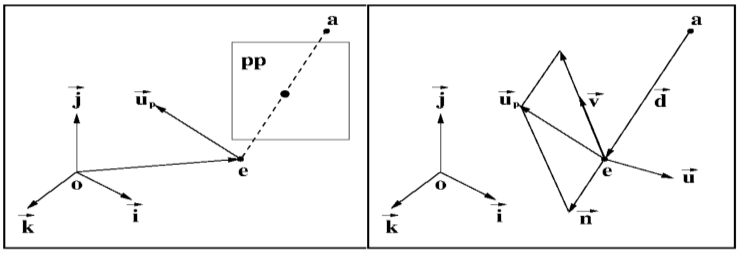

Figure 1. The projection plan (pp) and the referential of the observer's eye.

(I) **Frame in the observer's eye**

Consider the new orthonormal frame $(\vec{n}, \vec{v}, \vec{u})$, obtained from the world orthonormal frame by translation and rotations, with its center in the observer's eye and given by

$$\vec{n} = \frac{e-a}{|e-a|} \qquad \vec{v} = \frac{\vec{u}_p - (\vec{u}_p.\vec{n})\vec{n}}{|\vec{u}_p - (\vec{u}_p.\vec{n})\vec{n}|} \qquad \vec{u} = \vec{v} \times \vec{n}$$

So by a given point $P=(x,y,z)$ to pass to the coordinates of the eye (X,Y,Z) using homogeneous coordinates just consider the transformation

$$(X,Y,Z) = \left(\frac{x'}{w}, \frac{y'}{w}, \frac{z'}{w}\right) \text{ where } \begin{pmatrix} x' \\ y' \\ z' \\ w \end{pmatrix} = \begin{pmatrix} u_1 & u_2 & u_3 & (-e).\vec{u} \\ v_1 & v_2 & v_3 & (-e).\vec{v} \\ n_1 & n_2 & n_3 & (-e).\vec{n} \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix}$$

Using the OpenGL library [14] this transformation is given by the command ,

$$gluLookAt\,(e_1, e_2, e_3, a_1, a_2, a_3, u_{p1}, u_{p2}, u_{p3});$$

(II) **Normalizing the visualization region and leading the observer to infinity**

Consider now the dimensions of the window W (Figure 2) providing horizontal coordinates x=l (left), x=r (right), and the vertical coordinates y=b (botton) and y=t (top) and the region of space where the point lies fixing the previous plan by the depth (near) z=-n and depth (far) z=-f. To calculate final coordinates (X,Y), of the perspective projection of **P** on **pp**, one must now perform the following operations (Figure 2, right):

(a) shear H to centralize windows W about the depth given by the oz axis.

(b) adjust the LCD viewing pyramid for a change of scale S for side plans with 45 ^{0} in relation to the coordinated plans xz and yz

(c) finally use a transformation in perspective N taking the eye of the observer to infinity.

So **P'=(NSH)P** is obtained in homogeneous coordinates using the matrix

$$NSH = \begin{pmatrix} \frac{2n}{r-l} & 0 & \frac{r+l}{r-l} & 0 \\ 0 & \frac{2n}{t-b} & \frac{t+b}{t-b} & 0 \\ 0 & 0 & \frac{-(f+n)}{f-n} & \frac{-2nf}{f-n} \\ 0 & 0 & -1 & 0 \end{pmatrix}$$

Using the OpenGL library, [14], this final transformation is presented in the command,

$$glFrustum(l, r, b, t, n, f);$$

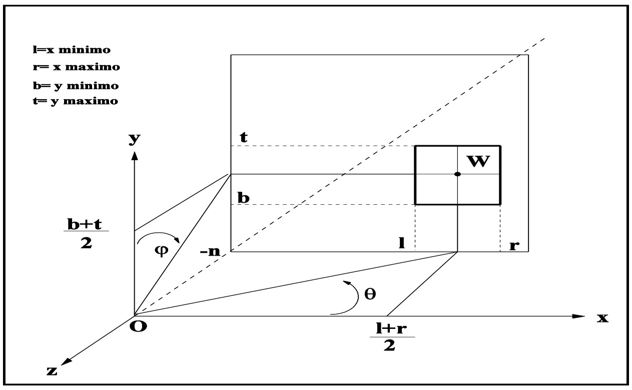

Figure 2. Parameters of the Window W

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2.1.2 Stereo Anaglyphic viewing with the Matrix Method

By designing a point P on a projection plan (pp), according to the observer, we find the Pl projection on the left eye (le) and the corresponding Pr to right eye (re), which must be on the same horizontal line. The distance between the points designed Pl and Pr is called Parallax and three situations may occur, depending on the relative position of the point P in relation to the projection screen (pp) and the eyes of the observer:

(i) after the screen where we have positive parallax (Figure 3, left).

(ii) on the screen where the parallax is null (Figure 3, center).

(iii) before the screen where we have negative parallax (Figure 3, right).

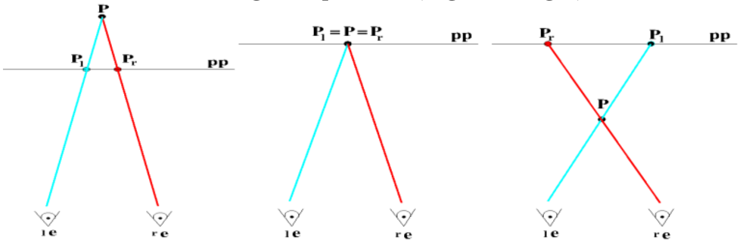

Figure 3. Projections in stereo with positive, null and negative parallax

In order to perceive the image at depth, it is necessary that each eye sees only its respective image. This is done in anaglyphic method as follows using an image editor:

(a) Name the left eye image of e-image and right eye of r-image.

(b) Decompose the left eye image in components R (red), G (green) and B (blue) and in order to keep the cyan color, the component R should be deleted.

(c) Decompose the image of the right eye in the R, G and B components and in order to keep the red color, it is necessary to delete the G and B components.

So, by using the anaglyphic glasses with red lens in the left and cyan lens in the right, we will be able to visualize the image at depth, as shown in Figure 4 the right image.

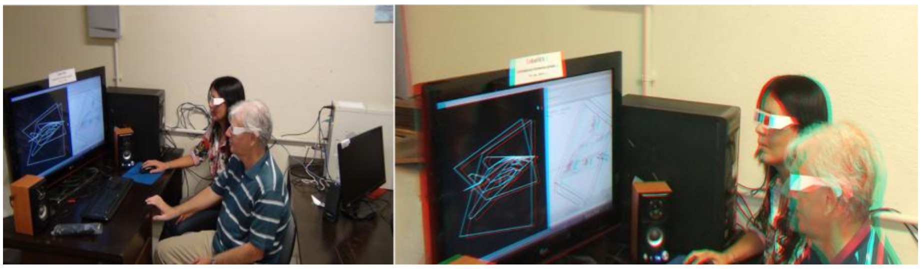

Figure 4. Monocular image (left) and anaglyphic binocular image (right), (LaborMA)

For the creation of a virtual stereoscopic image, the object must be drawn into a virtual screen considering:

(i) right eye:

glFrustum(xleft1, xright1, top, bottom, near, far);

gluLookAt(re, ra, $\overrightarrow{u_p}$);

and to extract the red component, we must consider the command,

glColorMask(GL_TRUE, GL_FALSE,GL_FALSE,GL_TRUE);

(ii) left eye

glFrustum(xleft2, xright2, top, bottom, near, far);

gluLookAt(le, la, $\overrightarrow{u_p}$);

and to extract the green (G) and blue (B) components to have the cyan color, we must consider the command, glColorMask(GL_FALSE, GL_TRUE, GL_TRUE,GL_TRUE);

After doing that, one just should superpose the images of each eye and the result will be an anaglyphic stereo image. Observe the hexahedron and the F117 airplane projections as anaglyphic stereo images in Figure 5.

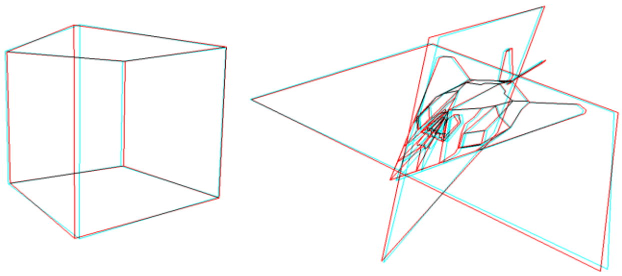

Figure 5. Perspectives in anaglyphic stereo using OpenGL of a hexahedron (on the left) and a F117 airplane (right)

2.2 The Proposed Method

This paper proposes the use of computational anaglyphic method, in which the binocular axonometric perspective is obtained from the mongean projections of the object. All these concepts are studied in Descriptive Geometry course which emphasizes the educational role of the software. It not only provides the appropriate spatial visualization, but also demonstrates and explores the concepts of mongean and axonometric perspective projection studied in the course. Its innovative nature comes from the implementation of stereoscopic vision from traditional methods used in Descriptive Geometry. The developed software uses the free educational program GeoGebra, [5].

2.2.1 Descriptive Geometry Basic Concepts and the Spatial Visualization Problem

Descriptive Geometry is an early discipline, specially of engineering and architecture courses. It addresses to the representation and solution of problems involving spatial mathematical entities such as points, lines, planes, polyhedrons, etc., through its cylindrical orthogonal projections in two planes perpendicular to each other, in which one is rotated over the other, with the aid of plane geometric properties, as shown in Figure 6. The figure obtained after this revolution is called Epure or mongean representation [10].

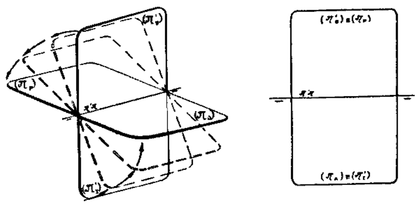

Figure 6. Revolution of the vertical plane on the horizontal plane (left). Epure or mongean representation (right)

The distance from one point to the horizontal plane is called quota. The quota coordinate is conventionally represented in Epure by the distance from the vertical point projection to the intersection planes line.

The distance from one point to the vertical plane is called afastament. This coordinate is represented in Epure by the distance from the horizontal point projection to the intersection planes line, according to Figure 7.

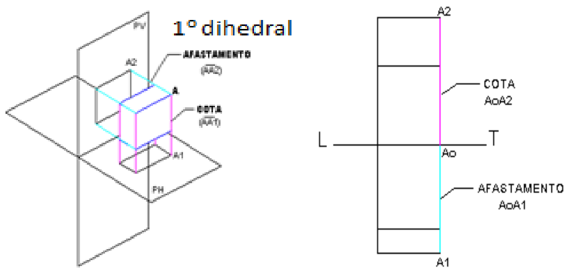

Figure 7. Afastament and quota’s first dihedral point. Spatial representation (left) and mongean representation (right)

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It has been observed that a large number of students have serious difficulties in relation to spatial visualization ability, and this is one of the main factors for failure in learning this discipline. The reduced workload and the lack of a prior contact with the basic concepts of the discipline are some of the factors that contribute to worsen this situation. The non-development of spatial reasoning during the school results in students, newcomers to undergraduate courses with difficulties to understand the concepts dealt with in disciplines like Descriptive Geometry. In addition to this factor, there is a lack of alternative learning that could minimize these difficulties and support the mental abstraction processes necessary for the development of spatial visualization skills. The real models are used to facilitate three dimensional understanding. Thus, we see the need to seek the use of modern techniques that could minimize this problem.

2.2.2 Anaglyphic Stereo viewing with the Proposed Method

The perspective is a graphical representation that shows the objects as they appear to our sight, with its three dimensions. The axonometric perspective presented in this work is an orthographic cylindrical projection on an oblique plan in relation to the three dimensions of the object being represented. This perspective is essentially technical. It is an issue of particular interest on the part of the students of engineering and architecture, since they need to develop their capacity for perception and creation of three-dimensional objects, in addition to being able of reproducing them in their orthogonal or mongean views, studied in Descriptive Geometry. With teaching/learning purposes, more often than not, it is necessary to draw an axonometry in order to clarify details that had not been fully understood in the mongean views. The axonometric perspective, which construction is based on the inscription of the solid in a trihedron tri-rectangle (three right angles), in which only the edges, called axes (axon=shaft, metria=measure), are considered. The projection of this trihedron in a plan can lead to the following types of axonometric perspective:-Conic: projection from an objective point.

-Cylindrical projection from a point of infinity

- Orthogonal: projection lines, orthogonal to the plane of projection.
- Oblique: projection lines, oblique to the plane of projection.

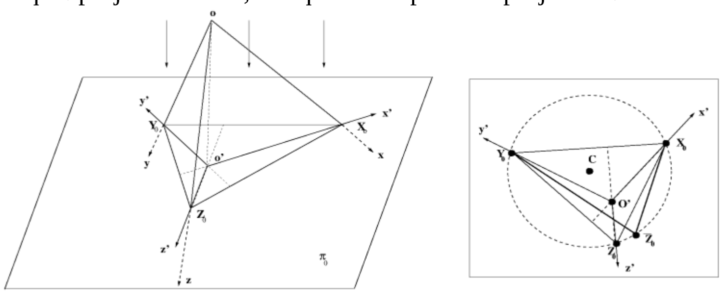

Figure 8. Orthogonal axonometric projection elements (left) and the second axonometric triangle (right)

Figure 8 on the left presents the method of cylindrical orthogonal axonometric perspective, with particular distinction to the elements used in its construction, where:

- **O** – The vertex of the trihedron goal. For being the closest point of the observer (found at infinity) is always visible on projection.
- **x**, **y** and **z** – axonometric axes
- **x'**, **y'** and **z'** projections of axonometric axes
- **Triangle** $\mathbf{X_oY_oZ_o}$ – axonometric or fundamental triangle
- **O'** – orthographic projection of the vertex **O**. There is a basic Geometry theorem which demonstrates that **O'** always falls on the orthocenter (date of heights) of the triangle $\mathbf{X_oY_oZ_o}$.

-$\boldsymbol{\pi_o}$ – projection plan, always considered in horizontal position. Keeping fixed the trihedron, the lifting or lowering of $\boldsymbol{\pi_o}$ raises similar axonometric triangles, which results in the same perspective, because this depends only on the shape of the axonometric triangle and not on the size of their sides.

The trihedron formed by orthogonal coordinate systems is projected on the projection plan, in such a way that the scale along the axes x, y and z are duly rearranged on the projected axes x ', y ', z ' according to the orthographic projection. This procedure is called a ranking of axes designed. Graduating the axes is to score on them a specific given unit. In fact, what is sought in order to draw the object perspective is the result of this degree in the projections of the axes (perspective unity).

As the angle formed by two shafts at the apex is 90°, the triangle is always an acute triangle axonometric (presents all three internal angles smaller than 90°). According to the size of the sides of the triangle, the cylindrical orthogonal axonometric perspective receives the following names:

Trimetry or anisometry: If the axonometric triangle is a scalene one, there will be three different perspectives of distinct units for the same unit, one for each axe designed.

Dimetry: If the triangle is isosceles, two perspectives will be alike and one will be different.

Isometry: it is the most widely used case, if the triangle is equilateral, all three perspectives will be the same.

In order to graduate the projections, we must first determine the real magnitude of the axes, to mark on them the given unit and to accomplish that, we must refute a pair of axes on the plane of the painting. After that, it is possible to obtain the degree from projections of axes, as presented in Figure 9.

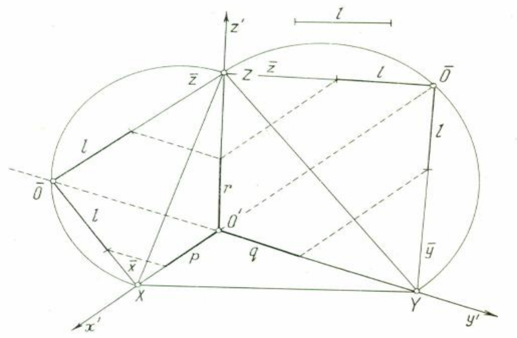

Figure 9. Graduate axonometric axes

Using GeoGebra educational software two axonometric projections with two different axonometric triangles are built. The triangles have two common vertices and the third one is shifted in space as shown in Figure 8 on the right. Using the anaglyphic method, with the figure in red to the right eye and the cyan one to the left eye, the projections of the hexahedron and the F117 airplane are obtained, as shown in Figure 10.

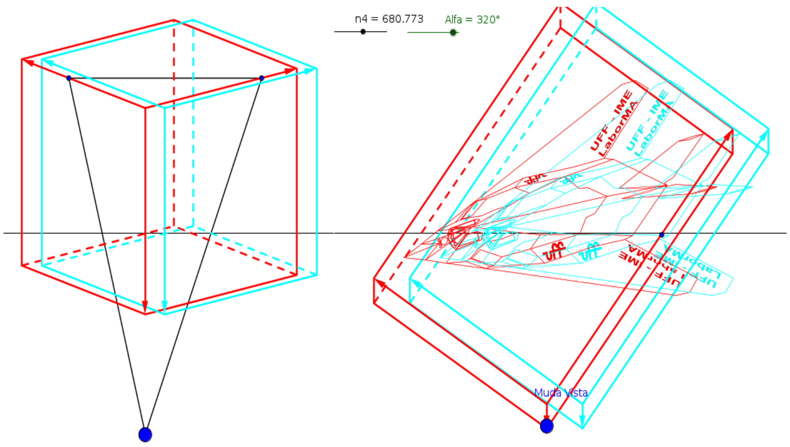

Figure 10. Anaglyphic stereo visualization using orthogonal axonometry of the hexahedron and the F117

Figure 11 shows the mongean projection and the stereo anaglyphic axonometric projections of the F117, as it appears on the screen of GeoGebra.

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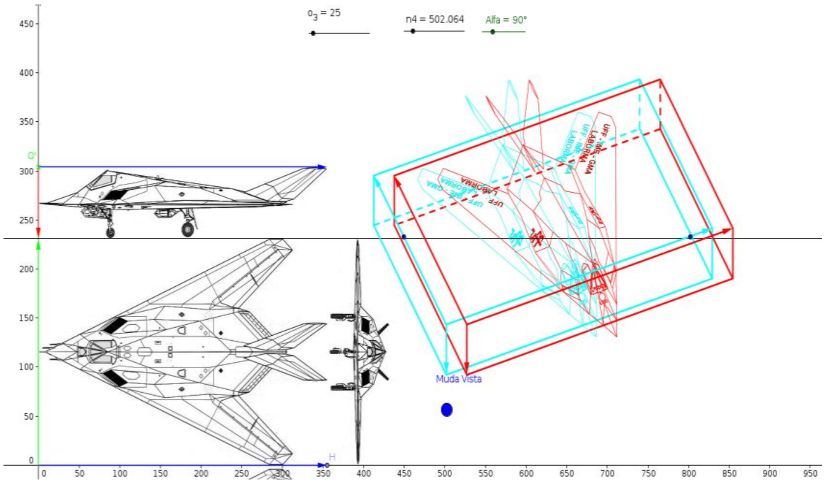

Figure 11. F117 with mongean projections and anaglyphic axonometric orthogonal projection

The mongean and perspective projections side by side and interactive, i.e. changing the mongean projection the stereo perspective changes automatically.

3. RESULTS

The tutorials were developed in the Laboratory of Applied Mathematics (LaborMA) for the Descriptive Geometry students of Engineering course, during the year of 2013, as seen in Figure 12. The tutorials were designed to test the proposed method with students who faced great difficult in learning this discipline. Two groups of fifty students each were provided with the tutorials. It became evident that the stereo perspective visualization using the axonometry offered a superior stereo vision at depth in relation to the matrix method used as default by the programs of stereo views in computer graphics. Every student who participated in the tutorials responded that the proposed method generates figures in stereo with better image quality than the traditional method. The use of stereoscopic techniques has great potential for the improvement of spatial visualization ability, particularly for individuals with greater difficulties, because they allow the understanding of spatial (three-dimensional) situations presented in exercises, making its development possible. Another benefit is that the monocular method of axonometry is a tool used in Descriptive Geometry for geometric solids visualization and obtained from the mongean projections of the object, also studied in this discipline. The software improved both: the visualization ability and the Descriptive Geometry basic concepts, which points out its educational role. In addition, we can state that the educational software GeoGebra also helps in the learning process, because it is not only easy to handle but also interactive, allowing the student to immediate change of point of view, increasing the understanding of the solid, from its projections. The discipline Professors observed an improvement in the academic performance of students who attended the tutorials and a study to evaluate the educational benefit of the tool is being prepared.

Figure 12. Students using anaglyphic stereo axonometric orthogonal projections in LaborMA

4. CONCLUSION

This work presented a new methodology for spatial visualization: the use of computational binocular axonometric anaglyphic method, in which the axonometric perspective is obtained from mongean projections of the object. These concepts are studied in the course of Descriptive Geometry which emphasizes the educational role of the software. The method was presented to the students during the year of 2013 and provided a greater depth of vision than the method of projective transformations used by default in stereo views in computer graphics programs. Its innovative characteristic comes from the implementation of stereoscopic vision from traditional methods used in Descriptive Geometry. The software was developed using the free educational software GeoGebra. For a future work, we intend to investigate the method using conical axonometric perspective.

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DELIVERY OF E-LEARNING THROUGH SOCIAL LEARNING NETWORKS

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ABSTRACT

Over the past two decades policies and speculations have been evident about the importance of internet use including technologies in education and learning at all levels to individuals and societies. The purposes, theories and ways in which learning with technologies ought to be conceptualised and functionalised is generating an increased body of literature. With the arrival of Web 2.0 and Semantic Web however not enough is known about the ways in which these online technologies interact and may interact with student's learning experience. There are gaps in our knowledge on the role of social networking sites on student learning experiences. Social media tools have become ubiquitous. You can see our students use them all the time. Among them most popular tools are Facebook, Wiki, YouTube, bulletin board, LinkedIn, blogging, and twittering. The advancement of modern technologies tries its best to accommodate the needs from people, especially the younger generation. As educators, how can we take advantage of this momentum? With the advent of Web 2.0 tools, educators are looking to these new technological tools to examine its potential in enhancing teaching and learning. While its runaway success as a social networking tool is now renowned, the use of Facebook for educational purposes may be considered still at its infancy stage. This paper will bring together recent research findings on how learning experience of students at higher and further education level is influenced by the latest development and technological advancements of social networking sites.

KEYWORDS

Social Learning Networks, Web 2.0 technologies, e-learning, social learning technologies.

1. INTRODUCTION

Social networking sites have seen tremendous growth and are widely used around the world. Nevertheless, the use of social networking sites in educational contexts is an under explored area (Ryan et al, 2011). Social networking sites (SNSs) have the potential to facilitate interaction, communication, and collaboration, and as a result have been prominently featured in discussions centring on the use of technology to support and amplify educational endeavours (Greenhow, Robelia, & Hughes, 2009). Empirical research on their role in complementary education is limited, even though researchers have identified an accelerating use of social software in formal learning contexts (Schroeder, Minocha, & Schneider, 2010).

Facebook™ is one of the most popular SNSs used today, as evidenced by its 500 million active registered users and its rapid growth rate estimated at 105 percent from 2008 to 2009 (Facebook, 2010a; comScore, 2010). It has been identified as a potential educational tool because it is already used extensively among college students. Bowers-Campbell (2008, p. 82) states, “Facebook™ is student-friendly, student centred, and student-controlled; the social nature of Facebook™ invites participation instead of mandating it.” In addition, Charnigo and Barnett-Ellis (2007) suggest that “by exploring new types of Internet services such as Facebook™ instead of quickly dismissing them as ir-relevant, we might learn new ways to reach out and communicate with a larger segment of our [academic library] users” (p. 31). Therefore, exploring a SNS tool such as Facebook™ in an educational context is both relevant and timely. Our objective is to evaluate factors, effects and influences of social networks on students social technology mediated learning.

The research problem: The use of social media by students has evolved the teaching and learning strategies but research on the influences of sharing collaborative tools in classroom such as social networks has not been fully investigate.

The research question: Are social networking software an influential tool in student's learning?

Hypothesis 1:“The use of social networks helps as a complementary tool to enhance student’s learning experiences”.

2. RESEARCH SCOPE

This research study aims to close the gap in the literature by drawing conclusion about the social learning technology as a framework that addresses the overlapping pedagogical needs of e-learning and social networks with suggestion of methods for implementation of social networks in learning environments. This study aims to use mixed methods of qualitative data analysis using case study and quantitative data analysis using descriptive statistical methods.

The literature review conducted identifies the work of many researchers focusing on the use of social networks and its effects on learning for many years since the emergence of information and communication technology in e-learning environments. Research studies suggest that using social networks with a potential to substitute learning management systems has pedagogical, social and technological affordances which allows distribution of announcement, sharing ideas and resources and implementation of online discussions. However, substitution of a Learning Management System (LMS) with social networks has constraints due to lack of support for file format that allows direct uploads and also the lack of organisation in developing discussions. Using Facebook for example; as a substitute for LMS enables learners to interact with peers and conducts easy communication but it fails to provide a safe environment as student’s perceived privacy is decreased. Research performed in this area suggest that for effective use of Facebook in learning, many other factors such as effective instructional design, positive instructor’s attitude and strong technical support are crucial. (Ozkan & Koseler, 2009).

One of the research areas that have been neglected is the information sharing feature of social media and its implications for learning. Other under searched areas are studies that focus on the challenges faced by higher education learners and the cause of learning difficulties with social networking for learning purposes. The need remains for qualitative investigations that enables our understanding of how social media impacts academic learning.

Another area which has been under researched is the effectiveness of social networks in higher education due to lack of studies that supports the successful implementation strategies of social networks for learning in higher education. Studies suggest that many factors need to be giving careful practical attention such as the type of learner and also learner’s characteristics need to be considered. Wang, Q., Woo, H. L., Quek, C. L., Yang, Y. and Liu, M. (2012).

3. LITERATURE REVIEW

Constructivist pedagogy focuses on students constructing knowledge. From a social constructivist (and constructionist) perspective, this construction occurs primarily through social interactions (Berger & Luckmann, 1966; Vygotsky, 1978; Wertsch, 1986). Web 2.0 collaborative technologies promote social interaction. They allow students’ work to be read and commented on by a larger participant audience than afforded in traditional constructivist education. Using collaborative technologies, students can communicate with classmates as well as with others around the world. Comments made by this diverse, participatory audience often generate discussions that enhance learning.

Web 2.0 tools can promote user participation and knowledge production and thus fit well with social constructivist pedagogical theories. These tools have the potential to transform classes from teacher-centric, transmission instruction to social constructivist, student-participatory approaches, from individual-focused pedagogies to learning community approaches. Even as constructivism has and continues to be a main focus of learning theorists, the technological tools used in education have become increasingly powerful and crossed the gulf between day-to-day life and education. These tools relate to one another under the term technology and are the subject of this study i.e. Social Learning Technology.

Social Learning Technology has been embraced by some and disgraced by many, yet today’s digital natives navigate virtual worlds without hesitancy or misgivings. Research suggests that “Students are far more technologically savvy than the institutions that support them” (Desai, Hart, & Richards, 2008, p. 329).

This poses a problem as teachers try to reconcile personal constructivist pedagogies with a tool they are unaccustomed to or intimidated by. Yet, it's this very social learning tool which opens the door to new and innovative applications of constructivist teaching and learning methods. According to Desai, Hart, and Richards (2008), "The vast amount of information that computers supply on a daily basis has allowed teachers and students new ways to explore education compared to ordinary instructional tools" (p. 329). Social Network Technology offers flexibility and adaptability reflective of pedagogies across various learning models based in constructivism.

According to Wenger (2002),"The community creates the social fabric of learning" (Wenger et al., 2002, p. 28). The community is a group of people who learn and interact together, building relationships that result in a feeling of belonging and mutual commitment (Wenger, 1998).

Brown (2001), states that interaction is at the heart of communicative competence. When a learner interacts with another learner he/she receives input and produces output. Young people can learn more readily when communicated information is tangible and directly accessible to their senses—visual, auditory, tactile, and kinaesthetic. With experience, learners grow in their ability to understand abstract concepts, manipulate symbols, reason logically, and generalize.

Communication provides opportunities for learning. In the cognitive learning tradition, participating with others in groups can provide an opportunity to generate explanations, which results in deeper individual cognitive processing and hence, better learning (Chi, de Leeuw, Chiu, & LaVancher, 1997).

Research and practice indicates that communities provide fertile ground for socio-cultural appropriation (adopting expert practices through social processes) as well. (Lave & Wenger, 1991) discuss the reciprocal relationship between communities and learning.

Virtual learning environments (VLEs) are widespread in higher education today, typically used

to deliver instructional materials and facilitate communication within a course. Remote delivery of courses became a viable option with the World Wide Web and online education of various sorts is now routinely available to vast numbers of students (Peffers & Bloom 1999; Alexander 2001; Chen & Dwyer 2003). Various terms have been used to label or describe forms of education supported by information technology. These include e-learning, web-based learning, online learning, distributed learning and technology-mediated learning; with e-learning probably the term most commonly used to describe education and training that networks such as the Internet support. A virtual learning environment (VLE) is an information system that facilitates e-learning. VLEs process, store and disseminate educational material and support communication associated with teaching and learning.

In terms of using new social networking tools and environments as a supplement to current

Classroom teaching, one of the initial challenges will be to develop learning activities that use these tools to leverage student motivation and learning. Researchers argue that this is made more challenging as children of the "digital age" have different needs than previous learners (Brown, 2002; Schrum & Solomon, 2007; Green & Hannon, 2007). Pedagogical methods may need to be adjusted in order to allow for students to increasingly learn from each other. Green & Hannon (2007, pg. 26) indicate, "with the advent of blogging and tools such as Wikipedia, young people are just as likely to seek feedback from their peers and strangers as they are from teachers and parents. This has led to the blurring of the boundaries between expert and amateur, friend and mentor."

4. METHOD

In this study the interpretive research method with the aid of pilot study method was used to investigate the use of social networks in classroom. The constant comparative method (Glaser & Strauss, 1967) was used to analyse online survey responses, arriving at categories and data patterns. We engaged in open coding of all data in order to identify emerging patterns with regards to student's online learning experiences on the same course of study. The patterns were compiled and codes confirmed across all participants. Open coding of data resulted in patterns that could be grouped into themes. Learners found their interactions with others were important in helping them make Sense of the subject matter and reported that these interactions extended their learning.

The ease with which participants were able to communicate was also deemed to be important to the social connectivity. 17

The participants in this study included students at a Higher Education Institution and its associated Further Education College studying on degree and advanced level courses. Learner's achievement data and online performance in a pilot study were collected and compared in order to establish the match between student's level of attainment and their online performance while using social networks such as Facebook as a complementary study platform.

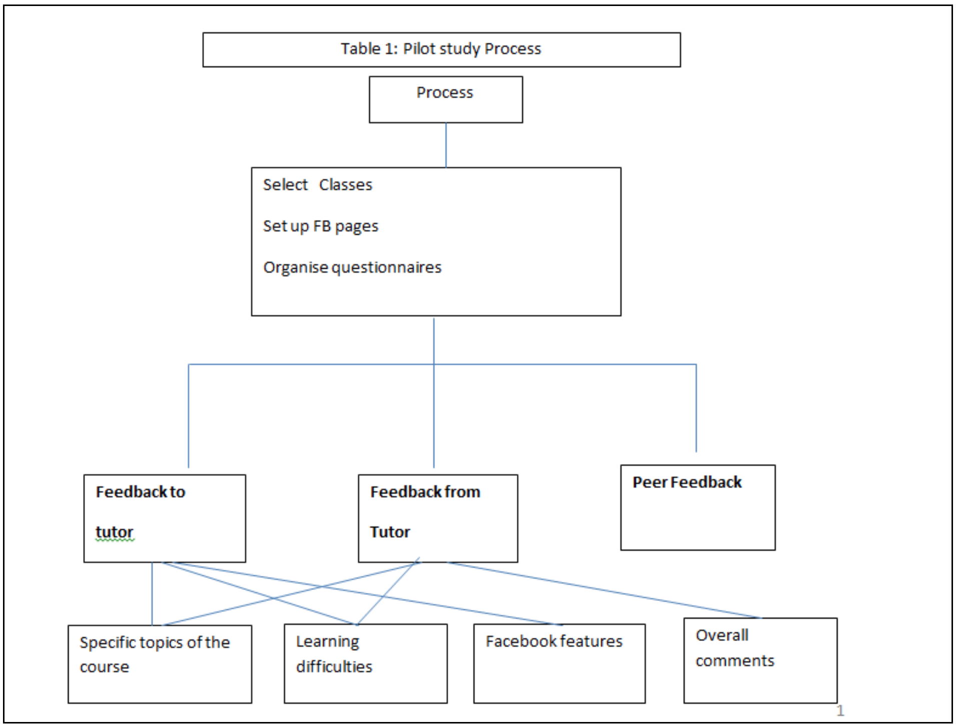
Second series of pilot study were conducted in order to evaluate the role of social networks and its effects on learning outcomes through enhancement of communication methods. Both qualitative and quantitative data were gathered and analysed with some suggested guidelines. Experiments were designed according to participant's level of study. The first pilot study involved three groups of students at Middlesex University on the first year of an I.T. Degree course on a study period of two weeks. The second pilot study involved four groups of students at an associated FE college on an advanced level ICT course on a study period of two months.

5. DATA COLLECTION

The survey was primarily used to collect responses to open-ended questions that sought feedback about (a) student experiences, and (b) specific learning activities and attributes of the course. The first study survey consisted of questions related to student's learning activities, tutor's teaching style and learner's attitude towards their tutor, learner's assumptions and regards towards using social networks as a tool and its future potential.

Data collected related to participant's response to questions. Data was coded and themes identified. Also data related to participant's predicted achievement grades were analysed against the data collected related to some open ended questions that relates to learner's feedback on their instructor's level of support and tutoring style. This statistical analysis identified that a positive correlation coefficient identified through this study suggest that there is an strong relationship between participant's level of achievement and their preference for their tutor's teaching style and their attitude towards using Facebook as a collaborative tool that enhances student's learning experiences.

Table 1. Pilot study process



5.1 Findings

The noticeable theme is that almost all members of these groups liked their tutors teaching style and their responses indicate that they were satisfied with the level of feedback and the support received from their tutor, although some results indicate that participants did not take part in the process; either because they did not regard the question as relevant or supportive. Another noticeable trend is that almost all participants found the creation of a Data Flow Diagram (DFD) a difficult task, as well as the creation of an Entity Life History (ELH), identifying entities for the Business Information Systems (BIS) module and drawing relationships. Another trend was the lack of or the irresolute responses as to whether the groups regarded Face Book (FB) to be a medium for enhancement of their learning with BIS module.

In the direct question and answer of 42 participants, 81% stated that they like using FB and 52% said it does facilitate communication and connection between people. Around 14% thought it causes distraction from studying and 10% said they did not like doing difficult things using FB while also 10% did not know FB’s potential use. Around 7% thought they do not like the lack of privacy and also around 5% said that FB pages lack required structure for learning. Less than 1% said they do not like using FB at all.

5.2 Interviews

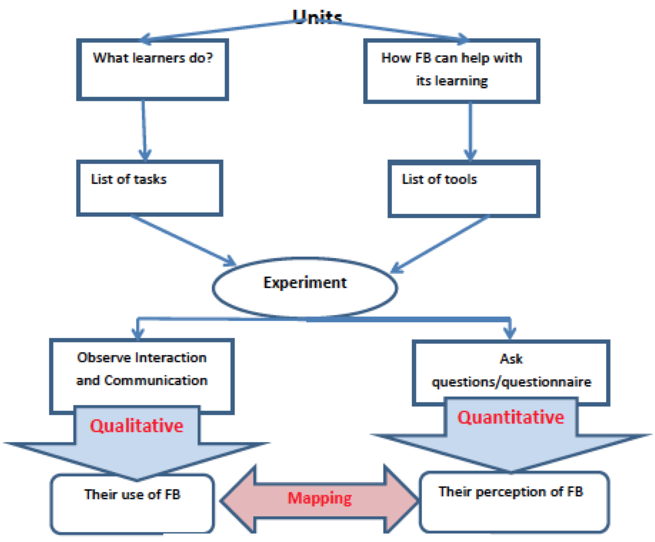
Interviewing participants in the three groups identified some themes. It can be seen from the pattern of its use that those participants who favoured and enjoyed using Face Book as a social media also used it for establishing communication and connecting to others within the same group or other groups outside university. A large proportion of those who favoured using Face Book also regarded its use as a positive aspect that enabled them to use instant messaging, chatting, tagging photos, watching videos etc. A comparison of the themes indicates that a user with a high positive response also corresponds to a low negative aspect. Amongst the implicit themes, there are a few anomalies that do not follow the pattern. For example user25 has a high positive response and also a relative high negative aspect in comparison to the other users. This could be an indication of the user’s balanced view of Face Book use.

This implies that this participant has either informed views on positive and negative aspects of Face Book or that is in favour of use of this media on moderation. A small proportion of approximately 4.8% of the users were able to lend themselves to both the positive and negative aspects of Face Book use; obviously indicating that the vast majority were very one sided.

5.3 Pilot Study Process Analysis

Participants in this experiment belong to two groups of first year and second year students. The unit delivers content on learning about computer systems that include both hardware and software. This group learns how the components of motherboard work and relate to each other in operating the hardware and also how the different software of a computer system including operating system and application software complement the tasks of the hardware. Students are assessed on the knowledge of these topics by completing tasks within projects that include individual and groups work and submit their reports through the Virtual Learning Environment (VLE) environment on the college’s website. Another module undertaken by the second year groups is software design in which students learn the history of development of different programming languages along with learning how to program within a fourth generation language such as visual studio. Assessment is based on demonstrating their knowledge of history of different programming language generation and classification, characteristics and features as well as development; testing and documentation of software designed and programmed using a 4GL. Majority of student’s work is based on independent learning and assessment while a small fraction of each module is based on group work and presentation.

Table 2. Mapping of Pilot study processes



5.4 Focus Groups

This study examined the effectiveness of using social network Facebook for improved communication by learners on advanced level of ICT course. All students who had completed their first semester at college were given the opportunity to participate in this study. Almost all students who were invited took part in this activity with a minority of those who had a more isolated presence and were not welcoming interactions with other classmates or tutor.

Once member of groups were selected and recruited, participants were informed that one aspect of the study would require them to photograph themselves and upload it on their profile. These photos were then to be uploaded to the Facebook research group created specifically for this study, and they were instructed to make brief comments about their posts. What transpired from there became a wealth of information from which it was possible to collect valuable data to build upon and report back as findings. The group was private, so activity such as photo uploads and messages was only visible to the members and administrators of the group, allowing participants to speak freely without sharing these updates with their entire Facebook network. This feature is also beneficial in that the group members can see and comment on each other's uploads, which creates discussion and an interesting dynamic to observe where tutor asked to perform similar tasks react to each other's interpretations of the task. What's also great about it is that we can communicate to the entire group at once to notify them of study changes, additional aspects of the study, let them know their posts are well received, and so on.

The biggest benefit is that Facebook's ubiquitous popularity makes it a simple tool for the participating groups to use – browsing, receiving messages, uploading photos and many other characteristics of the site are fairly common to most people, especially among the demographic we were studying (ages 16-24). The rise of smart phones and the many options for mobile uploads to Facebook (via text, email or through a mobile app) allowed participants to upload their content live from the location wherever convenient. As a result, this process was not cumbersome to participants and made it that much more enjoyable for them.

5.5 Observations

There was a diversity of expected and unexpected outcomes. Most students showed somehow an uncertain view on use of Facebook in presence of their tutor and although some seemed more forward for the idea, few could not understand the relevance at first. At first very few students communicated that they do not use this media at all and therefore lacked the required ability to enable them make a comment on Facebook's suitability for its purpose. It was interesting to see the same few participants had a totally different view following couple of sessions using Facebook for the purpose of this experiment.

The online interaction on Facebook indicated that instant messaging feature of communication to be a more favoured aspect of its use with these participants. Many students favoured the ubiquitous characteristic of Facebook and accessing this social network on Mobile technology. Many students were concerned about privacy issue with Facebook use and therefore did not regard its use for learning and communication to be a favoured feature to the point that even the issue of separating personal status from educational status on Facebook did not seem an attractive alternative to them. The major problem reported by some students was the issue of distraction and diversion from the focus of activities due to the social nature of Facebook.

6. DISCUSSION

The asymmetric information flow is a dominant characteristics of personalised platforms created. Web 2.0 creates the use of centralised nodes for social networking users. Through the shared online social networking sites, web users interact and exchange information with others which mirrors real life networks between people. Use of Web 2.0 emphasises collaboration, knowledge sharing and conversion amongst people. This is seen as a superior characteristic than just simply having a discussion within a public domain. The focus of Web 2.0 is on user driven content in which user messages do not represent goal orientated communication. As the concept of “Web 2.0” has quickly gained widespread popularity, a new generation of E-learning associating with Online Social Networking sites will impact students’ learning experience. Social networking software has provided many features that can serve the learning sector in many ways.

(Howe, 2006) claims that users recognise the web as first a service delivery platform and second as the collective wisdom of the crowd. These are the two important attributes of Web 2.0 technology. Facebook as a strong example of Groundswell phenomenon (Li & Bernoff, 2008), exists both as a service delivery platform and also as a stockpile for collective groupthink. Facebook promotes the user as a centralised node around which information revolves. The use of Web 2.0 and social networking technology represents an attractive force that empowers people’s ability to communicate and foster social connections with one another to create a variety of communities of practice.

For the purpose of next phase of this study, a series of pilot studies are considered. Under the pragmatic research approach and using mixed methods of qualitative and quantitative data collection, learner’s online response to surveys, interviews, and questionnaires will be logged as well as observation of their methods of communication, comment, tags, message and online pokes and chats will be collected. Also quantitative data related to performance and grades of these candidates using online media against these data obtained through traditional teaching methods are to be analysed through simple statistical methods, and interpreted.

7. CONCLUSION

The social learning technology framework proposed in this research study is a solution based on Web 2.0 tools and technology which defines a model for its role and application. It is aimed that this framework also will address the needs of its implementation in higher education and reach beyond its needs to persevere its integrity of use. The SLT framework focuses on social aspects evaluating group dynamics based on electronic learning and communication styles. This framework relies on technology support with the advent of web 2.0 technology tools and advanced e-learning systems.

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THE IMPLEMENTATION OF WEB 2.0 TECHNOLOGY FOR INFORMATION LITERACY INSTRUCTION IN THAI UNIVERSITY LIBRARIES

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ABSTRACT

Web 2.0 technology has drawn much attention recently as a fascinating tool for Information Literacy Instruction (ILI), especially in academic libraries. This research was aimed to investigate the implementation of Web 2.0 technology for ILI in Thai university libraries, in terms of information literacy skills being taught, types of Web 2.0 technology that were implemented, ways of implementing Web 2.0 technology, and problems in implementing Web 2.0 technology. Additionally, in case of the university libraries which did not apply Web 2.0 technology to their ILI, the research also explored their reasons, implementation plan, and factors important to their decisions on the implementation of Web 2.0 technology. Despite the research limitation in the context of Thai higher education, the research should be helpful to fulfill the research gap, and, particularly, to provide other university libraries with interesting suggestions on the implementation of Web 2.0 technology for ILI, including the reinforcement of the implementation.

KEYWORDS

E-learning, Information literacy, Information literacy instruction, University libraries, Web 2.0 technology

1. INTRODUCTION

Information Literacy (IL) has been the term coined since 1974 by Paul G. Zurkowski (Grassian & Kaplowitz 2009, p. 3). Now, it is still recognized and so important that "… it is a prerequisite for participating effectively in the Information Society, and is part of the basic human right of life long learning" (Thompson 2003). Many have defined this term but the one most commonly accepted is defined by the American Library Association (ALA) (Campbell 2004). It indicates that an information literate can find, evaluate, and use information effectively no matter where the information comes from (American Library Association 1989).

In academic setting, these three IL standards are best known (Webber 2008, p. 41): the standard issued in 2000 (ACRL 2000) by the Association of College and Research Libraries (ACRL), the standard issued in 1999 (SCONUL 1999), which was recently revised in 2011 (SCONUL Working Group on Information Literacy 2011), by the Society of College, National and University Libraries (SCONUL), and the standard issued in 2004 (Bundy 2004) by the Australian and New Zealand Institute for Information Literacy (ANZIIL). A correlation between these standards does exist as ANZIIL's standard is developed from ACRL's standard (Bundy 2004, p. 3) whereas SCONUL's recent standard is comparable to ACRL's standard (Martin 2013).

In this environment of information overload, IL is essential to an individual both as a person and a citizen. As a person, an information literate is able to be a lifelong learner who can determine information needs as well as locate, access, evaluate, and use information effectively and efficiently for personal, academic, and working purposes (Detlor et al. 2011, p. 572). As a citizen, IL contributes to an active participant who is able to gain and express information powerfully (Livingstone, Van Couvering & Thumim 2008, p. 105).

Since IL is a critical issue, librarians consider IL development as one of their key roles (Ferguson 2010) and Information Literacy Instruction (ILI) as one of their main services, particularly in academic libraries (Hart 2010, p. 181). Because today's society is networked, new Information and Communication Technologies (ICTs) should be incorporated into ILI (Fernandez-Villavicencio 2010, p. 128). Increasingly, a technology that has drawn librarians' attention recently is Web 2.0 technology (Luo 2010, p. 32).

Web 2.0 technology refers to web-based technology that emphasizes users, interoperability, communication, collaboration, and information sharing (Carpan 2010, p. 106; Whittaker & Dunham 2009, p. 51). The types of Web 2.0 technology that are among the most popular applications (Kelly 2008, p. 22) which can be useful to ILI are Blog, Instant Messaging (IM), Media Sharing, Podcasting, Social Bookmark, Social Networking, Virtual World, and Wiki (Fernandez-Villavicencio 2010, p. 131; Godwin 2008a, pp. 168-174; Grassian & Kaplowitz 2009, pp. 304-307).

Despite numerous positive potentials of Web 2.0 technology to ILI, as illustrated in some literature (Bobish 2011, pp. 56-63; Click & Petit 2010, pp. 138-141; Godwin 2007, pp. 105-110), it is a waste of opportunity that the technology offers (Hart 2010, p. 181) if no or only a few university libraries implement Web 2.0 technology for ILI. Additionally, since specific cases and the focus on one type of Web 2.0 technology prevail the literature on Web 2.0 technology and its adoption (Luo 2010, p. 33; Magnuson 2013, p. 250), it is necessary that a study revealing a holistic view be undertaken to fill the research gap. This is especially important in the context of Thai university libraries where most studies found are about the assessment of students' information literacy and there is currently no study addressing the application of Web 2.0 technology to ILI.

This research was aimed to investigate the implementation of Web 2.0 technology for ILI in Thai university libraries, in terms of information literacy skills being taught, types of Web 2.0 technology that were implemented, ways of implementing Web 2.0 technology, and problems in implementing Web 2.0 technology. Additionally, in case of the university libraries which did not apply Web 2.0 technology to their ILI, the research also explored their reasons, implementation plan, and factors important to their decisions on the implementation of Web 2.0 technology. It was hoped that the research should contribute to the implementation of Web 2.0 technology for ILI, including the reinforcement of the implementation, especially in university libraries.

2. WEB 2.0 TECHNOLOGY AND ILI

Since the introduction of Web 2.0 technology in the academic sphere, a variety of literature has valued its advantages to learning (Farmer, Yue & Brooks 2008; Luce-Kapler 2007; Minocha 2009; Vaughan 2010). In ILI, the technology has also enticed academic libraries for many reasons.

Firstly, today's students are digital natives, Internet generation, millennials, and NetGen (Kent 2008), characterized, for instance, by their natural use of information and technology as well as preference of collaboration, teamworking, and social networking (Godwin 2008b, pp. 5-6). They have widely used Web 2.0 technology (Collis & Moonen 2008, p. 95). Compared to their elders, they were the group doing these activities more: using social networking sites and IM, reading blogs, working on own blog, downloading podcasts, and participating in virtual worlds (Zickuhr 2010). In Thailand, the age group of 15-24 years also used the Internet most (National Statistical Office of Thailand 2011). Specifically, in a tertiary institution, it was found that the majority of undergraduates knew and ever used many types of Web 2.0 technology, namely, IM, Media Sharing, Podcasting, Social Networking, and Wiki. Also, the majority of them needed to use Web 2.0 technology for learning (Sawetrattanasatian 2013). As a result, implementing Web 2.0 technology for ILI to teach this user group should be useful as it was a way to reach them where they were acquainted to and would promptly engage in (Williams 2010, p. 161). Importantly, despite their familiarity with technology, it was described in the library and education domain that students were generally lack of information literacy skills (Detlor et al. 2011, p. 573).

Secondly, Web 2.0 technology could be diversely applied to ILI as depicted in some literature (Bobish 2011, pp. 56-63; Click & Petit 2010, pp. 138-141; Godwin 2007, pp. 105-110; Godwin 2008a, pp. 168-174; Grassian & Kaplowitz 2009, pp. 304-307; Luo 2010, pp. 34-36). On the issue related to ways of implementing Web 2.0 for ILI, the technology could be used for instructor's (instructors') own personal purposes (e.g. information sources for teaching, organization and management of teaching materials); examples to illustrate the concept of information literacy to learners; distribution of teaching content, news relevant to the instruction, and resource/information access to learners; cases, which learners will study and complete their assignments, so that they can understand the concept of information literacy; means of interaction, between instructor(s) and learners, and between learners; and places where learners share, work, and present their works (Deitering & Gronemyer 2011; Fernandez-Villavicencio 2010, p. 133; Godwin 2007, p. 110; Luo 2010, pp. 34-36; Whittaker & Dunham 2009, p. 57).

Finally, adopting Web 2.0 technology into ILI could support the pedagogy of constructivism which was "… increasingly popular among educators …" (Farkas 2012, p. 86). This is because while using Web 2.0 technology, learners are allowed to collaboratively create, gain, and share information. They could act as an active agent, not only a passive recipient (Dunaway 2011, p. 155). In brief, it could be summarized that Web 2.0 technology could reinforce active learning which could also be regarded as learner-centered learning in which learners could get involved (Grassian & Kaplowitz 2009, p. 223) and this is "…an important ideal, both in educational institutions generally as well as in library settings …" (Jacobson 2009, p. xxvi).

In the circumstance of academic, medical, and research libraries, only 18% of the articles, published during 2006-2011, were dealing with Web 2.0 tools used in user education and information literacy (Gardois et al. 2012, p. 90). Additionally, most previous studies on the integration of Web 2.0 technology into ILI were about individual types of the technology (Luo 2010, p. 33; Magnuson 2013, p. 250). There was not much empirical research, notably in academic libraries where the background of the current research was based. However, since grasping a comprehensive view of a phenomenon was indispensable to the insightful understanding, some stimulating studies did still exist.

Luo (2010) examined the current practice of Web 2.0 integration in information literacy instruction and found that librarians surveyed applied Web 2.0 technology in teaching IL. Their adoption of Web 2.0 tools could be divided into three levels: Level 1 – Using Web 2.0 tools to organize and manage course-related material for librarians' own purposes, Level 2 – Using Web 2.0 tools to facilitate the delivery of content to students, and Level 3 – Using Web 2.0 to illustrate IL concepts. Among these levels, Level 2 was found as the framework that most libraries applied for Web 2.0 integration into ILI. The study also revealed that the challenges librarians had to overcome were technical challenges, online vandalism, and students' preconceptions of Web 2.0.

Daniels & Huxor (2011) investigated the current level of Web 2.0 usage among academic liaison / subject librarians in IL programmes. RSS feeds, Weblogs, and Wiki were the most commonly used applications whereas Social Bookmark was used limitedly.

Magnuson (2013) examined how Web 2.0 tools in an online information literacy instruction course could correlate to ACRL's IL standard. Positively, it was reported that Web 2.0 could enhance all five IL standards. She also identified five themes in which Web 2.0 enhanced learning: sharing and collaboration, organization, creativity and enjoyment, catalyst for discussion, and learning about educational technology.

Regarding Thai literature, at the time when the current research was conducted, there was no study interrogating the implementation of Web 2.0 technology into ILI. There were only some studies reflecting the issues of IL development in academic libraries (Khamhomkun 2011; Sirichai, Techamanee & Treewanich 2010; Tuamsuk 2013).

3. METHODOLOGY

In this survey study, a questionnaire responding to the research objectives was developed as the research instrument. It was pretested by a random of ten library heads or library staff members who were responsible for information literacy instruction in ten faculty libraries, located in the universities from different geographical regions of Thailand.

After the pretest and revision, during August and October 2013, the final version of questionnaire was distributed by mail to collect the data from the library director/library head/library staff member who was responsible for information literacy instruction in all 127 Thai university central libraries. The questionnaire was divided into three parts: Preliminary data on ILI of the library (Part 1), Implementation of Web 2.0 technology for ILI (Part 2), and Non-implementation of Web 2.0 technology for ILI (Part 3). In regard to Part 2, ACRL's standard (ACRL 2000) was used for the question on information literacy skills being taught since it is in accordance with the SCONUL's and ANZIIL's standards, as mentioned above. Also, it is the influential standard in higher education (Magnuson 2013, p. 245). Of the questionnaires sent, a total of 93 were returned and usable for further analysis, so the overall response rate was 73.23%. Then, the data collected were analysed using frequency, percentage, mean score, and standard deviation.

4. FINDINGS AND DISCUSSION

After analyzing the collected data, the preliminary data on ILI of these respondents revealed that most university libraries provided information literacy instruction (76.34%). Among them, most had librarians as those who were responsible for ILI (90.14%) and had undergraduate students as their target audience (97.18%). The approach that most libraries took to providing ILI was independent instruction offered by the library as supplemental instruction to a curriculum (84.51%). Generally, the majority of university libraries (60.56%) did not implement Web 2.0 technology whereas the rest (39.44%) did implement it. To explain this, apart from what they answered for their reasons on the non-implementation, it may be due to the claim that "… librarians in developing countries are still at the early stage of getting themselves familiarized with the 2.0 tools …" (Esse 2013, p. 183).

4.1 Implementation of Web 2.0 Technology for ILI

This section would describe the major findings found for Thai university libraries who implemented Web 2.0 technology for ILI (39.44%) as follows:

4.1.1 Information Literacy Skills Being Taught

The majority of university libraries implemented Web 2.0 technology for ILI to teach all five skills as displayed in Table 1. The findings confirm Bobish's (2011) and Magnuson's (2013) literature describing the possibilities of Web 2.0 to foster all skills of ACRL's standard. Regarding the standard which most respondents (96.43%) applied Web 2.0 technology, it was Standard 2: Accesses needed information effectively and efficiently. This is in line with the research findings indicated that most Thai university libraries promoted accessing needed information effectively and efficiently (Khamhomkun 2011).

Table 1. Information Literacy Skills Taught by Implementing Web 2.0 Technology

Information Literacy Skills	Percentage
Standard 1: Determines the nature and extent of the information needed	85.71
Standard 2: Accesses needed information effectively and efficiently	96.43
Standard 3: Evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system	64.29
Standard 4: Individually or as a member of a group, uses information effectively to accomplish a specific purpose	71.43
Standard 5: Understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information ethically and legally	71.43

However, it is also noteworthy that Standard 3: Evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system was the standard that least university libraries (64.29%) implemented Web 2.0 technology although information evaluation was identified as a concept "… better illustrated with reference to the Web 2.0 technology" (Luo 2010, p. 36). More importantly, in today's world of abundant information, it is the skill that must be increasingly highlighted (Farkas 2012, p. 90).

4.1.2 Types of Web 2.0 Technology That Are Implemented

The majority of university libraries implemented four types of Web 2.0 technology for ILI as presented in Table 2. They were Social Networking (92.86%), Media Sharing (78.57%), Blog (64.29%), and Instant Messaging (IM) (57.14%). This may be because these types of Web 2.0 technology were quite prominent in the library realm. Social Networking, Blog, and IM were among the popular technologies for USA and UK librarians (Arif & Mahmood 2012, p. 475). Similarly, Social Networking and Blog were among the most used social media in European librarians (EBSCO 2010). In regard to Thailand, it was also found in a study on Web 2.0 technology uses and needs of state university libraries that Social Networking, Blog, and IM were the top three types of Web 2.0 technology that most state university libraries used (Paphatsurichote 2011).

Table 2. Types of Web 2.0 Technology Implemented for ILI

Web 2.0 Technology	Percentage	Web 2.0 Technology	Percentage
Blog	64.29	Social Bookmark	21.43
Instant Messaging (IM)	57.14	Social Networking	92.86
Media Sharing	78.57	Virtual World	10.71
Podcasting	35.71	Wiki	25.00

These four types of Web 2.0 technology could be implemented into ILI variedly as demonstrated in these examples. Social Networking, such as Facebook, LinkedIn, and Myspace, could be applied to ILI for illustrating the need of being able to consider the quality of information, promoting IL training activities, and communicating with patrons (Fernandez-Villavicencio 2010, p. 133; Luo 2010, p. 36). Media Sharing, such as Flickr, Picasa, Slideshare, and Youtube, could be applied to ILI for serving as a source for teaching, distributing instructional media, and sharing students' content (Luo 2010, p. 35; Whittaker & Dunham 2009, p. 57). Blog, such as Blogger, GotoKnow, and Wordpress, could be applied to ILI for presenting course-related content, supporting class interaction, and providing subject-related blogs that students could explore to have better IL understanding (Deitering & Gronemyer 2011; Luo 2010, p. 34-35). Finally, apart from functioning as a means to inform learners news relevant to the instruction or a place where learners could work and share, IM, such as, Google Talk (Google+ Hangouts in 2013), MSN Messenger, Skype, and Yahoo! Messenger), could be principally applied to ILI for communication (Godwin 2007, p. 110).

4.1.3 Ways of Implementing Web 2.0 Technology

The majority of university libraries used almost every type of Web 2.0 technology for distribution of teaching content, news relevant to the instruction, and resource/information access to learners, namely, Blog (83.33%), Instant Messaging (62.50%), Media Sharing (77.27%), Podcasting (60.00%), Social Networking (84.62%), Virtual World (66.67%), and Wiki (57.14%). The exception was Social Bookmark (50.00%) but the percentage was still the highest compared to other ways university libraries implemented Social Bookmark into ILI.

The findings correlated to what Luo (2010) found in her study that most librarians adopted Web 2.0 tools in ILI to facilitate the content delivery to students. Nevertheless, this way of implementing Web 2.0 technology could not yield the most benefits the technology could offer (Dunaway 2011, p. 152) as it is deemed as passive instruction where learners are the consumers, not active participants or creators. Consequently, they do not practice the activities of high order thinking involved in active instruction, which could result in preferable learning outcomes (Detlor et al. 2012, p. 156).

4.1.4 Problems in Implementing Web 2.0 Technology

According to the 5-Likert scale (most problematic, very problematic, quite problematic, not very problematic, least problematic), university libraries considered all four types of problems as *quite problematic* respectively: problems relevant to operation (3.22)[*], problems relevant to learners (3.10), problems relevant to instructor(s) (2.93), and other problems (2.90).

Concerning the sub-problems, all were rated as *quite problematic* except the one receiving the highest mean score under problems relevant to operation which was viewed as *very problematic*. The sub-problems receiving the highest mean score under each type of problem were as follows: The library did not have enough staff to implement Web 2.0 technology into ILI (3.65) for problems relevant to operation, learners did not have enough knowledge and skills to use Web 2.0 technology (3.15) for problems relevant to learners, instructor(s) did not have sufficient time to implement Web 2.0 technology into ILI (3.11) for problems relevant to instructor(s), and there were some risks in using Web 2.0 technology, such as the issues of authority, security, and privacy (3.28) for other problems.

Compared to all other sub-problems, that the library did not have enough staff to implement Web 2.0 technology into ILI is vital since it received the highest mean score and was the only sub-problem rated as *very problematic*. In some studies on IL reinforcement in developing countries (Baro & Keboh 2012; Sirichai, Techamanee & Treewanich 2010), inadequate number of competent or trained staff was also mentioned. Additionally, this was in accordance with the findings of the university libraries who did not implement Web 2.0 technology for ILI, described in the next section. This is because most of them did not implement Web 2.0 technology for ILI because they had a limited number of staff and existing staff already had a lot of works to do. Also, the sub-problem might be directly relevant to two internal sub-factors, important to the decisions on implementing Web 2.0 technology for ILI. They were instructor's (instructors') knowledge and skills to implement Web 2.0 technology into ILI and adequacy of library staff, which were ranked among the internal sub-factors receiving the first three highest mean scores by those who did not implement the technology.

Respecting the problems relevant to learners, that learners did not have enough knowledge and skills to use Web 2.0 technology is interesting as, generally, it is assumed that this generation of learners should be digital natives. However, they might have different technology literacy and competency (Farkas 2012, p. 88). The sub-problem was also aligned with Luo's findings that a challenge librarians should overcome when adopting Web 2.0 into ILI was students' unfamiliarity with the Web 2.0 technology (Luo 2010). Learner's knowledge and skills to use Web 2.0 technology was also a highly-rated external sub-factor, important to the decisions on implementing Web 2.0 technology for ILI, described in the next section.

Time is needed for librarians who teach IL to "… develop appropriate content, instruct, solicit feedback, respond and engage students in an active learning process …" (Owusu-Ansah 2004, p. 9). This statement is still true to the implementation of Web 2.0 technology for ILI and it might explain why the sub-problem that instructor(s) did not have sufficient time to implement Web 2.0 technology into ILI received the highest mean score for problems relevant to instructor(s). This might also be the result of librarians' work overload and staff insufficiency.

Finally, another sub-problem receiving the highest mean score that could hinder the implementation of Web 2.0 technology for ILI was the technology itself as there were some risks in using it, such as the issues of authority, security, and privacy. This might be due to its open unmonitored environment (Godwin 2007, p. 106) and its general nature of external hosting (Kelly 2008, p. 23).

[*] The number in parentheses is the value of mean.

4.2 Non-Implementation of Web 2.0 Technology for ILI

This section would describe the major findings found for the majority of Thai university libraries who did not implement Web 2.0 technology for ILI (60.56%) as follows:

4.2.1 Reasons of Non-Implementation

Most university libraries did not implement Web 2.0 technology for ILI because they had a limited number of staff and existing staff already had a lot of works to do (72.09%). In fact, even without the adoption of Web 2.0 technology, lack of staff was also another existing challenge librarians faced in ILI as stated in some literature both in developed and developing countries (Detlor et al. 2012; Idiodi 2005; Lwehabura & Stilwell 2008).

4.2.2 Web 2.0 Technology Implementation Plan

The majority of university libraries did not have a plan to implement Web 2.0 technology into ILI (53.49%). However, the number of those who did have a plan was not so different (46.51%). In respect to the latter group, most planned to implement Web 2.0 technology into ILI within more than a year. Notably, all who had a plan were interested in utilizing Social Networking. This might be because of its most familiarity (Kent 2008), its popularity among students (Godwin 2007, p. 108), and its promising capability to enhance all five IL skills in ACRL's standard (Bobish 2011).

4.2.3 Factors Important to the Decisions on the Implementation of Web 2.0 Technology

According to the 5-Likert scale (most important, very important, quite important, not very important, least important), university libraries considered both internal factors and external factors as *very important*. Similarly, all sub-factors under each type of factor were rated as *very important*. Table 3 shows the factors important to the decisions on implementing Web 2.0 technology for ILI together with the sub-factors receiving the first three highest mean scores.

Table 3. Factors Important to the Decisions on Implementing Web 2.0 Technology for ILI*

Factors	Mean
Internal Factors	**4.12**
Policy of the library administrators	4.33
Instructor's (Instructors') knowledge and skills to implement Web 2.0 technology into ILI	4.19
Adequacy of library staff	4.14
External Factors	**4.04**
University readiness of computer facilities and Internet	4.21
Support and co-operation of stakeholders in the university, such as administrative board, and faculty members	4.09
Learners' interest and co-operation	4.09
Learners' knowledge and skills to use Web 2.0 technology	4.05

*Under each type of factor, only the sub-factors receiving the first three highest mean scores were presented.

Considering the internal factors, the policy of the library administrators was rated with the highest mean score. This might be because their policy on the implementation of Web 2.0 technology for ILI could guide and encourage the staff's movement. Also, it could assure every kind of their support (i.e., money, time, resources). Analogously, the importance of this sub-factor could be illustrated with a survey on teaching and fostering IL programmes where lack of policy was a barrier (Baro & Keboh 2012).

Instructor's (instructors') knowledge and skills to implement Web 2.0 technology into ILI were highly important since instructors should develop a deeper understanding of the technology, skills, and new ways of working (Godwin, 2007, p. 104), so they could play with the technology to create something new and unique possible to the educational purposes (Magnuson 2013, p. 245). It is also critical when recognizing that lack of knowledge and skills on Web 2.0 technology was the problem that library staff in Thai state university libraries encountered with the highest mean score (Paphatsurichote 2011).

In case of external factors, university readiness of computer facilities and Internet was the most important as it received the highest mean score. This might be because it is impossible to implement Web 2.0 technology for ILI without computer facilities and Internet. Some findings of a study on highly cited factors contributing in the successful application of Library 2.0, which was underpinned by Web 2.0 technology, could also confirm this (Esse 2013).

With respect to support and co-operation of stakeholders in the university, such as administrative board, and faculty members, their support and co-operation could assist in a successful story of ILI (Detlor et al. 2011, p. 578). In addition, since low percentage was found for the cooperation between librarians and faculty members in a study conducted on ILI in Thai higher education (Tuamsuk 2013), this might clarified why university libraries determined support and cooperation of stakeholders in the university as the second most important external sub-factor to the implementation of Web 2.0 technology for ILI.

Concerning learners' interest and co-operation, it could definitely affect librarians' effort to implement Web 2.0 technology for ILI. If learners are not interested in ILI implementing Web 2.0 technology, they might not seriously participate in the teaching and learning activities that could lead them to essential IL learning outcomes. This is even more interesting when noting the findings in the Thai context that students were not interested in IL promotion activities (Khamhomkun 2011). Additionally, a special attention should be taken for this sub-factor since students might have the conception of Web 2.0 technology for social and entertainment purposes only and they might not be aware of or interested in its educational potential (Luo 2010, pp. 37, 39).

5. CONCLUSION

Although Web 2.0 technology and IL has just become a salient topic since 2006 (Godwin 2009, p. 267), the opportunity Web 2.0 technology brings to ILI has drawn much attention in library domain, especially the academic ones. Based on the research findings, the following recommendations for implementing Web 2.0 technology for ILI are proposed:

Since the majority of university libraries have not yet implemented Web 2.0 technology despite its advantages to ILI, the incorporation of Web 2.0 technology into ILI should be more reinforced. University administrators, including library administrators, should acknowledge the importance of ILI, particularly with the use of Web 2.0 tools, and should assist in the supportive atmosphere across the institution (e.g. adequate number of skilled ILI staff, equipped computer facilities and Internet, and co-operation among IL instructors, faculty members, and learners). Specifically, library administrators should encourage the implementation of Web 2.0 technology for ILI with a clear policy so that it could rigorously push the ILI staff's action. Apart from a proper personnel plan and job description, library administrators should also promote IL instructors' knowledge and skills to implement Web 2.0 into ILI through some staff development activities. This is also emphasized in some literature since training on various Web 2.0 applications in libraries was found important (Esse 2013) and needed by the majority of librarians (Arif & Mahmood 2012).

Pertaining to faculty members and learners, they should mutually co-operate with IL instructors in implementing Web 2.0 technology for ILI. This is because positive relationship with faculty members could leverage ILI support (Detlor et al. 2011, p. 578), including the experience with Web 2.0 technology. In regard to learners, they should widen their conception of Web 2.0 technology from social aspect and entertainment to academic practice. Moreover, they should acquire sufficient knowledge and skills to be able to use Web 2.0 technology effectively, safely, and morally for their learning.

Last but not least, IL instructors should enthusiastically develop their knowledge and skills to implement Web 2.0 technology into ILI. They should also experiment and create new ideas to figure out the best possibilities of integrating Web 2.0 technology into their instruction. They should adopt Web 2.0 technology to the most benefits it offers to teach all IL skills, increasingly Standard 3: Evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system, since least university libraries instructed it with the application of Web 2.0 technology. In addition, they should include various types of Web 2.0 technology in their ILI as a combination of Web 2.0 technology could result in a wide array of IL outcomes (Magnuson 2013, p. 250). Importantly, their instruction should be more active so that more desirable learning outcomes could be generated and it could have such an impact and sustaining influence that one active ILI session might be enough (Detlor et al. 2012, p. 156). This suggests that active ILI could also relieve the problem of time and staff limitation. Moreover, they should build a strong co-operation with faculty members as it is a key to success. They should also cultivate in learners an understanding of IL and its importance, especially achieving these skills with ILI implementing Web 2.0 technology. In case of the learners who have insufficient knowledge and skills to use Web 2.0 technology, they should provide them with some training. Finally, they should study the risks that might occur in using Web 2.0 technology so that they, or with the consultation of some experts or technologists, could overcome the problems and implement it into ILI properly.

This study should fill some parts of a research gap. In spite of this, additional knowledge on the implementation of Web 2.0 technology for ILI is still required so that better understanding and application could be revealed. Since the current research was on the quantitative paradigm, the investigation of implementing Web 2.0 technology for ILI should be further carried out on the basis of other paradigms for greater depth, namely, qualitative or mixed methods. Also, the current research explored the implementation of Web 2.0 technology for ILI only on the side of instructors in libraries. Therefore, future research focusing on learners, such as their perception and achievement (Luo 2010, p. 39) as well as problems and needs, in regard to the implementation of Web 2.0 technology into ILI is suggested.

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DESIGNING EDUCATIONAL SOCIAL MACHINES FOR EFFECTIVE FEEDBACK

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ABSTRACT

We report on our development of an educational social machine based on the concept that feedback in communities is an effective means to support the development of communities of learning and practice. Key challenges faced by this work are how best to support educational and social interactions, how to deliver personalised tuition, and how to enable effective feedback, all in a way which is potentially scalable to thousands of users. A case study is described involving one to one and group music lessons in an on-campus, face to face, higher education context that were observed and analysed in terms of the actions carried out by the participants. The actions are described and it is shown how they can be formalised into a flowchart which represents the social interactions and activities within a lesson. Through this analysis, specific scenarios emerged where the feedback being given might not be effective, e.g. the recipient not understanding the feedback or the provision of feedback which is not specific enough. In answer to these scenarios of ineffective feedback, the requirements for a technological intervention which aims to make the feedback more effective are proposed. With this in mind, we are then able to describe a novel technological platform which has been developed as part of a large-scale European research project and which aims to support effective feedback. The platform is based around focused discussion of time based media, embedded within existing teaching activities at a research led higher education institution in the UK. We outline how it is being used in a blended learning model to support the teaching and learning of music. We reflect on the experience of developing techniques and systems for enabling communities of e-learning and describe our evaluation methodology which involves several, ongoing case studies and approximately 400 users in its current phase.

KEYWORDS

Social learning, social timeline, feedback, MOOC, music education

1. INTRODUCTION

Our research project is concerned with the development of a social machine which aims to support and enhance the experience of learning music through the optimal provision of feedback. Key challenges we face in this work are how to support educational and social interactions, how to deliver personalised music tuition, and how to enable effective feedback, all in a way which is potentially scalable to thousands of users.

In this paper, we present our method for addressing these challenges through an initial period of teaching observation and analysis followed by the development of a technological platform via a participatory design process. The methodology is summarised in figure 1. Following that, two key research outputs are presented: an analysis of one to one and group music tuition within our institution and a novel e-learning platform we have developed in response to this analysis. The teaching analysis resulted in a list of archetypical teaching and learning activities, shown in table 1, an ontology of musical feedback, shown in figure 3 and flowcharts describing interactions within lessons as shown in figure 2. The technological platform is essentially a repository for audio and video recordings which allows the user to upload media then to share it with communities of other users who can then place comments relating to the media along a timeline. It is described as a set of system requirements in table 2 and as screenshots of its media discussion interface and social timeline in figures 4 and 5.

1.1 Background

Let us first consider what we mean by a social machine. Tim Berners Lee is credited with having coined the term social machine in 2000:

> Computers can help if we use them to create abstract social machines on the Web: processes in which the people do the creative work and the machine does the administration (Berners-Lee et al., 2000).

This quote is contextualised in the transition to web 2.0 where the process of publishing content and interacting online was democratised with technologies such as blogs, social networks and so on. In 2013, we find ourselves in the age of the social machine, where the point of interest for internet technologies is no longer the architectural underpinnings but the way in which people and machines interact within these systems. De Roure et al., are concerned with the observation of these social machines and provide some examples: Wikipedia, Ushahidi, Galaxy Zoo, reCAPTCHA and Mechanical Turk (Roure et al., 2013). Moving to the educational context, 2012 was the 'year of the MOOC' (Pappano, 2012); indeed, one of the authors of this paper ran a MOOC with an enrolled student body of 97,000. With their extreme student to staff ratios, MOOCs rely upon interactions between peers for support and assessment; this is a level of social interaction that seems beyond what has been seen previously within standard VLEs. Since they are technological systems supporting a range of social interactions, we consider them to be another example of a social machine.

Now let us consider the term 'feedback'. We define feedback in the educational context simply as a reaction to a learner's output which is somehow made visible to the learner. In higher education in general, feedback is considered very important. It is one of the key areas covered by the UK National Student Survey and historically one of the lower scoring areas in terms of student satisfaction (HEFCE, 2011). So feedback is important and is not always being done well, but how can we do it better? Juwah et al. present a list of 7 principles of good feedback in higher education, wherein good feedback a) Facilitates assessment (reflection) in learning b) Encourages teacher and peer dialogue around learning c) Helps clarify what good performance is (goals, criteria, expected standards) d) Provides opportunities to close the gap between current and desired performance, e) Delivers high quality information to students about their learning f) Encourages positive motivational beliefs and self-esteem and g) Provides information to teachers that can be used to help shape the teaching (Juwah et al., 2004). These are useful general principles but music education is a specific case where the contexts and nature of feedback are perhaps quite different. Therefore, in this paper we will present our analysis of feedback within music education with specific examples, then show how we have developed a technological system which aims to support that specialised kind of feedback.

1.2 Previous Work

In this section, we will provide a brief overview of some related work in the areas of social discussion of media, online music education and peer interactions. The platform provides a media repository and timeline based discussion functionality; a similar commercial platform is Soundcloud, which allows users to maintain and share a repository of audio files and to post comments to a timeline (Bird, 2014). Considering the concept of annotations placed on a timeline, Latulipe discusses various projects using timeline based discussion systems including the 'Video Collaboratory' (Latulipe, 2013). Puig et al. developed the 'Lignes de Temps' software which provides a multitrack timeline aiming to promote polemical discussion (Puig and Monnin, 2006). Moving to the music education area, there are a range of commercial online platforms such as ArtistWorks (Marshall et al., 2014) and Berkley Online from the Berklee School of Music. Indeed Berklee have been running musical MOOCs on the coursera platform, using SoundCloud for peer discussion (Nuernberg and Perrier, 2013). There has also been significant public research undertaken into technology for music education, such as the European funded i-maestro and VEMUS projects, both of which focused in part on the specificity of feedback (Ong et al., 2006), (Fober et al., 2007). The concept of social interactions between students within VLEs did not arrive with the xMOOC in 2012, of course; the cMOOC which came before it had perhaps a more radical, distributed pedagogy (Smith and Eng, 2013). Going further back, forums have been a standard component in VLEs for a long time and new types of VLEs emphasising social interactions have been reported in the literature. For example, Shi et al. describe their Topolor system which enables ‘social personalized adaptive e-learning’ (Shi et al., 2013). Finally, to contextualise our methodology, we use a grounded theory approach to analyse our lesson observations and a participatory design approach to develop the features of the platform (Charmaz, 2006), (Muller and Kuhn, 1993).

1.3 Research Questions

Our research project has several high level research questions:
(1) How well does our approach increase participation in musical learning activity?
(2) How important is giving and receiving feedback online for engagement with practice?
(3) How do we correlate engagement and feedback in a community?
(4) What is the right level of social coordination and structure that students want for online-supported learning? Can we provide interfaces for non-technical people to design social coordination?
(5) How can we evidence musical competencies and musical development in students?
(6) How can automatic techniques be used to evidence feedback in music learning?

In the work presented here, we describe our ‘approach’ and provide evidence about the nature and importance of feedback which underpins several of the questions above. We also provide answers to how one might evidence musical competencies.

1.4 Structure of this Paper

The background and motivation for the work has been presented in this section. In section 2 we will describe our methodology for building social machines combining teaching observation and participatory design. In section 3 we present the outputs of the methodology including the observed teaching and learning activities, types of feedback and a description of the features of our new platform. In section 4 we describe the ongoing evaluation of the platform with 400 users. The paper ends with a discussion and conclusion in section 5.

2. A METHODOLOGY FOR BUILDING SOCIAL MACHINES COMBINING TEACHING OBSERVATION AND PARTICIPATORY DESIGN

The development of our platform has taken place in 4 phases. In phase 1, teaching observation, we observed and recorded 23 undergraduate instrumental and vocal performance lessons at our institution. The lessons involved 9 teachers teaching guitar, voice, piano and group and 14 individual students. The lessons were in either one to one or group format and spanned the popular and classical music degrees. Recordings of the lessons were transcribed to approximately 500 pages of text and notes were taken by the researcher observing the lessons. In phase 2, analysis, a grounded theory approach was used to code the activities within the lessons in order to identify key teaching and learning activities. This approach ‘fosters seeing your data in fresh ways and exploring your ideas about the data through early analytic writing’ (Charmaz, 2006). The activities were then organised into higher level descriptions in the form of flowcharts describing different types of lessons. A particular emphasis was placed on the flow of feedback between participants in these lesson archetypes. In phase 3, basic requirements, we drew up some basic requirements for the platform in order for it to support the teaching effectively. This would allow us to bootstrap the basic functionality of the platform ready for the next phase. In that phase, participatory design, we used a participatory design approach, where the input of users is sought and acted upon throughout the iterated development lifecycle (Muller and Kuhn, 1993). In a sense, the final phase includes its own observation, analysis and requirements phases, except that the observations are of users using the system (for real teaching and learning). This final phase is ongoing. Figure 1 illustrates the relationship between the 4 phases.

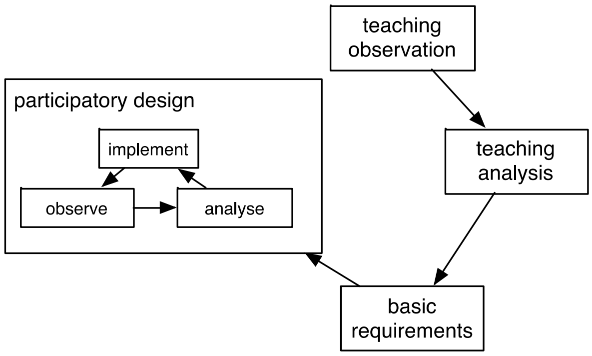

Figure 1. The 4 phases of platform development

3. OUTPUTS FROM THE METHOD

In this section we will present the outputs generated by the teaching analysis and participatory design process.

3.1 Enumerating Teaching and Learning Activities

We were able to identify 9 distinct teaching and learning activities from our lesson transcripts and observation notes and these are shown in table 1 with examples of each from the transcripts.

Table 1. The 9 distinct teaching and learning activities in one to one and group music lessons

Activity	Description	Example
Transmission	**Tutors provide theoretical and practical information to students**	so whatever you do to your mouth, it's the same sound because the tongue is going right up against the soft palette, so the sound can only come out in your nose.
Performance modelling	**Tutors or students perform good and bad examples of extracts from a composition 1**	A musical activity
Identify and solve	**Identify, discuss then suggest solutions to performance problems.**	Okay, did you hear that? The music is very uneven... Let's experiment a bit. Let's do it this way. I'll play the right hand with you the first time. I am going to go for just a legato version. Then you will have a go at it hands together and I would like you try to a legato version so then you are not affected by the separation of the notes.
Practicing solutions	**Students put the solutions from the identify and solve activity into practice in their playing**	A musical activity
Feeding back	**Self, peer and tutor feedback on a performance, after it has happened**	That's fine, that sounded pretty good. The very first time it sounded - your down beat sounded a little bit like `oh this is a down beat, I'm going to play loud now.' Always be careful about how you're shaping it.
Checking student understanding	**Initiated by student or tutor, student understanding is verified through dialogue**	[Tutor] From there, just flatten the 3 and you've got Dorian and add to that flatten the 6, you've got Aeolian, if you want to continue, what would you do next? Anybody know? [Student] Flatten the 2? [Tutor] Exactly right! Flatten the second, becomes? [Student] Phrygian. [Tutor] Phrygian, that's right! Which is a very nice scale, I'm fond of it.
Discussion of goals and ideas	**Discussion and negotiation of assessment or other goals and**	[Teacher] What is romantic for you? Let's engage in this kind of discussion. What is romantic? It's important.

	creative ideas	What is romantic for you? [Students]: To express your emotions, along with that establishing a connection. [Tutor] Don't you think that being romantic also sometimes can mean trying to be a bit more individual than you normally are in the real world, to be more special?
Performing	**Students performing a prepared piece**	A musical activity
Directing	**Tutors verbally guide a student performance in real time**	[Teacher] Top string this time. Take that off so you're playing - you want that note. There's G. Put your little finger back. G7. Put your finger back. The difference where your first finger is, yes, that's suspended, that's G. You can hear it.

3.2 Teaching Workflows

Through our lesson analysis, we were able to identify lesson archetypes which appeared several times in the observations. We call these archetypes ‘teaching patterns’, after Eckstein et al. (Eckstein and Bergin, 2002). A complete description of the teaching patterns is beyond the scope of this paper but a single example flowchart representing a lesson where a student performs in front of their tutor and peers can be seen in Figure 2.

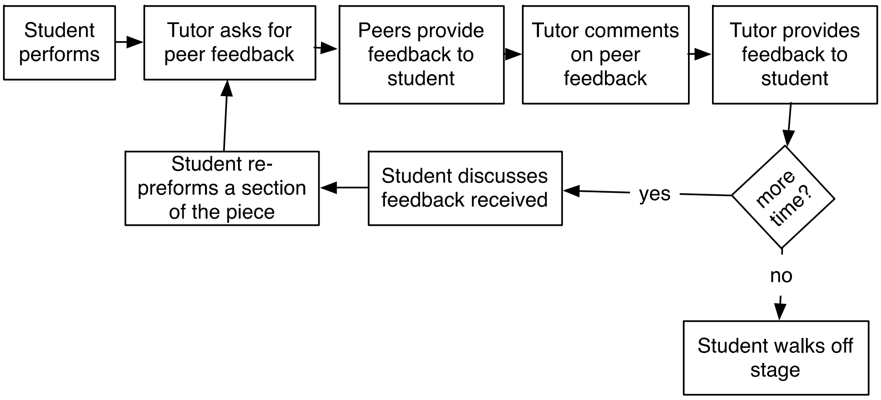

Figure 2. A flowchart describing a peer feedback lesson where a student performs in front of their peers and tutor then receives feedback

3.3 Feeding Back about Music

Perhaps unlike some other subjects, there is a rather discrete and finite ontology underlying the types of feedback one might receive about playing a musical instrument. As part of our analysis, and based on previous work, we have developed a detailed ontology to describe feedback on musical performance, shown in figure 3. It should be noted that we have identified two broad types of feedback: firstly, feedback connected to desirable traits in a musical performance, as shown in the majority of figure 3 and secondly, ‘information for guiding tactics and strategies that process the domain specific information’ after Butler and Winne (Butler and Winne, 1995). The latter might also be expressed as encouraging the learner to develop their self reflective skills, their *inner teacher*.

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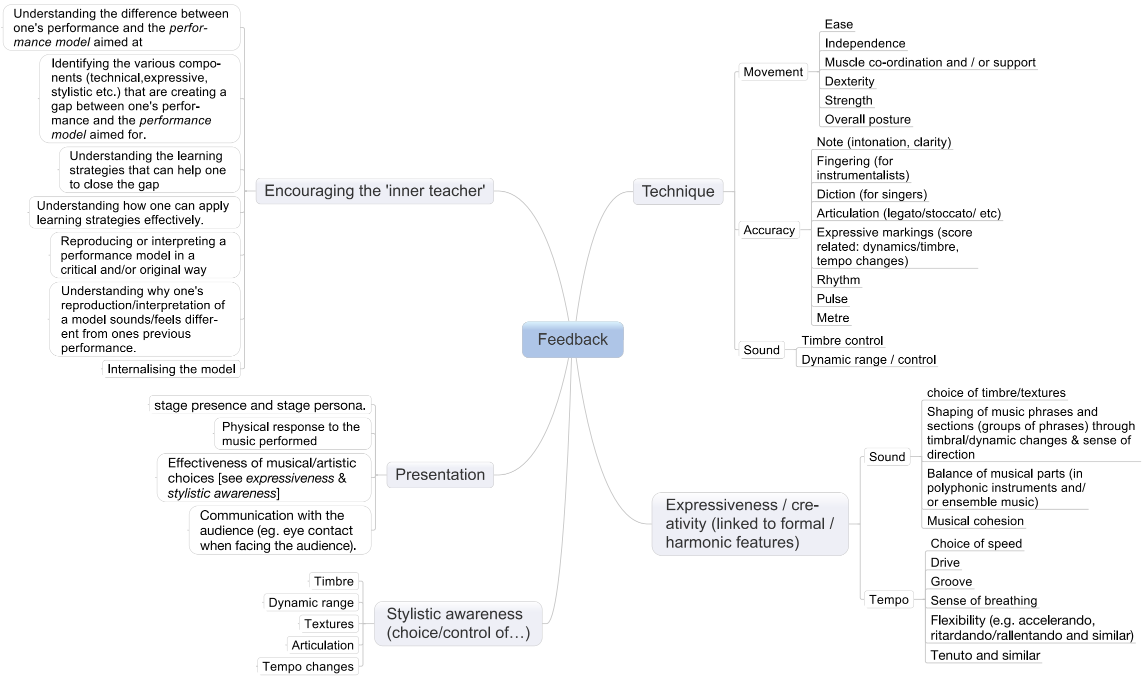

Figure 3. The ontology we developed which describes feedback about musical instrument playing

3.4 An Understanding of Problems with Feedback Provision Motivating Essential Platform Requirements

We now have a clear idea of the context within which feedback is given (e.g. lesson flowchart in figure 2) and the expected content of that feedback (i.e. the ontology in figure 3). However, we were able to identify several reasons why feedback might not be effective, listed below. Note that at this point, we begin to consider the basic requirements for our platform which will allow it to address these problems directly.

(1) *The underlying ontology driving the feedback is not well understood.* The platform should be able to gradually expose an ontology in a range of ways. (e.g. through suggestion of relevant terms, and the provision of automated, high level annotations)
(2) *The feedback is not remembered*. The platform should make feedback easily accessible for later reflection, not hidden away in a forum somewhere, for example.
(3) *The tutor is the sole source of trusted feedback.* The platform should embody a community of learners pedagogy, to emphasise the value of feedback from peers and tutors alike.
(4) *The feedback given to peers is not honest, e.g. 'too nice'*. By building a platform that enables more precise feedback related to a specific ontology, feedback should naturally become more honest, as the emphasis for the feedback is aimed away from the individual and towards particular aspects of a performance.
(5) *The relevance of feedback to a particular performance is not understood*. The platform should encourage the provision of feedback which is specific and well justified.
(6) *The feedback is too narrow*. Here, the feedback focuses on a limited part of the ontology, typically due to time constraints in a lesson. The platform should encourage a community discussion around a greater number of performance aspects.

3.5 Platform Design

The final phase of our methodology was the iterated development of the platform. This process is ongoing, but it moved through 8 versions during the first year, where increasing numbers of users were involved at each stage. The resulting platform is essentially a repository for audio and video recordings which allows the user to upload media then to share it with communities of other users who can then leave comments along a timeline. Its key features are listed in table 2 and shown in figures 4 and 5. At the end of this first year of development, the system was in active use within 5 undergraduate modules at 2 institutions. In the following passage, the key features and motivations for their inclusion will be discussed.

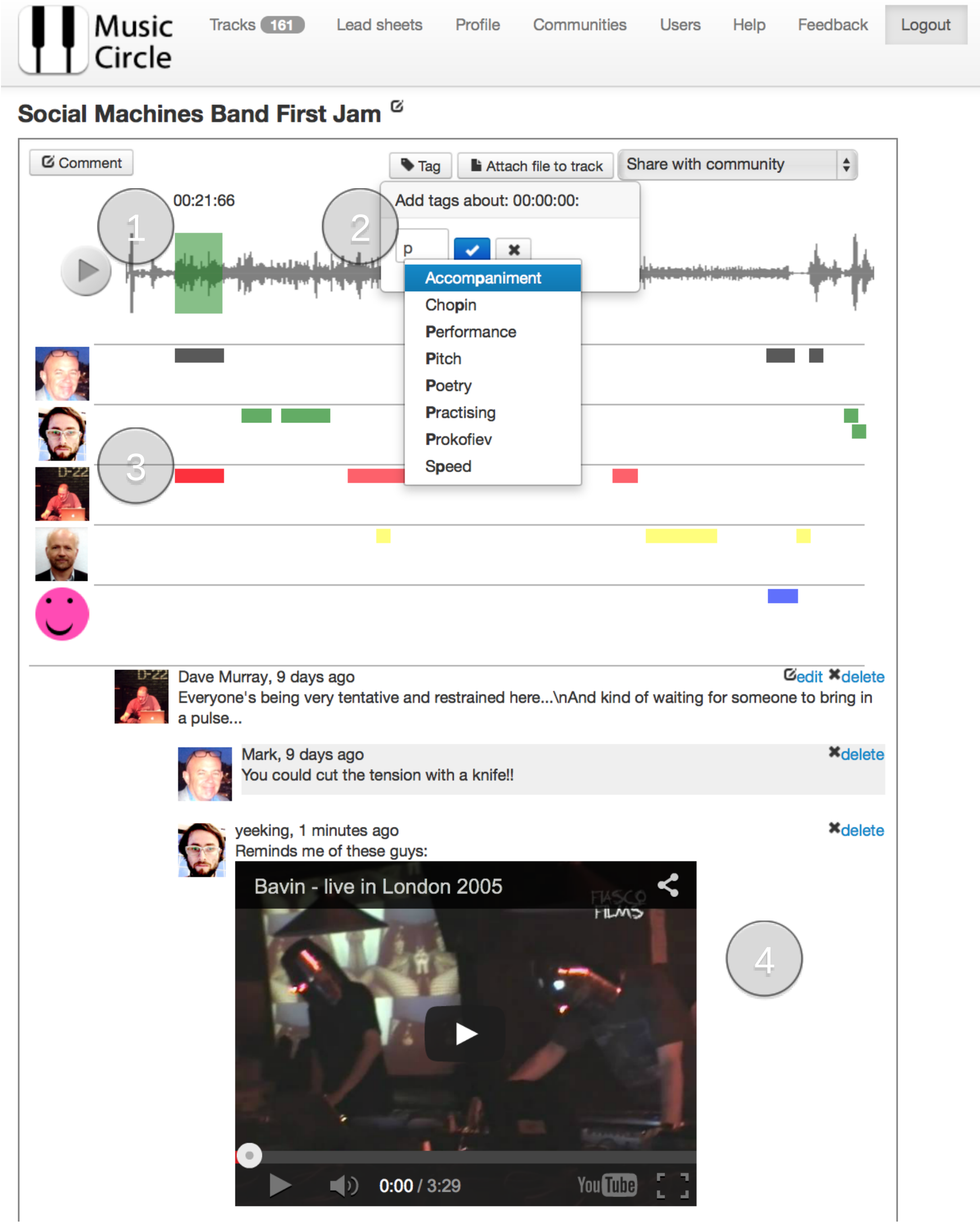

Figure 4. The music circle media discussion interface. 1) The waveform display, showing a highlighted region, 2) The tagging dialogue, showing a drop down list of pre-used tags 3) The social timeline, showing sets of time linked comments created by several users 4) a discussion thread based on a single region in the recording, including an embedded youtube video

Table 2. The key features of the system compared to some pre-existing systems which we have used for teaching at our institution

Feature	MusicCircle	SoundCloud	Mahara
Easy access, personal media repository with mobile media capture client	**X**	**X**	
Simple, transparent sharing and community model	**X**		**X**
Intuitive discussion interface with content prompting	**X**	**X**	
Social timeline with region selection	**X**		
Powerful discussion system	**X**		**X**
Automatic feedback agent	**X**		
Suitability for use as a research platform (data access, privacy etc.)	**X**		**X**

Easy access, personal media repository with mobile media capture client

The aim is to remove barriers to content uploading and sharing and to make content easily accessible for later review. The platform includes simple record and upload apps for iOS and Android to make content addition as easy as possible as we identified that the often over-complex process of putting content into VLEs can be a serious barrier to uptake for students.

Simple, transparent sharing and community model

The aim is to increase user confidence in uploading and sharing media. The platform provides a very clear method of controlling who the content is shared with. Also, users can delete any comments made about their content.

Intuitive discussion interface with content prompting

This feature aims to motivate commenting activity and to encourage use and understanding of appropriate terms from the ontology.

Social timeline with region selection

Feedback is always connected to a particular range of time in the media. Also, all commenting users have individual timelines displayed below the media. This promotes awareness of the community opinions, making feedback specific to a person and a time.

Powerful discussion system

Users can reply with audio, video, text and so on. Audio and video responses within the platform can then become a subject for discussion in themselves, with their own social timeline.

Automatic feedback agent

We are developing software agents which are able to feed- back automatically about musical performances. They work by comparing different perfor- mances and making high level comments about the variations, connected to the feedback ontology. This provides a 'neutral' source of feedback and exposes the learner to the on- tology. A full description of the feedback agent is beyond the scope of this paper but it is built around machine learning and audio analysis techniques.

Suitability for use as a research platform (data access, privacy etc.)

We need to be able to ensure the data is appropriately protected and that it can be accessed for analysis throughout the project. Also, we need to be able to rapidly prototype and integrate different components to our platform for experimentation.

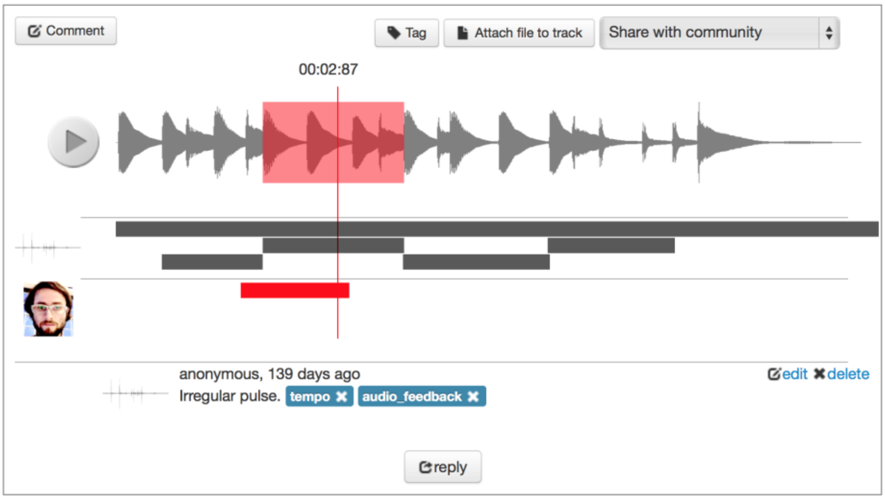

Figure 5. The social timeline, showing sets of annotations from two users. Each block in the timelines represents an annotation connected to a specific region in the recording. Here, the top timeline was created automatically by the feedback agent

The key features of the platform are listed in table 2, where we also compare them to the closest equivalent commercial system, SoundCloud and a well known open source e-learning tool with social features, Mahara.

4. A DESCRIPTION OF OUR ONGOING EVALUATION WITH 400 USERS ACROSS 2 INSTITUTIONS

The participatory design process aims to suggest then optimise platform features. In a sense, this represents an ongoing, evaluation and improvement cycle. However, as stated in the introduction we are interested in the evaluation of social machines and the activities they enable at a higher level than basic platform features. In this regard, we are running significant case studies with our platform with approximately 400 users spread across 2 institutions and 5 different modules. The evaluation scheme consists of qualitative and quantitative methods. In particular, we will be using interviews, survey tools and user activity metrics including social network analysis. This will allow us to address the research questions listed in section 1.3 with a variety of perspectives. We anticipate being able to analyse a data set containing hundreds of media items, thousands of comments and many thousands of interactions.

5. CONCLUSION

Work has been presented which faces the challenges of how to support educational, social interactions, how to deliver personalised music tuition, and how to enable effective feedback. A methodology for addressing the challenges has been described which takes real observational data and analyses it into formalisations of teaching and learning activities. The outputs from this methodology have been presented, including a list of key teaching and learning activities, a flowchart describing the interactions within a typical lesson, and an ontology of types of feedback. It has been shown how the outputs have been iteratively interpreted into the design for a novel e-learning platform driven by social interactions and effective feedback. The current system has been introduced and the ongoing evaluation with 400 users has been described. The immediate targets for our future work are to increase the number of learners operating within the platform, to conduct an investigation of the wider applicability of the system, for example as a means to deliver recordings of lectures and the development of our tool kit for quantitative evaluation of the system. Inspired by the examination of

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the importance of feedback presented here, the longer term goal is to develop a deeper understanding of the nature and importance of feedback in the learning and creative processes.

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A SUPPORT SYSTEM FOR ERROR CORRECTION QUESTIONS IN PROGRAMMING EDUCATION

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ABSTRACT

For supporting the education of debugging skills, we propose a system for generating error correction questions of programs and checking the correctness. The system generates HTML files for answering questions and CGI programs for checking answers. Learners read and answer questions on Web browsers. For management of error injection, we have analyzed types of errors and defined the processes of error injection as code transformation patterns. The system synthesizes code fragments including errors by transforming correct code fragments according to the selected patterns. Full coverage of all possible answers is difficult. Instead, we have adopted a strategy to restrict editable points and possible answers from the educational view. To confirm the effectiveness of the system, we have generated questions using several examples and applied them to a programming exercise as an evaluation experiment.

KEYWORDS

Error Correction Questions, Programming Education, Debugging

1. INTRODUCTION

In programming courses, students learn skills for coding, code reading, and debugging through various kinds of exercises. Although debugging is important for actual software development, it is difficult for students, even who have a good understanding of programming, to acquire skills to debug programs effectively [6][7]. In this paper, we focus on learning support for debugging, whose controlled exercises are difficult to be provided.

Typical exercises in programming courses are describing full codes and filling empty boxes embedded in the texts of codes. Through describing full codes, learners find errors and inevitably try to debug for detecting faults. Debugging experiences, however, are different for each learner, and teachers cannot control experiences for them to use all necessary debugging skills. In the case of exercises using questions for filling empty boxes, learners may not have chances to debug because the codes they read do not include any errors, and they can fill answers without compiling and testing. For controlling their experiences of debugging, exercises using error correction questions are suitable. Learners read codes and need to detect errors that are injected purposely. Teachers can select errors for injecting according to debugging skills to be learned.

Preparing error correction questions is, however, a tough work for teachers. It requires injecting various errors in code fragments and check the correctness of all possible answers, some of which may be unexpected one but correct. There are some researches for supporting these work flows [2][7][8][10], but a few ones for automatic systems of question generation and correctness checking [2][8]. The key questions about constructing the systems are how to manage error injection into code fragments and how to cover all possible answers in correctness checking.

In this paper, we propose a system for generating error correction questions and checking the correctness. The system generates HTML files including editable text forms for answering questions and CGI programs for checking answers. They are deployed on a Web server and learners read and answer questions on Web browsers. For management of error injection, we have analyzed types of errors and defined the processes of error injection as code transformation patterns, which we call *error patterns*. The system synthesizes code fragments including errors by transforming correct code fragments according to selected error patterns. If the system allows the learners to edit any points in codes, it needs to accept all possible correct answers. Full coverage of all possible answers is difficult. Instead, we adopt a strategy to restrict possible answers to the ones that is reasonable for learning objectives, which mean the syntax and semantics of the language, typical program descriptions, and algorithms that learners should understand. We have analyzed types of possible answers and propose constraints of editable points in codes on answering questions. For evaluating the system, we have implemented a prototype of the system and generated questions for learning the syntax and semantics of conditional branches, loops, arrays, strings, pointers, and structures, and a sorting algorithm.

The main contribution of this paper is to provide a fundamental framework of automatic generation and checking answers of error correction questions for debugging exercises. On the framework, the errors are defined as code transformation patterns, and this makes it easy for teachers to add new programs and errors. We hope that the discussion about what errors and programs are effective in terms of acquiring debugging skills and how we collect them in practical programming exercises is opened up.

In the following, we analyze error correction questions and discuss reasonable constraints in Section 2, and show a design of the system in Section 3. In Section 4, we show an experiment for evaluating the system and discuss its results. We show related works in Section 5 and conclude our research in Section 6. Though we use the C language in this paper, our study is not restricted to it.

2. TYPES OF ERROR CORRECTION QUESTIONS

2.1 Error Correction Questions

```
#include <stdio.h>
#define MAXSIZE 128

int main(void)
{
  int data[MAXSIZE];
  int size, sum, count, i;
  double avg;

  sum = 0;
  size = 0;
  while (scanf("%d", &data[size])
               != EOF) {
     sum += data[size];
     size++;
  }

  avg =  (double) sum / size;
  printf("avg = %f\n", avg);

  count = 0;
  for (i = 0; i < size; i++) {
     if (data[i] > avg) {
        count++;
     }
  }
  printf("greater than avg: %d\n",
          count);

  return 0;
}
```

(a) Correct Program

```
#include <stdio.h>
#define MAXSIZE 128

int main(void)
{
  int data[MAXSIZE];
  int size, sum, count, i;
  double avg;
                 ________
  sum = 0;
  size = 0;
  while (scan("%d", _data[size])
               != EOF) {
     sum += data[size];
     size++;
  }

  avg =  (double) sum / size;
  printf("avg = %f\n", _avg);

  for (i = 1; i <= size; i++) {
     if (data[i] > avg) {
        count++;
     }
  }
  printf("greater than avg: %d\n",
          _count);

  return 0;
}
```

(b) Program including Errors

Figure 1. Error correction question (1): condition, loop, and array

An error correction question contains a program code including errors and requires the learners to modify them correctly. An example is Fig. 1, whose specification is "Calculate the average value while reading a list of integer values in a file, and then print a number of values that are greater than the average." Program (a) in Fig. 1 is a correct program, and program (b) includes four errors: in Line 12, (1) the function name **scan** is a misspell of **scanf**, and (2) an address operator **&** is missing in an argument; in Line 21, (3) the initializer and the condition in the **for** loop do not match to the range of the array referred in the loop; in Line 23, (4) variable **count** is referred without initialized. The underlined italic texts are editable elements, that is, learners can modify them. The blank lines at Line 9, 17, 20, and 28 are also editable, where learners can add statements. When a question has many editable elements, it tends to become difficult and to allow unexpected answers. In Section 2.5, we discuss the restriction of editable code elements from the educational view. Fig. 1 is a question designed for beginners of programming who is learning the syntax and semantics of conditional branches, loops, and arrays. By this question, we hope that learners learn the usage of the **scanf** function, necessity of variable initialization, and a typical loop to scan an array.

```
 1: struct person {
 2:     char name[64];
 3:     double height, weight;
 4: };
 5:
 6: void swap(double *a, double *b)
 7: {
 8:     double _tmp;
 9:     tmp = *a; *a = *b; *b = tmp;
10: }
11:
```

```
12: void sort_by_height(
13:         struct person p[], int size)
14: {
15:   int min, i, j;
16:
17:   for (i = 0; i < size-1; i++) {
18:     min = i;
19:     for (j = i+1; j < size-1; j++) {
20:       if (p[j].heihgt ≤ p[min].height ) {
21:             min = j;
22:         }
23:       }
24:       swap(_p[j].height, _p[min].height);
25:     }
26: }
```

Figure 2. Error correction question (2): a sort program of an array of structures

We show another example in Fig. 2. It is a more complicated program using pointers, structures, and the selection sorting algorithm; the structure **person** represents a personal physical datum for each person and the function **sort_by_height** sorts an array of the structure. The sort function gets an array by argument **p** and its size by argument **size**, and it sorts **p** in ascending order of a member **height** with the selection sort algorithm. It contains five errors: (1) in Line 6 and 8, the type of function **swap**'s arguments and local variable **tmp** must be **struct person**; (2) in Line 19, the condition must be **j < size**; in Line 24, (3) all address operator **&**s are missing for both arguments; (4) the index **j** of array **p** must be **i**; (5) all member references of **height** are unnecessary.

These examples imply that error correction questions are more difficult than fill-in-the-blank questions. Fig. 3 shows (a) an error correction question and (b) a fill-in-the-blank one about **if**-branches and strings. The function **strconv** changes upper letters in the ASCII string **s** to lower ones and lower letters in **s** to upper ones; for example, **"Hello World!"** is changed to **"hELLO wORLD!"**. Program (a) includes three errors: in Line 3, (1) the equivalence operator in the condition of the **while** is wrong; (2) the logical operators in Line 4 and 7 are wrong; in Line 7, (3) **else** is missing before **if**. In our experiences, error (3) is relatively hard to find at a glance, although this program is simple and short. On an error correction question, firstly, learners read a program, secondly, they find errors, and finally they correct the codes, that is, adding, deleting, replacing, or moving codes. Finding and correcting errors require understanding the control flows, data flows, and logics of programs in addition to the syntax of the language. On the other hand, program (b) shows explicitly blank boxes where learners need to write correct codes. They may write correct codes without comprehension of programs. For example, at the first blank in Line 7, there are clear hints, **if** in Line 4 and the following parentheses. Furthermore, from the syntactical correctness, it should be filled with either **if**, **else if**, **while**, or **switch**.

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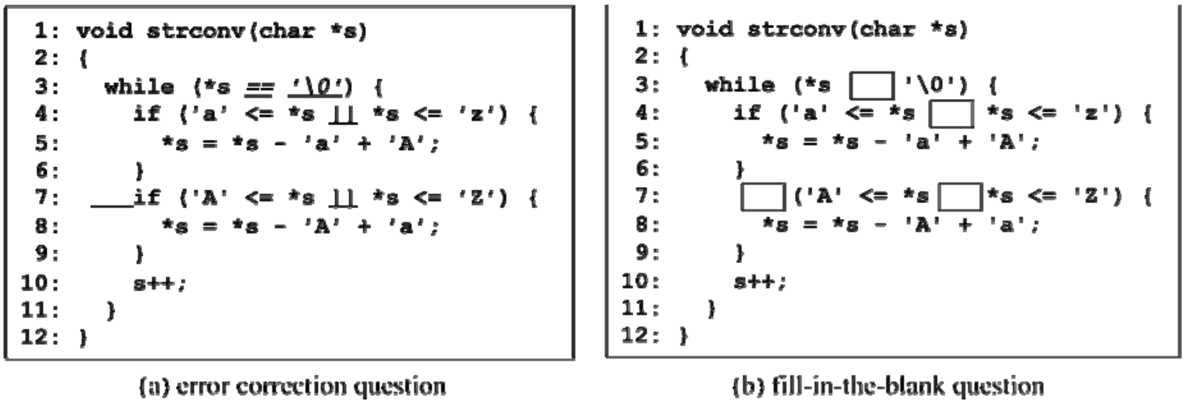

Figure 3. Error correction question and fill-in-the-blank question: **`if`**-branches and strings

When we generate error correction questions, we need to maintain the readability of codes. Codes should have comprehensive structures of the units of inputs, main processes, and outputs because learners may have less skill for reading. Unnatural descriptions in codes may give undesirable hints to learners. We have adopted the following coding styles: (S1) a variable is used for one purpose; (S2) the initialization of a variable that is used in a loop should locate just before the loop; (S3) two semantic process units are separated by a blank line; (S4) no successive blank lines are allowed. While injecting errors, removing statements may cause two successive blank lines in codes. They should be integrated into one blank line because they indicate a definite lack of a statement. For example, in Fig.1 (a), when we remove the assignment statement in Line 21, we also remove the following new line because Line 20 is a blank line.

Table 1. Samples of errors for error correction questions of programs

Learning Objective	Error	Edit Operation	Correctable Point(s)	Possible Represen-tation(s)	Type
Reading primitive values with **`scanf`** function	Missing address operator **&**s before arguments (Fig. 1 error (2))	delete	one	one	(a)
Reading strings with **`scanf`** function	Unnecessary address operator **&**s before arguments (**`char []`**)	insert	one	one	(a)
Operators	Wrong operator (Fig. 3 error (1),(2))	replace	one	one	(a)
Branches	Missing else (Fig. 3 error (3))	delete	one	one	(a)
Loops	Wrong initialization and condition in a loop (Fig. 1 error (3))	replace	one	multiple	(b)
Types	Wrong type (Fig. 2 error (1))	replace	one	one	(a)
Structures	Unnecessary member references (Fig. 2 error (5))	insert	one	one	(a)
Data flows of variables and initialization	Using a variable without initialization (Fig. 1 error (4))	delete	multiple	one	(c)
Data flows in a loop	Moving the assignment before a loop inside the loop	move	multiple	one	(c)
The elements to be swapped in the selection sort algorithm	Using wrong indexes on swapping elements in an array. (Fig. 2 error (4))	replace	one	one	(a)

2.2 Errors for Questions

For analyzing types of errors used in error correction questions, we have collected errors in our programming courses and the related papers [3][6][9][11]. These papers have reported that the students often make syntactical mistakes such as missing a semicolon and lacking one of a pair of curly braces or parentheses. In general, it is relatively easy for students to correct syntactical errors because a compiler detects them and shows error messages with line numbers. We have collected logical errors such as using a variable without initializing or initialized with a wrong value because these errors significantly contribute the development of debugging skills Compilers do not detect these types of errors, and learners need to read a program carefully and understand its logic.

We show examples of errors and the learning objectives of them in Table 1. We have analyzed these errors in terms of edit operations and the numbers of correctable points and possible representation. A correctable point means an editable point at which we can write a possible representation. A possible representation is one of the code fragments that are acceptable as correct answers. It may be semantically different from the original (see Section 2.4).

2.3 Edit Operations for Injecting Errors

We have analyzed edit operations to inject errors in code fragments. We have classified the operations into four types: *insert*, *delete*, *replace*, and *move*. The column *edit operation* in Table 1 shows operations for each error. Though an operation *move* is a combination of *delete* and *insert*, we have identified it as a primitive because the two operations should be occurred simultaneously.

The errors injected by deleting code elements or replacing code elements with others are the most typical ones. A missing assignment of an initial value and a wrong relational operator in a loop condition are examples. They are caused by deleting the assignment or replacing the operator with another one. Error correction questions of theses types are relatively easy to prepare. The number of these errors we found is greater than the ones of others. Instead, the errors of *insert* and *move* are restricted. Though it is not difficult to insert or move an element in codes, these errors would happen rarely because they break data flows or introduce unnecessary statements in contexts, and it is easy for learners to find them.

If we may not consider all possible answers, checking the correctness of answers becomes easy to be implemented; the system needs only to check that each modified element is same with the original one. For the *move* operation, the system needs to check both of modifications of *insert* and *delete* are correct. The difficulty is to cover all possible answers, and we discuss it in the next section.

2.4 The Number of Correctable Points and Possible Representation

We have analyzed correctable points and possible code fragments for the errors that we found. Possible answers mean a set of answers whose positions in codes and representations are different. We ignore the differences of the representations of syntactical equivalent expressions, such as a difference of **a+b** and **b+a** because it is possible to generate all representations of expressions systematically. Our system is for beginners education, and the expressions of the answers are small, for which it is possible to generate all alternatives in practical time. We also ignore differences of white spaces. We explain how to ignore the differences in our implementation in Section 3.1. In the following, we consider the possible answers whose position and/or semantics are different.

The results of the analysis are shown in Table 1 as the numbers of correctable points and possible representations. For considering the difficulty of the correctness checking, we categorize errors into four types: (a) one correctable point and one representation, i.e., not existing any other answer, (b) one correctable point and multiple possible representations, (c) multiple correctable points and one representation, and (d) multiple correctable points and multiple possible representations.

Type (a) represents the errors for which the original positions and code fragments are the unique answers. The supporting system checks only one position and one fragment for each error and is easy to be implemented.

Type (b) represents the errors for which the original positions are unique answers, but there are variations in code fragments to be placed. For example, an *n*-times loop including an error, `for (i=1; i<n; i++)` can be corrected as either `for (i=0; i<n; i++)` or `for (i=1; i<=n; i++)`. They cannot be checked syntactically, and this correctness depends on contexts.

Type (c) represents the errors for which the original code fragments are the unique answers, but the position of each error is not fixed to one. An error of this type occurs when a statement is removed. For example, in Fig. 1 (b), the initialization of variable `count` can be inserted at any lines between Line 9 and 20.

Type (d), which does not appear in Table 1, represents the errors that have multiple answers in positions and code fragments. This type of errors makes the system complicated. The answers other than the original ones tend to be unnatural and inadequate from the educational view. For example, we can correct the errors at Line 21 in Fig. 1 (b) by replacing `data[i]` with `data[i-1]` in Line 22. If we restrict the correctable points of the above example to Line 21, the error becomes type (a), which is the simplest type. This example suggests us that restriction of acceptable answers is a reasonable approach.

2.5 Restriction of Correctable Points and Editable Points

How to restrict correctable points is a difficult question because they depend on the semantics of errors and target codes. One of the simplest ways is to restrict to the original positions and code fragments, as type (a). The errors in type (b) can be changed to type (a) by restricting correctable points. For example, in an error code fragment of an *n*-times loop, `for (i=1;i<n;i++)`, by allowing modification of the operator `<` in the condition, only `for (i=1;i<=n;i++)` can be acceptable. For accomplishing this, the system needs the ability to modify fine-grained elements.

Strong restrictions, however, provide clear hints to learners and easily lead them to the answers. To avoid correctable points becoming clear hints, we introduce editable points. Editable points exist at all positions similar to correctable points and the learners cannot distinguish them on the system. For example, in Fig. 1 (b), the correctable point of lacking operator `&`s is at the front of the second argument at Line 12, and the editable points are at the front of the second arguments in the `printf` functions at Line 19 and 27. Editable points include correctable points, and we can define them in the same way of correctable points. The difference between them is the modification of texts. When they are injected in the codes, the texts at the correctable points are replaced with error ones, but the ones at the other editable points are not changed. This introduction of editable points embraces the contradiction that they increase possible answers, which have been excluded by the restriction of correctable points. Unfortunately, this contradiction is not able to resolve systematically. How to select patterns for editable points are responsible for the users as teachers.

An error with multiple correctable points, like type (c), occurs when an assignment is deleted. The error can be corrected by adding the original assignment at any point unless it is to preserve the original data flows. Strictly speaking, the correctness checking of type (c) requires data flow analysis, which makes the system complicated. To keep the system simple, we introduce the constraints reasonable from the educational view: (i) only assignments for initialization can be deleted; (ii) editable points where learners can insert statements are restricted to blank lines. The rule (i) is introduced because missing initializations are typical errors, and the questions deleted other kinds of assignments become the same with fill-in-the-blank ones for understanding algorithms which are out of our targets. The rule (ii) prevents the learners from confusing by multiple possible answers. Under these constraints and the coding style (S1) and (S2) in Section 2.1, we can identify the valid correctable points without data flow analysis, which are blank lines located between sibling statements before the deleted assignment. For example, in Fig. 1 (b), the correctable points are the blank lines at Line 9, 17, and 20; the one at Line 28 is not a correctable point.

The errors of type (d) are problematic, but they are minor in our experiences. The purpose of the error correction questions is to develop skills for identifying typical errors. The errors of type (d) deeply depend on semantics of code, and they are not typical. We should avoid this type of errors or try to change it to type (c) or (a) by restriction of editable points. In this paper, we do not discuss this anymore.

3. AUTOMATIC GENERATION OF ERROR CORRECTION QUESTIONS

3.1 Overview of the Supporting System

We have developed a supporting system of error correction questions. Fig. 4 shows an overview of the system. The system consists of two components. One is a presentation system that provides a set of error correction questions to the learners, and they answer on it. The answers are checked by the system, and the results are returned to the learners. It is implemented as a Web system, i.e., a set of HTML files, JavaScript programs and Perl CGI scripts that are deployed on a web server. The learners read and answer questions on web browsers. The other component of the system is a generating system of error correction questions. A user as a teacher selects a correct program and error patterns. The system applies the patterns to the correct program and generates both of an HTML file of the question and a CGI program for checking answers. The HTML file contains a program including injected errors and editable points.

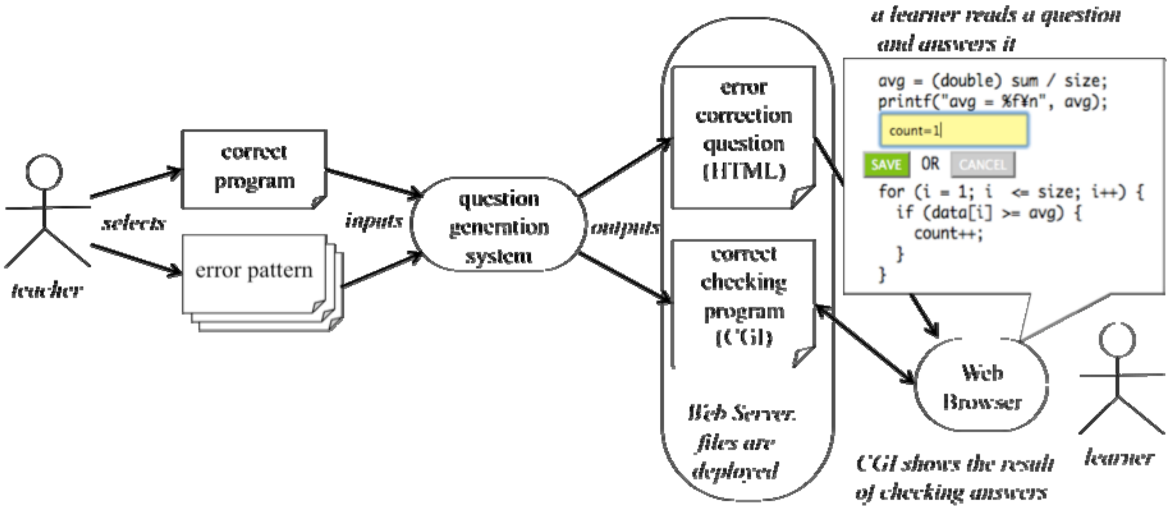

Figure 4. An overview of the supporting system for error correction questions.

The checking CGI programs can accept variants of expressions, such as a variant **`b+a`** for **`a+b`**. The equivalence of expressions is complicated to evaluate in practice, and the development of the evaluation algorithm is out of the scope of this paper. We have implemented an evaluation code optimized for our examples. Answers for all examples are small expressions, and we do not accept unnatural answers, such as **`a+0`** for **`a`** and **`5-5`** for **`0`**. Therefore, the number of variants that we should consider is small.

The presentation system needs to hide editable points from the learners. If all editable points explicitly appear on question pages, the learners can easily guess the answers. For this requirement, we have adopted JEIP[1], a plug-in of jQuery, which hides editable points from a learner until the user moves the mouse over the texts on them. If the user clicks an editable point, an input field and a save button appear at the point. After changing and saving all editable points where the user consider need to modify, the user can submit answers to the system by pressing the submit button.

A demonstration of error correction questions is available at http://ecq.tebasaki.jp/.

[1] jQuery Edit In Place (JEIP), http://josephscott.org/code/javascript/jquery-edit-in-place/

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3.2 Error Patterns

For managing correct programs and errors separately, we define errors as code transformation patterns. We also define editable points in the same way of errors, which do not modify programs in practice. This separation makes it easy to add a code fragment and another type of errors newly. We have implemented the system on a program transformation, called TEBA [4], which has a parser of code fragments including additional symbols, such as program patterns. TEBA also provides a transformation system on token-based syntax trees, and it allows modifying the fine-grained elements as discussed in Section 2.5.

An error pattern consists of two parts, *before-part* and *after-part*. A before-part is a target code to be modified, and an after-part is a new code as a replacement. For abstraction of syntactic elements, typed pattern variables can be used. In error patterns, the correct tokens in the before-part and the error tokens in the after-part are surrounded by the special tag, **<@** and **@>**. In an error patterns of *delete* type, the tag in after-part surrounds an empty token since error tokens never exist. The line where the tag exists becomes a blank line after the error pattern is applied. In an error pattern of *insert* type, the correct tokens in the before-part are empty. In one of *move* type, we use the tag, **<#@** and **@>**, for grouping a set of deleted tokens and inserted ones. We describe an injection of editable points as an error pattern whose before-part and after-part are the same. We show three examples of error patterns in Fig. 5.

```
% before
for ( ${e1:EXPR} = <@ 0 @>; ${e21:EXPR} <@ < @> ${e2r:EXPR}; ${e3:EXPR})
   ${s:STMT*} $;
% after
for ( $e1 = <@ 1 @>; ${e21} <@ <= @> ${e2r}; ${e3})
   ${s} $;
% end
```

(a) replacing initializer and the operator of the condition in a **for** loop (Fig. 1 error (3))

```
% before
<@ ${var:ID_FVAR} = ${lit:LITERAL}; @>
for (${e1:EXPR}; ${e2:EXPR}; ${e3:EXPR} )
    ${s:STMT*} $;
% after
<@ @>
for (${e1}; ${e2}; ${e3} )
  ${s} $;
% end
```

(b) deleting an assignment just before a **for** statement (Fig. 1 error (4))

```
%before
swap(${a1:EXPR}<@ @>, ${a2:EXPR}<@ @>);
%after
swap(${a1}<@ .height @>, ${a2}<@ .height @>);
%end
```

(c) inserting unnecessary member references **.height** (Fig 2. error(5))

Figure 5. Error patterns as code transformation

4. DISCUSSION

4.1 Generality of Error Patterns

To confirm that the system can generate error correction questions, we have defined 15 patterns for injecting errors and 10 patterns for setting editable points, and applied them to 4 sample programs: Fig. 1, Fig. 2, Fig. 3, and a binary search function. The error patterns we defined are varied in generality. For example, a pattern of removing addressing operators **&**s can be applied to all code fragments that include the operators. The error pattern Fig. 5 (c) is less general, which depends on the function **swap** and the structure **person**. In our defined patterns, 10 of 25 patterns are program specific. These patterns are difficult to be reused, but they are useful for generating questions optimized for learning objectives. For example, in Fig 2., while we have described an error pattern for inserting unnecessary references (Fig. 5 (c)), we have selected a member name, **height**, because the specification of the program requires to sort data by the member. We have set an editable point on the indexes of `p[j]`, but not the ones of `p[min]`. If both of them are editable, another answer becomes acceptable; the answers, `p[min].height > p[j].height` in Line 20 and `swap(&p[min], &p[j])` in Line 24, are valid. We also have made a space editable before variable `tmp` in Line 8 because we expect that learners may insert `*` in the same way of the parameters *`a` and *`b` without thinking semantics deeply.

From our experiences, the error patterns for learning the syntax and semantics of the language tend to be general, and the ones for learning algorithms tend to be specific. For improving the reusability, we need to investigate the way to make program specific patterns more general. It may be possible to describe the contexts of applying patterns and its edit operations separately. Though the contexts depend on programs, we expect operations can be described in general styles.

4.2 Experiment and Evaluation

We also have made an experiment of the programming exercise using the generated error correction questions. The subjects are 10 undergraduate students in the third grade, who had taken programming courses and have the skills for developing small programs. The purpose of the experiment is to find unexpected answers. As a result, we have not found unexpected answers that are correct. This means the restriction of our approach works as expected. We, however, have found redundant answers. For example, a student has inserted `avg = 0;` at Line 9 in Fig. 1 (b). The variable `avg` is never referred before the assignment at Line 18, and no initialization is needed. In the question of Fig. 2, there was an answer that the condition of the `for` at Line 17 was changed to `i < size`. Though it executes the redundant process on `i == size-1`, it produces the same result as the original program. How to treat redundant answers depends on the purpose of the exercises. Our system cannot support the case that the teachers want to judge redundant answers as correct because the correctness checking is implemented based on text matching. For checking redundant answers, it may be effective to compare the results of the original codes and the answered codes by tests for the sufficient coverage of inputs, while it makes the system more complicated and requires more efforts for teachers to prepare adequate test sets.

5. RELATED WORKS

AEGIS[2] is a system to generate questions from XML documents and supports three types: multiple choice, fill-in-the-blank, and error correction. An error correction question is generated from a multiple choice question by fusing the choices to the code. AEGIS requires describing a full XML description of questions, including codes and errors, and does not support automatic synthesis of questions. Our system separates descriptions of codes and error patterns and synthesizes questions from them. The interface of error correction questions generated by AEGIS is quite simple. It shows the text of a code on which errors are marked, and the learner inputs answers in the text fields. The interface of our system hides errors and allows modifying the elements that are not in error. Our system provides an exercise environment similar to the traditional ones using papers and pens.

Itoh et al. proposed a method for generating error-correction exercises for learning algorithms [10]. It determines the fault positions by the algorithm design paradigm and injects faults by the syntax-directed faults patterns, which are specific to the algorithm education. By specifying a set of correct programs, an algorithm design paradigm such as divide-and-conquer, the number of errors to be injected, and the number of source code files to be generated, the system generates source codes including errors automatically. Though it supports error injection, it does not propose a method for the correctness checking. Our system allows injecting an error at any positions, and it does not depend on specific domains of program educations. However, it requires manual selection of error patterns while considering possible answers. A support method for selecting patterns is a future work. Patterns should be selected from the multiple views such as learning objectives, the difficulty of questions, the degree of learners' understanding, and so on.

From the view of code transformation, our system is a kind of a mutation system [1][5]. A mutation system generates multiple variants of a code by adding small changes to its copies. The distinctive application is the test set evaluation in which test sets are tested how many variants they can detect as errors. Mutant systems add changes randomly, but our system adds changes in a restricted manner.

6. CONCLUSION

We have proposed a support system for generating error correction questions and checking answers. On the system, we can describe error patterns of injecting errors to codes, and the system synthesizes questions from them. The system also generates CGI programs for checking answers. We have collected some typical errors in programming and generated questions. We have showed the validity of our system by a small experiment. We need to make experiments with a large number of subjects.

Collecting other errors that are effective for acquiring debugging skills is a future work. Although some researches have reported syntax errors by novice programmers [3][6]][9][11], a few logical errors are known. While we can collect syntax errors by logging compile errors, to collect logical ones we need to investigate programming processes; we have an interest in how they correct faulty programs, for which compilers report no error. Work-in-progress codes and input data they select to test programs may be helpful for teachers to analyze their errors. An integrated development environment for education is one of the suitable systems to preserve learners' processes.

We hope that discussion about learning support for debugging using error correction questions is opened up.

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A PLATFORM FOR LEARNING INTERNET OF THINGS

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ABSTRACT

This paper presents a model for conducting Internet of Things (IoT) classes based on a web-service oriented cloud platform. The goal of the designed model is to provide university students with knowledge about IoT concepts, possibilities, and business models, and allow them to develop basic system prototypes using general-purpose micro-devices and a cloud and service infrastructure. The model was based on a cloud infrastructure deployed at the E-Business Department at the Belgrade University, and some implementation details are given. The model was tested and evaluated in a pilot course.

KEYWORDS

Internet of Things, Raspberry Pi, Arduino, Cloud Computing

1. INTRODUCTION

The expression "Internet of Things" describes the existence of a number of various things or objects like tags, sensors, actuators, mobile devices, capable of cooperating in order to achieve a common goal (Atzori et al. 2010). Such intelligent devices can take a number of forms and roles, and the composition of such systems can be adjusted dynamically, according to the needs of the users. This gives IoT an almost unlimited area of application within both business and industry (process management, intelligent transport, automation), as well as in homes and public environments (smart homes, e-health, assisted learning).

The term IoT encompasses an unbounded, growing set of devices and technologies, and as the IoT technologies gain traction globally, the need for experts that combine knowledge from various technical fields increases. IoT projects are likely to need designers, system integrators, developers and technicians in order to take an idea from inception to execution. Such diverse requirements can create an understanding gap between business-oriented individuals and their ideas, and the actual implementers that deal with realistic constraints. Ideally, an individual with an IoT business idea would be able to understand the possibilities and work in a small team, developing a prototype using off-the-shelf parts.

Introducing IoT into an environment is accomplished by introducing and interconnecting intelligent devices and, essentially, making an environment intelligent and supportive of any human activity. Applications of IoT are therefore as diverse as human activities and environments are. It is impossible to foresee the specifics of future IoT development, but some currently relevant, broad domains of application include transportation, logistics, healthcare, smart homes/offices/plants, and personal and social domains (Atzori et al. 2010).

Internet of Things represents an advanced paradigm, one that requires technology, knowledge and infrastructure, available in rich, developed countries. However, IoT solutions and especially IoT education can immensely benefit developing countries, offering a way of catching up faster, as well as a profitable industry for outsourcing, with predictions of IoT market being worth 22 to 50 billion dollars in 2020 (Schlautmann et al. 2011). Thanks to the cheap micro-devices like Raspberry Pi and Arduino, it is possible to develop various systems with less investment into infrastructure. The Raspberry Pi is of special interest, since it represents an entire computer the size of a credit card, and some systems based around it can be found in (Raihan 2013)(Kaloxylos et al. 2014). Raspberry Pi and similar devices are generally complemented by software APIs that abstract low-level operations, allowing effective utilization from a higher perspective, which is well-suited for individuals with a background in business informatics.

Traditional teaching in practical engineering areas usually has a twofold structure, where the first part presents theoretical foundations, and the second introduces real-world issues and applications. A different approach explored by some institutions gives more freedom to students, allowing them to choose the direction, breadth, and depth of their education, as well as combine their pre-knowledge from other areas of study (Director et al. 1995). These stipulations can still potentially be applied even in the context of a single IoT course, especially if it is not strictly hardware-oriented. Small classes comprised of business informatics students could produce a motivating and individual experience for every student by taking advantage of their diverse background.

Inclusion of technology into higher education is well suited for models based on constructivism and socialization, and can transform the educational process by making it more effective and attractive to students (Bustos Andreu & Nussbaum 2009). IoT classes can capitalize on this effect since they inherently deal with technological gadgets and information communication technologies. Several types of environments also attempt to produce an experimental setting combining people and technology in order to motivate innovation, development and research. Some examples of such environments and approaches are given in (Chin & Callaghan 2013), where “living labs”, “iCampus”, “smart box”, and Pervasive-interactive-programming are combined to produce a highly motivating and effective educational environment.

Depending on the educational context, several approaches to teaching IoT can be adopted. At the lowest level are individual IoT devices, and understanding them requires the knowledge of electronics and low-level microcontroller programming. The middle level is informatics-oriented, encompassing communication protocols, system integration, web services, human interfaces, etc. At the highest level are the design and business aspects of developing IoT applications. Teaching IoT comes with a set of problems for both the students and the educators, especially when concentrating on the higher levels of IoT. The main problems are (Callaghan 2012): the lack of electronic design expertise among students; the need for complex hardware and software tools; the time-consuming nature that limits complexity; and student-built hardware usually has fixed functionality and too simple to give realistic product development experience.

One approach in teaching IoT is the use of simulation tools to simulate the devices or the environment in which they are deployed. An example can be seen in (Yilmaz 2011) where the authors utilized a test card capable of processing digital and analog inputs and simulating home appliances, a model of a home, and a simple control interface with 3D models of house interior. In this approach, the teaching can be performed even without some or all of the hardware, and it allows the course to concentrate more on the software aspect of IoT. However, the simulation cannot replace the benefits of actually working with the IoT devices and potentially constrains the students’ imagination, making them think within the limits of the simulated scenario.

Working in the wide field of IoT technologies can require skills such as problem solving, team work, and leadership, as well as practical experience with actual “things” used. The active learning approach is shown to be very effective in such conditions, and a mixture of collaboration, competition and peer learning in a hands-on environment reinforces the students’ transversal skills (teamwork, communication, critical analysis) (Panadero et al. 2010).

The main aim of this paper is to improve the process of learning IoT using modern technologies and a hands-on approach. A model for conducting hands-on IoT classes with business informatics students, supported by a cloud infrastructure and web services is presented. The model relies on the existence of cheap, general-purpose programmable devices like Raspberry Pi microcomputer and the Arduino microcontroller boards. Using these devices, it is possible to easily produce slightly less efficient IoT solutions that do not require specialized components or expert knowledge to build. A pilot class was performed with a small group of interested students as a test of feasibility, and this paper, accordingly, represents a starting point for further research that will be performed on larger groups of students.

2. MODEL FOR TEACHING IOT

The generic model of platform for teaching IoT is shown in figure 1 and describes the required equipment and supporting infrastructure. The model is split into three layers – the device layer, the service layer, and the app layer. Some components used in the actual implementation at the Department for E-Business of the Faculty of Organizational Sciences at the Belgrade University are also mentioned below.

Ideally, the equipment for an IoT class should be as rich as possible, allowing the students to design a multitude of solutions. In reality, financial limitations can be severe, especially in poorer countries, and the equipment should be selected carefully. The main components at the device layer should be multifunctional, cheap microcomputers and microcontrollers, capable of taking many roles according to user programming. Such devices are readily available, the examples being the Raspberry Pi and Arduino which were used in the pilot implementation. Temperature, light, noise, and other sensors are usually simple and cheap, while expensive actuators and controllable appliances can be simulated by using diodes and simple circuits (Yilmaz 2011).

The operating logic can be distributed between devices, but an easier solution is to centralize it behind a well defined web service API. Devices that perform measurements (i.e. sensor nodes) can occasionally report to web services which take on the role of the middleware in the system. The devices can receive their instructions either by polling predetermined services, or by running their own web services for input if they are powerful enough. The web service approach is especially beneficial in an educational, cooperative environment. Students can develop their own services and share them with other students; more complex services can be built by integrating students' services with cloud-provided and external web APIs. Client applications, whether web, desktop, or mobile-based, interact only with the web services and need not concern themselves with device-specific knowledge.

The core component for IoT class implementation was the web hosting service freely provided to the students, which was implemented using the ISPConfig software allowing the deployment of student web services and web applications. Reporting of sensor readings was recognized as a common scenario in IoT applications, so a simple API was provided to the students for this purpose, allowing the storing, use, and sharing of sensor readings, as well as importing or generating external data for use in simulations of some specific conditions. SMS sending/receiving service was also provided to the students, and other services could be provided depending on the existing infrastructure of the educational institution. All services that need user accounts for their operation can, for improved interoperability, rely on the centralized store of student credentials. In the actual implementation, the OpenLDAP directory used by the learning management system of the Department was used for this purpose.

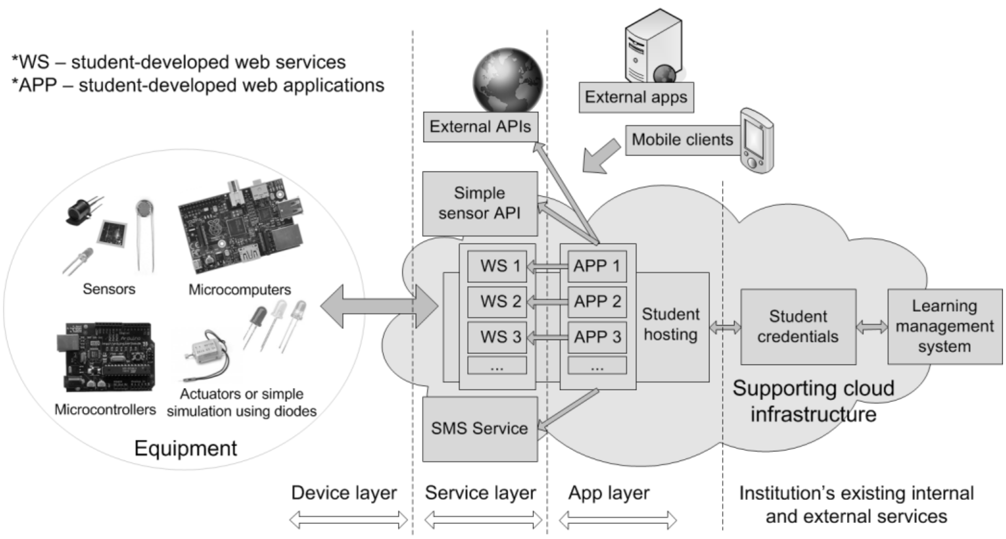

Figure 1. Model of infrastructure layers

The implementation of the presented model can potentially be very complex, with a large number of interconnected services, some of them possibly integrated with existing learning systems in order to allow easier tracking and grading of student activity. Although not necessary, an optimal solution in such conditions is to utilize a cloud platform, providing high scalability and redundancy, with better utilization of available processing resources (Beaty 2013; Sultan 2010). The suitability of utilizing cloud infrastructure in higher education is presented in a number of research papers (Despotović-Zrakić et al. 2013; Ercan 2010). The pilot class relied on the existing, OpenStack based cloud infrastructure used by the E-Business Department.

3. COURSE STRUCTURE

The goal of the IoT pilot course is to introduce and educate students with a background in business informatics in using the hardware, operating systems, software, and tools for automation of smart environments. The course consists out of four units (figure 2):

- Introduction to technologies used,
- Defining scenarios,
- Developing web services,
- Developing web and mobile applications

The students are first introduced to all of the elements of systems used for smart environment automation. This introductory part includes a review of hardware components, scenarios of their use, business models for their application, and successful existing systems.

The course is realized mainly through laboratory exercises. The students should be divided into teams, and the exercises done in the form of workshops. During the semester, students should receive a specific task for every exercise. These tasks describe the context of application and the method for exercise completion. Every team should get a number of user requests for development of an intelligent environment. Based on these requests, the students need to envision a scenario and design two schematic representations showing hardware components that would satisfy these requirements. The first scheme should give a technical presentation of sensors and actuators and their connections to microcomputers and microcontrollers. The students can, for instance, use a free, open-source application called Fritzing for this purpose. The other scheme is to present the entire intelligent environment with the locations and interactions of larger units comprising the solution, and the students can create it using any standard software for drawing diagrams.

The implementation of the hardware environment should be based on the previously designed scheme for interconnecting sensors and other devices. For this task, the students are to be provided with devices like Arduino microcontrollers, Raspberry Pi microcomputers, and various sensors, actuators, and other components. In order to make it easier for the students to review their knowledge at home, without actual equipment, a set of video clips showing different aspects of handling the hardware and other tools can be provided to them.

After the implementation of the hardware infrastructure, the students should design and implement a software system to complement their previous solution. Arduino microcontroller uses a modified version of C++ programming language, while the Raspberry Pi platform best supports the Python programming language, and the students should utilize any previous knowledge available and work on those parts they are most familiar with. The students can utilize Xively in their projects, the public cloud service for collecting and accessing data from various sensors, or develop similar solutions smaller in scope.

As previously mentioned, the exercises are performed in the form of workshops, where every team receives a specific context and a task to implement a scenario for use of smart devices in said context. The examples of some of the main contexts/tasks include the following:

- Smart home context - Arduino or Raspberry Pi are to be used in combination with temperature sensor. If the temperature exceeds a certain value, an SMS message should automatically be sent to the owner of the smart home. Using a web or mobile application, the owner has a continuous insight into the measured temperature.
- Smart classroom context - Arduino or Raspberry Pi are to be used in combination with an NFC tag reader and a digital display. During the entry into the classroom, every student should tap his NFC card on the reader, which will register his presence in the current lecture. Since the capacity of the

classroom is limited, if all seats are taken, the display outside of the classroom should show an appropriate notice. The students can use a web or a mobile application to check the number of free seats in the classroom.

- Smart library context - for smart library automation, the students should utilize noise sensors and a speaker in combination with the standard Arduino or Raspberry Pi devices. If the noise sensors record an amount of noise above a certain limit, a voice message should be played using the speakers in the library. The administrators should be able to check noise levels using a web or mobile application.

The final outcome of this course should be the integration of all laboratory exercises into a single project. The final grade is composed out of grades for tasks completed in exercises, the grade for an electronic test, and a grade for completion of the project, with the tasks and the project making up to 80% of the grade. The project should define user requirements, scenarios, project documentation, web services, and a web or mobile application for automation of the smart environment.

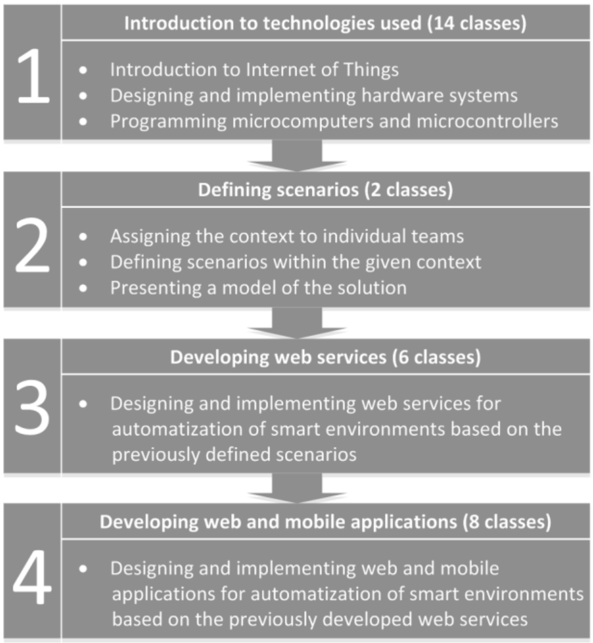

Figure 2. IoT course structure

4. PILOT CLASS IMPLEMENTATION AND RESULTS

The pilot course was implemented at the Laboratory for E-Business according to the course structure outlined in the previous chapter, with 8 students of master studies taking it as an elective class. All of the students were between 20 and 25 years of age, all had similar backgrounds in business informatics, with only slight variations in their area of specialization and interest, and that half of the students were employed in some form (part-time or full). The pilot course was shorter in length compared to the previously described structure and consisted out of 12 classes in total, four covering the introduction and remaining eight the other, practical sections.

After the completion of the entire course, the students were presented with a questionnaire with questions grouped into five sections: demographic data, opinions about course structure and execution, opinions about workshop content, student’s motivation, and student’s perception of own knowledge. Students were also graded according to their completed tasks, project, and test, and out of eight students participating, three had the final grade 8, four had the grade 9, and one had the maximum grade of 10, for an average of 8.75.

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The questions from the first group concerning the course structure and execution were to ascertain whether the course structure was well balanced, if the tasks were too difficult and the allotted time sufficient, and what was the students' opinion of the interaction model between the students and teachers, as well as the interaction between students themselves. Here, 62.5% students thought that the optimal length of a single class within the course was three hours, while the remaining students approved the actual length used (1.5 hours). All students, however, agreed they had sufficient time to complete the tasks they were assigned. The tasks were mostly marked as being of medium difficulty (87.5%), but most of the students (75%) thought that the assistant's help was needed, and 25% thought it was necessary. All of the students agreed that the competitiveness between the groups was a motivating factor.

The third part of the questionnaire was concerned with the actual content of workshops and was to ascertain as to which parts of the workshop were best liked by the students, which were considered the most difficult, and which were seen as the most important. These questions were to provide insight into the balance of the course. Accordingly, the activity of thinking up IoT scenarios was mostly ranked as average (62%), with all other answers going above that. The students also thought this activity was of average interestingness (50%), and that the proper understanding of the scenarios was very important for completing the given tasks. Most of the students didn't have any preknowledge about IoT, but didn't think that dealing with the hardware was too difficult. This part of the tasks was rated mainly as very interesting (50%), and a similar opinion was received concerning the importance of these technologies in the wider task. The students had, on average, best preknowledge in the domain of web services, since this was a part of their earlier education (50% marking it as average), but most also thought that dealing with services was of medium and high difficulty. This can be explained by the fact that it was expected for the students to have a certain preknowledge in this area, and the requirements were accordingly stricter. The students also thought that web services were a crucial component of their solutions (25% - important, 75% - very important). The main sentiment was that the Android development was not too difficult, and that this activity was very interesting (50%). Some of these results are given in Table 1.

Table 1. Questions concerning the perceived interestingness and difficulty of dealing with IoT hardware and web services

Question	Answer	# responses	Question	Answer	# responses
How interesting was dealing with software and hardware components?	Very boring	0	How difficult was dealing with software and hardware components?	Very easy	2
	Boring	1		Easy	2
	Average	2		Average	2
	Interesting	4		Difficult	2
	Very interesting	1		Very Difficult	0
How interesting was dealing with web services?	Very boring	1	How difficult was dealing with web services?	Very easy	1
	Boring	1		Easy	0
	Average	1		Average	2
	Interesting	2		Difficult	3
	Very interesting	3		Very Difficult	2

The fourth part of the questionnaire was short, and contained questions about how the students were motivated to continue improving their knowledge of the technologies covered during the class. 75% of students were motivated to do so, with 12.5% motivated partially, and remaining 12.5% not motivated.

The final part was concerned with the students preknowledge and about how they perceived their improvement in certain areas. Students did not have much knowledge about IoT beforehand, but had an average level of knowledge with programming and working with web services. The students mainly had only an elementary level of knowledge about Android OS, with only some of them having completed an elective course in Android programming. The students thought that the provided educational materials were sufficient (75%), and that they have gained a satisfactory amount of knowledge about IoT and other applied technologies.

Additionally, the students were asked to give their opinions about the class and about possible improvements. All of the opinions were very positive, and some of them are given below:

- "Intriguing, interactive, and fun. Motivating."
- "It's very interesting to see the practical results of programming"
- "It allowed me to review important things"
- "There should be more classes like this. Working on a concrete example, whose state can be modified through PHP or Android was a top-class experience"

- “No objections. The workshop was interesting and motivating. Also, to see the results improves the dry programming experience a lot.

5. CONCLUSION

The presented model has several advantages - it is cheap, effective, scalable, and well-suited for students not coming from a hardware background. The model requires some supporting infrastructure and establishing a number of software services, but all well within the capabilities of any business informatics or software oriented curriculum. The students taking part in the pilot class were well-motivated, but the short class length and small number of participants did not allow us to make any general conclusions, and further research will be performed in future classes.

The main deficiency of the pilot class was the fact that only eight students participated. Still, there is currently not many research papers concerning the course structure and execution of IoT classes, and some general remarks, possibly useful for future research and larger IoT classes can be given based on the obtained results and experience. The students rated the help from the assistants as very important for the completion of their tasks; this especially needs to be considered if future classes are performed with a larger number of students. IoT exercises that attempt to encompass both the hardware and software aspects of IoT should likely be of longer length, as the students were mostly in favor of 3 hour classes over those twice as short. The SMS service that was provided to the students for sending and receiving SMS messages was very well liked, although it was not a core part of the IoT classes. This is probably the case since the SMS messages are a very familiar concept, and it allowed the students to envision IoT integration in a more realistic manner. The educational institution should therefore attempt to provide the students with as many other services as possible in order to widen the possibilities and increase student motivation. Students also felt that seeing the results of programming immediately was motivating, and IoT exercises should be designed in such a way to provide directly verifiable results, and preferably a direct impact on the physical world in some way.

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DEALING WITH MALFUNCTION: LOCUS OF CONTROL IN WEB-CONFERENCING

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ABSTRACT

This paper considers how students deal with malfunctions that occur during the use of web conferencing systems in learning arrangements. In a survey among participants in online courses that make use of a web-conferencing system (N = 129), the relationship between a preference for internal or external locus of control and the perception of technical difficulties is examined. This study starts from the idea that the experience of malfunctions has an influence on the acceptance of information systems in education, while support services are availed mainly by users who act responsible in using technology anyway.

KEYWORDS

Malfunction, Technology Acceptance, Web-Conferencing, Webinar, Locus of Control

1. INTRODUCTION

People who are involved in teaching and learning often consider the use of an information system in terms of substitution. That is: A digital appliance replaces analogue practice. Especially online communication and collaboration – online courses in the realm of education – are compared with face-to-face meetings. Starting from the notion of “cyberspace” for the Internet, we are used to metaphors that compare applications of information and communication technology to known and familiar structures of the real environment (“space”) that surrounds us. In this paper we consider “virtual classrooms”, referring to the use of web-conferencing systems for synchronous online collaboration in education.

In this introduction we are going to review the relevance of malfunctions that occur during the use of web conference systems for the acceptance of information systems in education. We then draw attention to the concept of locus of control, which might explain the prevalence of technical difficulties. In the second part of this paper, we present a study that examines the preference for internal or external locus of control concerning technical difficulties in online courses. A conclusion ends this paper, which presents some insights for support services in online education and questions for further research.

1.1 Technology Acceptance and Malfunctions

It stands to reason that a comparison between two forms of collaboration is followed by a preference for one or the other option. In a comparison between two ways of interaction and conversation, people are likely to consider the additional benefits of each alternative. They may also deliberate on efforts that can be avoided or even may imagine opportunities that arise from a combination of both alternatives. The individual weighting of single factors, the evaluation of specific criteria and even expectations concerning the options at stake are rarely purely rational. Nevertheless, the acceptance of a new, technology-based form of communication and collaboration can be explained by a cost-benefit analysis. Some values justify the use of technology for teaching and learning, for example, the avoidance of expenses for travel, or an increased benefit such as better learning opportunities – or, maybe, just the fun to make use of a new technology.

Furthermore, it may be assumed that the need to ensure the correct operation of the technical equipment adds as an expense in this cost-benefit analysis. The provision for a flawless operation requires time, and material as well as personnel resources. Personnel resources include knowledge, experience and problem-solving strategies. Malfunctions, breakdowns or system failures interrupt or diminish the benefits of technology use. In addition, malfunctions cost time for troubleshooting and fault elimination. Malfunctions in web conferencing are particularly burdensome. As opposed the use of Internet technologies in asynchronous mode (for example, in online courses with common learning management systems, but also for online education with services and applications of Web 2.0), synchronous online collaboration (employing video and audio conferencing as well as a shared workspace or a shared desktop) is likely to stop when one participant encounters a technical problem. Technical malfunctions in web-conferencing often result in poor audio quality, e.g. noise or echo in voice transmission, unbalanced sound volume, or even in acoustic feedback (Larsen effect). Frequently, video pictures from some participants are missing, due to a wrong set up of their webcams or low bandwidth. Low bandwidth or server overload may also result in high latency, which confounds the notion of real-time collaboration in a joined workspace.

In addition, web-conferencing systems are quite complex. The average user is unable to evaluate the reason for malfunctions. In web-conferencing, insufficient sound quality may be due to server load, bandwidth of the Internet connection of single participants, the encryption in the domestic Wifi network, or even hardware of one participant, like cable, microphone and speakers. It is noteworthy that most of the web conferencing systems from the current generation provide a functionality to integrate a conference call on landline telephones in the meeting, in order to ensure hassle-free conversation. The landline telephone network is considered to be both easy to use and extremely reliable.

And although landline telephony nowadays is based on a global technical system that is, like the Internet, digital and packet-oriented (cf. Janevski, 2014, S. 23ff), we take landline telephones “for granted”, that is: They are considered to be part of the “real world”, and not part of “cyberspace”, just like most of artefacts that surround us in everyday life as well as in learning spaces. As long as walls, tables, pens or projectors fulfil their function without difficulty, they disappear from consciousness. Only a malfunction, or a “breakdown” (with reference to Heidegger cf. Winograd & Flores, 1986, S. 68ff), discloses technology.

Neither research in instructional design nor development in technology enhanced learning has addressed malfunctions in technical systems, their impact on teaching and learning or their relevance for the acceptance of digital technology in education broadly. More generally, there is only few research on anger and frustration in dealing with software and computers (cf. Bessière, Newhagen, Robinson, & Shneiderman, 2006; Charlton, 2009). Ergonomic requirements for the use of software applications name “error tolerance” and “conformity with user expectations” as two out of ten design principles (ISO 9241-110, see Schneider, 2008). Usability evaluation is oriented at these principles, as well as their relevance to perceived usability is investigated (cf. Pataki, 2009, S. 100ff). However, current models on technology acceptance (TAM3 as a prominent example, cf. Venkatesh & Bala, 2008) do not explicitly incorporate negative, hence frustrating user experiences as explanatory factors. Malfunctions are likely to affect both “perceived usefulness” and “perceived ease of use”; but still, in TAM3 these factors are explained by external determinants (like subjective norm) and internal determinants (like computer-related self-efficiency), not by frustrating events.

Obviously, research and development in technology enhanced learning is based on an affirmative attitude: Since everybody wants to demonstrate how things work, reports on failure are hard to publish. Therefore, from a technical perspective malfunctions are generally regarded as a technical problem, which in turn is to be solved with more or better technology (cf. Morozov, 2013). Education however, should take into account how students adopt technology. The efforts to care for the hassle-free operation are only one part of the story. Becoming aware of personal responsibility in dealing with technology is a prerequisite for the responsible use of technology, and as such, an important part of media literacy.

1.2 Locus of Control and Malfunction

There is an important differentiation for efforts in dealing with malfunctions: time, knowledge and problem-solving strategies for coping with malfunctions are individual resources; while technology itself, infrastructure as well as staff for maintenance and support are usually beyond control and influence of the individual user. The concept of locus of control suggests itself here (cf. Rotter, 1954, S. 105ff). In differential psychology, we may differentiate between an internal locus of control and an external locus of control, that is: People are more or less convinced that events are the consequence of individual action (not necessarily of their own), or that events can not be influenced by individual action. In various fields of research, this distinction was further elaborated towards a multidimensional model. Interestingly, relevant research is rather concerned with failure than with success. The notion of locus of control comes into play when the avoidance of damage or the improvement of pain is addressed. There is considerable research in the field of health, illness and recovery, including the Multidimensional Health Locus of Control Scale (MHLC) regarding individual attitudes and beliefs towards illness and healing (cf. Wallston, Wallston, Kaplan, & Maides, 1976).

For a technology-related field, some studies on risky driving behaviour are apposite to the question of this paper. For issues related to road accidents, there is a scale measuring dimensions in locus of control concerning traffic (cf. Özkan & Lajunen, 2005). The starting point here is the assumption that an internal locus of control in terms of traffic accidents is a key prerequisite for drivers to avoid risky driving. The named study differentiates the external locus of control between technology (e.g., the condition of the vehicle, the condition of the road) and fate; as well as the internal locus of control beliefs are distinguished between self and other road users. This structure allows an analogy to the study presented in this paper. The use of web conferencing systems is a complex technical system that requires a well operating infrastructure (servers, broadband Internet), while disturbances are hard to assess and therefore may appear to be fateful. In addition, multiple users contribute to the success of communication and collaboration; hence users might attribute responsibility for error-free operation to themselves or to their peers.

1.3 Research Questions and Hypotheses

The field of the present study is web-based synchronous collaboration. We examine web-conferencing in the context of online education, using Adobe Connect™ for course sessions, also known as “virtual classroom” or “webinars”. The objects of the investigation are the dimensions of locus of control, and their relation to technical malfunctions. In view of the above, the following questions arise:

- Is it possible to assess different dimensions of locus of control with respect to malfunctions in collaborative, web-based work environments?
- Is there a connection between the locus of control and perception of technical difficulties?

Accordingly, the working hypotheses are that locus of control beliefs for coping with technical difficulties have a dimensional structure, and that, in view of differential psychology, there is a relationship between the dimensions of locus of control and the perception of technical difficulties.

An educational relevance of this relationship arises from the very pragmatic question of suitable support services as well as from issues related to the acceptance of web-based synchronous collaboration in online education. As already mentioned, the questions that have been raised are also relevant with respect to media literacy, since internal location of control beliefs are a prerequisite for responsible handling of technology.

2. INVESTIGATION

As part of a survey on the acceptance of web-conferencing systems in distance education (cf. Junge, Klebl, & Mengel, 2011) students of the University of Hagen (N = 129) have been asked about the *Level of Perceived Technical Difficulties* while attending synchronous online sessions (i.e. “webinars” with audio and video communication as well as with shared presentation or shared workspace). In the following, we present the research design and the research instruments, and then outline the sample. In a third subsection, the results of the statistical analysis are presented. The paper concludes with a summary of results and an outlook to follow-up research in the last section.

2.1 Research Design and Instruments

The survey was conducted via an online questionnaire (in German language). Only students that had already participated in one or more web-conferencing sessions using Adobe Connect™ were invited. As part of a planned analysis to the Extended Technology Acceptance Model (TAM3, cf. Venkatesh & Bala, 2008), the questionnaire comprised scales for *Computer-Related Self-Efficacy*, *Computer Anxiety*, and *Computer Playfulness*. Based on existing survey instruments, new items had been developed for the presumed dimensions of *Locus of Control* (*Self*, *Other*, *Technology*, *Fate*, *Authority*), which are essential for the study presented here.

Likert scales were used for all the latent variables mentioned so far, with three or four items per each factor based on a reflective measurement model. In order to provide the opportunity to express an indecisive attitude, five response options were offered (from “totally agree” to “totally disagree”). The coding was carried out by numbers 1 to 5, where a low value represents a high level of agreement with the item statement. The online questionnaire represented the response options horizontally, with equal distance between the radio buttons. As generally accepted for Likert scales, we consider the response options as an equidistant scale and treat the resulting manifest variables as interval-scaled.

In addition to these factors, the *Level of Experience* with the web-conferencing system Adobe Connect™ is of importance for the further report of the study. Therefore, we asked for the number of sessions where the respondents had participated. In the following subsections, we give more details about the latent factors.

2.1.1 Level of Perceived Technical Difficulties

Some item statements concerning the *Level of Perceived Technical Difficulties* addressed the time factor (e.g. “Due to technical problems, sessions with Adobe Connect are unnecessarily prolonged.”) In addition, items considered cognitive load in relation to technical difficulties (e.g. “Occasionally, the distraction caused by technical errors outweigh the benefits of Adobe Connect.”). The four items used result in a consistent scale (Cronbach's $\alpha = .88$). On average, the level of technical difficulties is perceived as neutral ($\bar{x} = 2.8$) and has a reasonable variance (SD = 0.9).

2.1.2 Locus of Control: Self, Other, Technology, Fate, Authority

Item statements for *Self*, *Fate* and *Authority* as dimensions of *Locus of Control* were adapted from the German version of the Multidimensional Health Locus of Control Scales (MHLC), according to Muthny & Tausch (cf. 1994). However, four items were selected from six. They describe aspects such as responsibility (e.g. for *Self*, “I am responsible for ensuring that the session using Adobe Connect works well.”) or compliance (e.g. for *Authority*, “The best way to work smoothly with Adobe Connect is to follow the instructions exactly.”). In order to measure locus of control beliefs in terms of *Other*, various aspects such as responsibility, carefulness or behaviour were transferred from item statements related to *Self* (e.g. “Only if all participants have the required technical skills, a meeting with Adobe Connect can operate smoothly.”).

Statements about *Technology* were only loosely inspired by the English questionnaire for Traffic Locus of Control (T-LOC, cf. Özkan & Lajunen, 2005). The transfer considered abstract concepts of complex technical systems (such as infrastructure, in T-LOC “dangerous roads”, for web-conferencing “Often, there is something wrong with Adobe Connect since the Internet connection is interrupted.”). The locus of control beliefs are assessed object-related, that is: Each item statement comprises or implies a reference to the employed web-conferencing system Adobe Connect™.

A confirmatory factor analysis was executed in order to validate the presumed dimensional structure (extraction of factors by Principal Component Analysis, Varimax rotation with Kaiser Normalization). However, not all dimensions emerged in the factor structure clearly while involving all twenty items. In particular, the items related to the influence of the *Authority* do not form a consistent dimension and mingle with the items for *Self*. A second, exploratory factor analysis that excludes seven items without clear relation to a latent factor is apt to validate the dimensions *Self*, *Other*, *Technology*, and *Fate* with the remaining thirteen items. Conceptual considerations and a final audit of internal reliability result in a dimensional structure with four items for these four dimensions of locus of control (with .55 < Cronbach's α < .85). The dimension of the *Authority* was not longer considered in the following evaluation. The locus of control beliefs for *Self*, *Other*, and *Technology* are rated on average slightly more affirmative ($2.7 < \bar{x} < 2.9$), for *Fate* slightly more negative ($\bar{x} = 3.5$). The factor *Technology* has a lesser variance (SD = 0.6) than the other dimensions (0.7 < SD < 0.8).

2.1.3 Computer-Related Self-Efficacy, Computer Anxiety, Computer Playfulness (Anchor Factors)

The item statements of these latent factors match an adequate translation of the *anchor factors* from the Extended Technology Acceptance Model (TAM3, cf. Venkatesh & Bala, 2008). There, they form a general framework for the acceptance of specific software applications, supplemented by Perceived External Control.

In contrast to the latent variables for the locus of control scales these anchor factors are operationalised without reference to any specific information system. For all three latent factors, the respective four manifest variables generate a consistent scale (with $.71 < \text{Cronbach's } \alpha < .86$). The respondents rated *Computer Anxiety* on average rather low ($\bar{x} = 4.4$), while in contrast they assessed their *Computer-Related Self-Efficacy* and their *Computer Playfulness* rather high ($\bar{x} = 1.9$ and $\bar{x} = 2.2$).

2.1.4 Level of Experience

Three groups for *Level of Experience* were formed based on the requested number of meetings in which the respondents participated. A separation between *once*, *several times* (2 to 3) and *frequently* (4 or more) resulted in approximately equal groups (N = 45 , 41, 43).

2.2 Sampling Design and Data Collection

Data were collected via an online questionnaire. For pragmatic reasons, students that participated in online courses using the web-conferencing system Adobe Connect™ were asked to participate in the study. To this end, lecturers were asked to send an e-mail with an invitation to the students who have participated in their course between or shortly after the lessons. Therefore, it is not known how much students actually were asked to participate; hence it is impossible to give a statement about the return rate. In addition, conclusions about effects of cluster sampling are not possible, because it can be assumed that individual students had participated in several courses and, therefore, were invited twice or more to participate in the study. Participation was rewarded by inclusion in a prize draw. Participation in the draw was voluntary and anonymous by means of an identification number.

2.3 Results

A total of 133 students participated in the survey and fully completed the questionnaire. Due to implausible data (in particular on the number of meetings in which the respondents have participated) four records were excluded. Of the remaining 129 respondents, three-quarters were female (76%), one quarter male (24%). On average, participants were 36.8 years old. The standard deviation in age was 8.1 years, with an age range from 21 to 59 years. Most students are enrolled at the Faculty of Cultural Studies and Social Sciences (76%). The remaining participants study at the Faculty of Mathematics and Computer Science and at the Faculty of Law.

2.3.1 Relationship between Locus of Control and the Level of Perceived Technical Difficulties

Starting from the working hypothesis, that there are different dimensions of locus of control in coping with malfunctions, and that these different locus of control beliefs influence the perception of technical difficulties, the relationship between the dimensions of locus of control beliefs and the level of perceived technical difficulties has been investigated. Of course it is impossible to draw a conclusion of cause and effect from a statistical correlation at the first attempt.

A Pearson’s product-moment correlation for each dimension in *Locus of Control* (*Self, Other*, *Technology*, *Fate*) results in moderately strong correlation coefficients that are each highly significant ($p < .01$). There are the negative correlations for the internal dimensions (*Self* $r = -.38$; *Other* $r = -.29$). Students who experience fewer technical difficulties are more likely to believe that they or others can influence successful operation. As expected for the external dimensions, the correlations are positive (for *Technology* $r = .41$, for *Fate* $r = .55$). People who tend to assume that errors in technology or just fortune determine successful operation experience more technical difficulties.

In addition, the interactions have been tested by a regression analysis, using the *Level of Perceived Technical Difficulties* as the dependent variable. A linear regression analysis which includes all four dimensions as independent variable in the model results in an explained variance of 33%. In this case, only the regression coefficient for the external locus of control beliefs are significant ($p < .05$) and confirm the positive relationship (for *Technology* ß = .34; for *Fate* ß = .47).

2.3.2 Relationship between Anchor Factors and the Level of Perceived Technical Difficulties

It raises the question whether more general psychological dispositions in relation to the use of computers determine the perception of technical difficulties, in contrast to the specific beliefs of locus of control related to the particular web-conferencing tool in this study. With the anchor factors of TAM3 (*Computer-Related Self-Efficacy*, *Computer Anxiety*, and *Computer Playfulness*), the questionnaire assessed attitudes towards computer in general, which may also determine the perception of technical difficulties.

A Pearson's product-moment correlation for each *Anchor Factor* in relation to the *Level of Perceived Technical Difficulties* demonstrates no significant correlations. Also, the result of a linear regression analysis with the *Level of Perceived Technical Difficulties* as the dependent variable yields no relation. Only about 5% of the variance in perceived technical difficulties is explained by the anchor factors. For the present study, no influence of general attitudes toward computer usage on the perception of technical difficulties can be found.

2.3.3 Relationship between Locus of Control and Anchor Factors

Furthermore, the dimensions in *Locus of Control* are independent from the general attitudes toward computer usage as well. The matrix of Pearson's product-moment correlation between the dimensions in *Locus of Control* (*Self*, *Other*, *Technology*, *Fate*) and the *Anchor Factors* of TAM3 (*Computer-Related Self-Efficacy*, *Computer Anxiety*, and *Computer Playfulness*) reveals no significant correlations, with only one exception. There is a low, but significant correlation between *Computer Playfulness* and the *Locus of Control for Other* ($r = .22$ at $p < .05$). Some of those who like to experiment with the computer are slightly inclined to shift blame for any malfunction in computer-based interaction to others. Nevertheless, from the present study it can be assumed that the dimensions of locus of control are independent constructs.

2.3.4 Level of Experience as a Possible Cause

One question that remains unanswered so far is whether different control beliefs actually affect the perception of technical malfunctions, or, on the contrary, a repeated experience of technical malfunctions causes people to develop an attitude of powerlessness. Who often experienced that technology does not work will be inclined to value own capabilities inferior to technical operations and fate. Reversed: Who is convinced that the responsibility for error-free operation lies with the users, will take action to prevent malfunctions.

The present study may provide a clue how to explain the relationship between *Locus of Control* and *Level of Perceived Technical Difficulties*. It is assumed that it makes a substantial difference, whether a user uses a tool for web-conferencing *once* (for a typical session of a maximum of 120 minutes), *several times* (several sessions over at least a week or two) or *frequently*. The more often the tool is used, the more likely are malfunctions. At the same time users get used to the system and gain some skills and knowledge in troubleshooting, especially when users tend to internal locus of control beliefs (*Self*, *Other*).

A review of the differences between the groups that had taken part in sessions with the web-conferencing tool *once*, *several times* or *frequently* does not result in significant mean differences, neither for the *Level of Perceived Technical Difficulties*, nor for the dimensions in *Locus of Control* (One-way ANOVA, equal variances assumed, post-hoc test with Tukey-HSD).

It may therefore be concluded for the present study that both the dimensions in *Locus of Control* in coping with malfunctions as well as the *Level of Perceived Technical Difficulties* remain stable over a certain period of time. In this short term view, experience does not affect locus of control beliefs. Under the assumption that frequent use cause more technical errors, it may be concluded that it is not the perceived technical difficulties which affect the locus of control beliefs, but vice versa.

2.3.5 Gender Differences

Despite the unbalanced distribution of men and women in the sample, an analysis on differences between the sexes is advised. In general, there are no significant mean differences for the dimensions in *Locus of Control*. However, women tend to perceive more technical difficulties (*Level of Perceived Technical Difficulties*: $\bar{x} = 3.3$ for women compared with men $\bar{x} = 2.7$, t- test $p < .05$). Therefore, differences between men and women contribute to the variance in the perception of technical difficulties. It is not clear what disposition may provide an explanation here, since there are no significant mean differences between the sexes for the *Anchor Factors* of TAM3 (*Computer-Related Self-Efficacy*, *Computer Anxiety*, and *Computer Playfulness*).

3. DISCUSSION

The study presented in this paper confirms the assumption that it is possible to differentiate dimensions of locus of control beliefs for coping with malfunctions in web-based collaborative work environments. These locus of control beliefs are, on the one hand, *internal*, relating to human beings as responsible and capable: The participants in the study consider it more or less important, what they or others do to avoid malfunctions. On the other hand, locus of control beliefs are *external*, that is: The respondents consider it more or less a matter of technology or fate whether something works or not.

It can also be shown that these locus of control beliefs are associated with the perception of technical malfunctions. Who has an internal locus of control faces less technical difficulties. Who is convinced that the influence of human beings is limited perceives more technical difficulties. By comparing with the level of experience in using the web-conferencing tool in question it can be concluded that negative experiences of technical difficulties do not affect the locus of control beliefs. Hence, locus of control beliefs guide the perception of malfunctions. These locus of control beliefs are more general than self-efficacy expectations. That is: There is no salient difference between the attribution of responsibility to oneself or to others; just as there is no important difference between the consideration of technology and destiny. The decisive difference lies in the attribution of responsibility to human actors as opposed to non-human factors.

Starting point for the present paper is the assumption that malfunctions of technology in teaching and learning add to the individual cost-benefit analysis concerning the usage of information systems in education. On the basis of the above, it can be concluded that the perception of technical difficulties is significantly determined by different dimensions of locus of control. However, the study presented above has not investigated the direct relationship between malfunction and acceptance. This connection is quite plausible, but not proven as yet.

Given the model of technology acceptance TAM3 (cf. Venkatesh & Bala, 2008), it stands to reason that experiences of malfunctions have influence on "perceived ease of use" as well as on "perceived usefulness", and thus have impact on "behavioural intention to use". Here, further investigations should assess the relevance of failure and frustration. It would be interesting to examine the time course of frustration and competence in the context of locus of control beliefs. We suggest a U-shaped curve of competence experience in coping with malfunctions: Initial difficulties may lead after a few sessions to an experience of powerlessness. After a while, users acquire routines to manage these difficulties or to avoid them. This leads to a competent and self-responsible use.

The present study is approached from the perspective of differential psychology, which underlies the concept of the dimensional structure of locus of control beliefs. Different people have different preferences, to which they attribute responsibility for an error-free operation. These preferences – internal or external attribution; to *Self*, *Others*, *Technology*, or *Fate* – is of importance for preparing and supporting the use of technological devices and applications in communication and collaboration. It can be assumed that support services will be accepted from those persons who have an internal locus of control, in particular for the dimension of *Self*. Who believes that the responsibility for a trouble-free session lies with herself or himself, will read the instructions needed to prepare everything well and is likely to develop routines for trouble-shooting, in order to experience less technical difficulties.

However, those who are inclined to believe that nothing can be done anyway, because technology simply is supposed to work (and if not, this is due to defects or misfortune), will not be accessible for instructions and help during preparation. The result could be described as "preaching to the converted" – more often than not observed by support stuff: Any services reach only those who are already in a position to act responsibly with technology.

The question remains about how to help and support those who currently take little or no responsibility for the prevention of malfunction. From the concept of locus of control, it can be concluded that services that fully exonerate the user are indeed well received by people with external locus of control beliefs, but then require more and more support, since they do not encourage self-reliance. Therefore, support service should promote personal responsibility for technology use. This can be done, for example, by setting goals for an online course, targeting an undisturbed web-conferencing session by evaluating malfunctions and praising circumspection, know-how and responsibility. The factors that foster self-reliance in adequate settings could be the subject of further research and development.

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Short Papers

COPYRIGHT AND CREATIVE COMMONS LICENSE: CAN EDUCATORS GAIN BENEFITS IN THE DIGITAL AGE?

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ABSTRACT

In this society of digital environment, to keep pace with the technological change that causes the difficulties of information access together with royalty fees remunerated for making use of copyrighted materials, Creative Commons (CC) license is introduced. However, debates on the issues of copyright and CC license have widely arisen. This research is aimed to prove as to whether CC license destroys the balancing interests between the right holders and the public at large, including educators, through the fair use doctrine. Specifically, it is conducted to explore the legal strategy of CC license and analyze its potential for enhancing the sharing, distribution and reuse of creative works, especially in the digital era. The research findings suggest that the CC license can alleviate some of the problems caused by the copyright conflict and this can be helpful to the public, with no exceptions to educators. Moreover, some interesting recommendations are proposed to uphold the great benefits of CC license to be adopted in line with the copyright law.

KEYWORDS

Copyright, Creative Commons License, Digital Age, Educators, Information Access

1. INTRODUCTION

Due to the rapid change of technology, there is a huge demand for free images and music for educational use in schools, with many people just copying anything from the Internet without asking for permission or acknowledging the source. The right holders thus intentionally create a technological measure to restrict copyright material access. As a result, knowledge transfer through information access is unreasonably prohibited. Many people are of their views that as digital technology thrusts complexity upon copyright law, conflict has escalated between copyright holders desperate to institute a vigorous enforcement mechanism against copying in order to protect their ownership and others who underscore the importance of public interests, including those in the educational sector, in accessing and using copyrighted works.

As the copyright movement grows, however, other movements are also gaining momentum – and fast. The copyright regime in many countries is considered to be too rigid, onerous and expensive to facilitate the exchange of ideas and encourage creativity. Instead, it is seen as protecting the monetary interests of those who create works without incentivizing the sharing of those works with the community so that they can be improved upon and added to.

Legal scholars, users of protected works, and some creators have criticized the current copyright regime for its overreaching scope and duration. Different technical protection measures that restrict certain uses of works, legally backed by international copyright treaties and domestic copyright law, have increased concerns that copyright is developing into becoming a general regulation on the use of information. This development and copyright’s starting point of giving automatic exclusive rights to cultural objects have spurred counter movements into existence. Technology has been an important driving force of peer production development. It promotes practices and tools that encourage sharing, openness and peer production. Meanwhile, social structures have also required revisions. The default copyright system that is based on automatic exclusivity does not serve collaboration as such. Even though the communities have not lobbied for new legislation, they have created community norms that are implemented into copyright licenses and community guidelines. Collaboration is therefore hindered. Creative Commons (CC), set up in 2001 by Lawrence Lessig, is an organization that works in tandem with existing copyright regime, but allows those who wish to license copyright in their works while reserving only the most basic of all rights, to do so within the legal framework. It does this by providing what are called “Creative Commons license” (CC license) free-to-use and by providing information and tutorials on its use.

Nonetheless, CC license has been the subject of heated debate, seeing great success and enthusiastic converts as well as staunch opponents and troublesome legal quandaries amongst both policy-makers and users. CC license is both praised and criticized for attempting to strike a balance between the protection of intellectual property and the need to encourage and foster collaboration; the philosophical foundations of the enterprise have been both lauded and lambasted, making the task of trying to understand what role CC license can play in today’s world an exceptionally interesting one.

Many users and scholars are of their views that CC license is an extension of Copyright. CC license gives the creators the ability to dictate how others – users may exercise the creators’ copyright rights, allowing such users to copy the copyrighted works, make derivative works, distribute them, and so on. In terms of educational development, particularly in the digital era, CC license extremely opens new opportunities and ideas to both teachers and students. It also really helps to expand on copyright and encourage stakeholders to use materials in ways the creators are comfortable with. More importantly, there is arguable that the introduction of CC license may diminish the value of fair use doctrine under the copyright system. Thus, the researcher would like to prove as to whether CC license destroys the balancing interests between the right holders and the public at large, including educators, through the fair use doctrine. Specifically, this research is conducted to explore the legal strategy of CC license and analyze its potential for enhancing the sharing, distribution and reuse of creative works, especially in the digital era.

2. THE NATURE OF COPYRIGHT AND CC LICENSE

As the matter of fact, copyright law and CC license play different roles but CC license does not contravene the original purpose of copyright law as well as fair use doctrine. Copyright law protects any creative works since it is expressed into tangible and fixative form. Nobody can legally use such copyrighted works beyond fair use doctrine without a license. On the other hand, CC license serves as a license that people who want their works to be shared can issue. Certainly, such creative works are protected under copyright law – they are copyrighted works for being shared and everyone, encompassing educators, can make use of them under the conditions set up through licensing system.

More descriptively, it is simply realized that the default setting of copyright system is all rights reserved – exclusive rights, which are generally so called. Users are required to get the permission to access the exclusive rights. License agreement is a significant tool for the right holders to screen the users to make use of their copyrighted materials. Users are required to acquire a license for every use of a work that is protected by these exclusive rights unless the exception of fair use is applied. The barriers to access are, thus, effectuated by two separate aspects of copyright law: first, the legal right to restrict access and to apply for injunction in case of unauthorized use, and second, information costs associated with securing a license (Elkin-Koren 2006). Certainly, royalty fees remunerated to the right holders often become an issue, particularly in the educational realm where non-profit purposes dominate. Accordingly, accessibility of copyrighted works can be continuously going down. Undoubtedly, copyright infringement at the same time is dramatically increasing due to circumvention of access costs under the territory of licensing agreement. CC’s strategy presupposes that minimizing information access costs is critical for enhancing access to creative works. It seeks to reduce these costs by offering a licensing platform. The strong copyright protection has fueled counter movement led by CC to introduce permissive and royalty free licenses.

CC is a non-profit organization, which operates licenses to reduce the legal costs associated with the use of copyrighted works, especially for non-profit purposes to engage in creative enterprises, so free use of creative works can be promoted. This initiative operation is using licensing agreement for the purpose of strengthening the public domain. With respect to the goal of increasing access to and sharing of intellectual property, CC considerably allows copyright holders to release some of their exclusive rights while retaining the other.

Respecting fair use doctrine and CC license, they are different. Fair use is described as a limitation and exception to the exclusive rights granted by copyright law to the authors or right holders of creative works (Fair Use 2014). It has been developed over the years as courts tried to balance the rights of right holders with society's interest in allowing reproducing in certain, limited, circumstances. Considering CC license, it has recently been launched to expanding the range of creative works available for others to create upon legally and to share. Thus, some scholars are of views that "CC is possibly the best publicized of the efforts to create an artificial public domain through contracts, to compensate for badly eroded zone of copyright-free work" (Aufderheide & Jaszi 2011, p.12). In the event where copyright law gives right holders the exclusive rights, fair use of copyrighted works is provided to balance the interests of right holders and the public. However, whether or not the reproduction is within the boundaries of fair use depends on the fact of particular circumstances. It is simply said that fair use is a balancing test. This means that a set of requirements or circumstances – the four factors (U.S. Copyright Office 2012) – must be fulfilled for the exception to apply. Additionally, the four fair use factors work differently. Every fair use must fulfill some standard in regard to each factor. In brief, fair use allows limited reproduction of copyrighted work certain uses. On the contrary, under the territory of CC license, users are eligible to have extra rights to use the contents. Nevertheless, CC license does not replace or diminish fair use, but if users want to do more than fair use allows, they can examine the terms of CC license in order to consider what it permits and they are required to do in return subject to the terms used. In other words, CC license is not an attempt to supplant or to be better than fair use but it is, rather, an attempt launched as a special aid.

3. COPYRIGHT AND CC LICENSE IN THE DIGITAL AGE

The digital environment, which significantly reduced the cost of communicating and sharing works, has enabled new modes of production and distribution of information. Digital networks allow dissemination of works to a wide range of users at a very low cost, thereby reducing the role of some traditional intermediaries (such as the recording industry), while introducing new intermediaries (such as search engines) into the dissemination process (Elin-Koren 2005). Digital networks further enable the development of content, such as text and software, through collaborative efforts by individuals, involving educators, who interact and communicate with one another, often without any claim for exclusive rights in it. An example to illustrate this is an initiative in Argentina called "Encipel", which is an educational community for creating documents that can be reviewed and improved by the community to share knowledge (OER Case Studies 2013).

However, current copyright regime can be considered as a major obstacle for creative activities. First, people are concerned about the rapid expansion of copyright in recent years. The inefficiencies created by expansive copyright, by restricting access to information and restraining the ability to creation, are becoming an interesting issue that needs to take into a consideration. Secondly, the public are very much concerned with the shrinkage of the public domain while they are also enthusiastic about the open competition and free culture. They wish to safeguard the public domain and encourage sharing and reusing of creative works by individual creators. Lastly, it seems that many of the new opportunities that were made possible by the digital technology are increasingly reaped by the massive enclosure of the public domain and the increasing commodification of information (Elin-Koren 2005).

The proprietary regime in recent years covers more copyrighted works in both analogue and digital forms. It affords protection to types of works, or new aspects of works, that used to be in the public domain, for instance, copyright and neighbouring rights afford protection for facts and mere data (Reichman & Uhlir 2003). The copyright bundle of rights has been expanded and covered a wider range of uses; for instance, the right to prevent unauthorized access to works in digital format which brought out the introduction of provisions concerning technological protection measures (TPMs). TPMs are a form of Digital Rights Management (DRM). DRM is the term given to various technologies used to control access to digital works or devices, to protect copyright in those works or the works used on the devices. For example, the iTune store incorporates DRM into its music, so that any music purchased from iTunes can be downloaded to a PC, burnt to a CD or downloaded to an iPod, but not downloaded and played on an MP3 player.

In addition, copyright law creates relatively high information costs, due to the nature of copyright subject matters: non-tangible assets. In order to facilitate the right holders' incentive in creating intellectual works to support the public's knowledge attainment, the law provides remuneration in a form of royalty fees to compensate their endeavour. Every property right imposes information costs related to ascertaining the contours of legal relationship pertaining to the owned asset and determining the boundaries of goods to which it applies (Guibault & Hugenholtz 2006). In the case of copyright, these costs tend to be prohibitively high due to the fact that rights in creative works are not intuitive; the right holders are required to create their works so that they are granted the exclusive rights over such creative works. However, these high costs can be disadvantageous to educators whose purposes are not for profits.

Copyright law made it difficult to take advantage of the new opportunities offered by digital networks. If licensing costs and legal exposure to copyright liability remain the same, creating and distributing online becomes expensive, notwithstanding the low cost of production and distribution. Furthermore, the proprietary regime has a tendency to further colonize other ways of producing content (Elin-Koren 2005). If one has to purchase a license to use someone else's work, he/she is more likely to release his/her output under restrictive terms, either to comply with the license of the underlying work, or to recover the cost of creation. This makes it difficult to create outside the proprietary model and thereby forces that model into the copyright one. This creates a chilling effect on individual creation. Legal counseling and licenses are more affordable and accessible to business. Thus the legal complexity created by the copyright regime gives businesses an advantage over individual creators, including educators.

CC license allows the public to share their information on the Internet without being accused of copyright infringement. It advocates the use of copyright in a different way that would ultimately change its meaning. The strategy of CC license not only creates a public domain, but also encourages free of any exclusive proprietary rights under the intention of copyright regime. It responds to the problems in copyright law particularly in the digital environment, concerning the ambiguity between licensing agreement and contract as well as provisions regarding Technological Protection Measures (TPMs) that are too much restrictive to encourage the public to access information for non-commercial purposes. In an academic environment, for instance, Open Educational Resources (OER) are some benefits derived from CC license. This is because these teaching, learning, and research materials in any medium permit the free use and re-purposing by others. As a result, in regard to educators, finding, sharing, combining, and customizing text-books, courses, and lesson plans could be done freely and easily (Education n.d.).

Notwithstanding, it is important to understand that CC license is not created to subvert the copyright system. Many people have the misconception that they have to give up their copyright when CC license is applied. This is not true. The authors of such works need not to give up their copyright when they use CC license. In fact, most of CC license criteria of permissions to the public are certainly based on the copyright. It is likely to comprehend that CC license just gives more freedom to the users and in the meantime controls how the information will be used. In UK, for example, the Open University launches an initiative entitled "OpenLearn" to "reduce the costs of course development for everyone in education and improve quality by openly sharing quality-assured educational materials" (OER Case Studies 2013). It makes use of CC BY-NC-SA, which allows others to remix, transform, and build upon a work non-commercially, as long as the work is credited and the new creations are licensed under the identical terms. (About the Licenses n.d.)

The benefits of using CC license for individuals are that they can customize the rights they would like to give, and also still have control over their works. By contrast, a regular standard copyright cannot do so. Under the realm of copyright legislation, users have to stick to the copyright legislation no matter what they like or not. Authors, creators, or right holders have to compromise on several aspects of distribution when they use copyright. Many stakeholders acknowledge that CC license liberates them from all such things (Elkin-Koren 2005). Still, the works created for CC license are definitely protected under copyright law as such works are expressed into fixative and tangible forms. Thus, in order to use CC license, creators need to have a copyright. Their copyright can then be modified to suit their needs by CC license (Frequently Asked Questions 2014).

Creative works are, indeed, copyrighted. Copyright law protects original works of authorship, and CC licensing scheme does not change this. However, it changes the pervasiveness of copyright. Licensing copyrighted materials used to be the domain of corporations. Individual creators were always the owners of their creative works, and works which were not intended for commercial use remained the sole property of the authors even after they were made available to the public online. Many works were posted online without any restrictions, on the implicit presumption that re-use was permissible for non-commercial purposes. This thriving environment of information, produced and shared by peers, has driven the Internet to its colossal success at present (Guibault & Hugenholtz 2006). Individuals never bothered to assert their rights or engage in licensing. Licensing was either too complicated or too expensive. On the whole, individuals did not expect any revenues from sharing their creative works, and normally avoided the legal cost of licensing. By reducing the cost of licensing, CC license makes licensing more accessible to individuals, thereby strengthening the hold of copyright in our everyday life. It seemingly empowers individuals with legal powers that were once available only to industry. It makes copyright accessible to all. Now that individual authors are not only aware of the proprietary regime but are also armed with an efficient mechanism to execute their intellectual property right, they may use it to set limits on the exploitation of their works.

The metaphor of property is rather powerful. Intellectual property, however, is not merely a metaphor (Guibault & Hugenholtz 2006). It constitutes an effective legal mechanism that allows exclusion. The need to secure permission prior to the use of any creative works is the main barrier for sharing and collaborating among individual creators. It is the main cause of the transaction cost that CC seeks to reduce.

As stated above, there are some concerns about the replacement of copyright by the adoption of CC license. According to the research's analysis, it can be confident to affirm that CC license is not created to subvert copyright norm. Instead, it can work in parallel with the copyright law. As the understanding of the licenses spreads, greater numbers of content users, particularly educators, will specifically seek out materials that are covered by a CC license. A renewed sense of openness – rather than restrictiveness – will support new educational efforts, particularly in developing countries, that cross institutional and national boundaries. Educational content will be shared freely, with programs and degrees based on learning objects and resources from multiple sources. Globally, both developed and developing countries are adopting CC license for education, ranging from Argentina to the USA (OER Case Studies 2013). In addition, CC license can still be a useful tool to encourage people both right holders and users to publish and make use of copyright respectively via the Internet. However, it should also be kept in mind that the good system of CC must be consistent with the purpose of copyright law. This means CC license must be adopted to support the knowledge acquisition via electronic media and meanwhile it must maintain the value of copyright norm by broadening the means to access copyrighted materials transformed in digital devices.

4. CONCLUSION

The emergence of digital world has brought with it collaboration on a global scale. In today's age of digital technology, including the sharing and collaborative environment of Web 2.0, arguments about copyright issues, especially copyright infringement, emerge. As CC license enables users to create and share creativity as they choose, it can, therefore, be regarded as a fascinating tool in a legal aspect that can benefit many, involving educators. It is undoubtedly used as a popular alternative to the "all rights reserved" copyright license that we are all familiar with. Nonetheless, it is important to note that CC does not replace copyright. Those who have chosen to use CC license still own the copyright of their works, they are simply licensing its use through CC license. According to the analysis, this research also proposes some interesting recommendations to uphold the great benefits of CC license to copyright norm as follows:

1. CC license should not diminish fair use doctrine. Fair use already allows people to use copyrighted works. However, under the fair use doctrine, it is required to consider some factors to determine what is "fair". In its most general sense, fair use of a copyrighted work is any copying of copyrighted materials subject to some limitations for some fair purposes, such as comment, criticism, news reporting, and scholarship (U.S. Copyright Office 2012). On the contrary, there is no need to consider any factors to make use of the copyrighted works through the adoption of CC license. This does not mean CC license is trying to diminish the value of fair use doctrine. Instead, it helps to broaden the accessibility of copyrighted materials in the digital era. It allows the free distribution of creators' works for non-commercial purposes. Allowing broad noncommercial use of otherwise protected materials significantly expands the pool of resources educators can use in teaching and learning. Therefore, it is introduced to broaden the scope of fair use doctrine, which may be called as "fair use plus". Under copyright law, nobody is allowed to reproduce copyrighted works without the right holders' permission but with CC license, stakeholders – both creators and users – can keep hold of the copyright and still make money on the works, while allowing the public to spread the words widely.

2. License terms of CC license should be transparent. In order to cut down the complication, high costs, and time consuming of traditional copyright license, CC license should set out a transparent range of licensed terms that allow people to state just how far they are prepared to share or give away for free their outputs. It is agreeable that each CC license comes with the same baseline user rights and restrictions. These allow the materials to be copied, distributed and reused, at a minimum in its current form, for non-commercial purposes, and as long as the original creators are credited. Once a contract is in place, the terms and conditions of the contract prevail over copyright law because a contract is considered to be a private bargain between private actors, whom are presumed to have equal bargaining power to negotiate the terms and conditions of the contract. To assist copyright law regarding its condition on licensing mechanism, the substantiality of CC license is to extend individuals' opportunity to adapt the license to their needs regardless payment as there are many choices available. Some familiar CC license choices are CC BY, which allows others to distribute, remix, transform, and build upon a work, even for commercial purposes, as long as the work is credited for the original creation; CC BY-NC, which is identical to CC-BY but allows others to make use of this term under non-commercial purposes; and CC-BY-NC-SA, which resembles CC BY-NC unless others license their new creations under the identical terms (About the Licenses n.d.).

3. Moral rights should be pondered within the adoption of CC license. The focus of moral rights is not on corporation or commerce. It is to offer legal protection for an author's right to be acknowledged as the creator of his or her own work. To an extent, moral rights can also protect the integrity of creative works, empowering authors and artists to protest damaging or demeaning treatment of their works. Indeed, the approach of moral rights to creative works is the foundation of the CC license, by means of which, a work is effectively released to the public. This form of publication ensures that the works are available for use without copyright restrictions, but this is not without conditions: attribution and integrity are protected, to varying degrees, and in various guises, as authors decide. The provision of CC license closely approximates the legislative provisions of moral rights. Also, author's moral rights are in no way affected by CC license. Instead, CC license prevents anyone re-using the work from doing so for commercial purposes. Regarding perspective of moral rights, the third license, which adds a "no derivatives" principle to the attribution license, is noteworthy too. It provides that no person should make a derivative work based on the original work. This means this license allows for redistribution, commercial and non-commercial, as long as it is passed along with credit to original creators.

4. CC license must be an optional tool to solve copyright conflict. Since CC license is not anti-copyright per se, but argues for use of more flexible and open copyright licenses within existing copyright law, it actually obscures the real copyright issues we face currently, and keeps people to settle on the proper parameters of digital information use, access, retrieval, and preservation in the 21st century. However, it should play as an optional tool to resolve a conflict surrounding copyright. In the best case scenario, with a balanced and effective law that serves citizens and corporate owners equally well, a CC license is unnecessary. This is because a good copyright system can already provide the expansion of protection as well as the expansion of private use, exceptions to and limitations on copyright, which is an essential means of striking the right balance.

ACKNOWLEDGEMENT

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THE CURRICULUM DESIGN AND DEVELOPMENT IN MOOCS ENVIRONMENT

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ABSTRACT

The paper selects over 20 online courses and analyses the subjects, organization, the way to show the content of the courses, the use of media, and design of the teaching in the case study of Chinese popular MOOC platform. On this basis, the paper summarizes the principles of curriculum design and design models in MOOC environment, such as practical course content, minimized but continuous course structure, simplified course content, the effective combination of the media with the content, learners-centered, and stressing social construction. The author is not only a member of the curriculum development team of MOOC, but also experiences the online courses as a learner, and tries to summarize the principles of curriculum design and design models after analyzing the design elements with the case study method.

KEYWORDS

Massive open online courses, Curriculum design, Knowledge Construction, Cognitive load theory.

1. INTRODUCTION

MOOC has been opened in a number of universities, institutions and organizations. In the year 2013, some top universities in China such as Tsinghua University and Peking University formally proclaimed to join edX, which is one of the three popular MOOC platforms. In October the same year, Tsinghua University formally opened the MOOC platform Xuetangx.com, thus making its curriculums available all over the world. As a member of the curriculum development team of Chinese MOOC, the author herself also experiences the online courses as a learner, and tries to summarize the principles of curriculum design and design models after analyzing the design elements with the case study method. Finally she hopes that this paper can be useful for the following curriculum development.

2. CASE STUDY

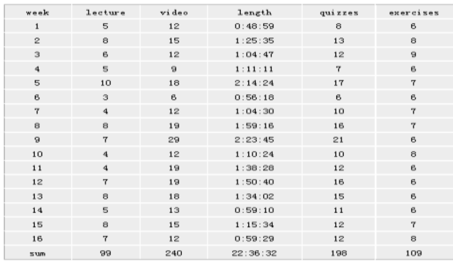
Over 20 online courses are selected and discussed about the advantages and disadvantages of their design. The selection of the subjects, organization, the way to show the content of the courses, the use of media, and design of the teaching are analyzed in details in the case study as follows.

2.1 The Selection of the Courses and Their Organization

According to the statistics, there are totally 147 online courses on the Xuetangx.com platform, including computer, cloud computation, entrepreneurial management, data science, social science and thinking training, etc. Among all these courses, over 20 subjects which are developed by Tsinghua University are selected for us to analyze.

Most online courses on the Xuetangx.com are published weekly in each semester. The courses are introduced by chapter or topic. Every unit is showed in a short video which lasts 1 to 15 minutes.

Figure1 shows the contents of the subject Principles of Electric Circuits, which is organized chapter by chapter. Figure2 is the resource list of the subject Principles of Electric Circuits, in which 99 lessons are arranged in 16 weeks. In addition, 198 tests, 109 assignments and 240 videos which last at most 12 minutes are also included.



week	lecture	video	length	quizzes	exercises
1	5	12	0:48:59	8	6
2	8	15	1:25:35	13	8
3	6	12	1:04:47	12	9
4	5	9	1:11:11	7	6
5	10	18	2:14:24	17	7
6	3	6	0:56:18	6	6
7	4	12	1:04:30	10	7
8	8	19	1:59:16	16	7
9	7	29	2:23:45	21	6
10	4	12	1:10:24	10	8
11	4	19	1:38:28	12	6
12	7	19	1:50:40	16	6
13	8	18	1:34:02	15	6
14	5	13	0:59:10	11	6
15	8	15	1:15:34	12	7
16	7	12	0:59:29	12	8
sum	99	240	22:36:32	198	109

Figure 1. Contents of Principles of Electric Circuits

Figure 2. Resource List of Principles of Electric Circuits

As we can see, every video features only one topic, short time and brevity, thus contributing to the concentration of the learners.

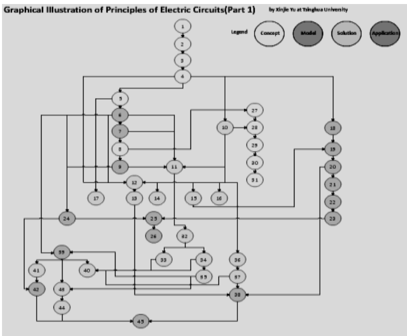


Figure 3. Knowledge Structure of Principles of Electric Circuits

Figure 3 is about the knowledge structure of the course Principles of Electric Circuits. The figure shows the hierarchical relationship between the knowledge. Besides, some pieces of the videos are arranged in accordance with the order of the knowledge.

2.2 The Way to Show the Content by Multimedia

The beginning video of every course is usually about the general idea of the course. It is designed to be dynamic in order to attract the students.

History of Chinese Architecture has the unanimous style. As we can see in the figure4, the start of the PPT, the explanation of the teacher and what is shown in the video are unified aesthetically and clearly show the style of Chinese architecture.

Figure5 is a picture of the course Principles of Electric Circuits which combines various media such as blackboard, PPT, experiments, thus solving the problems of most science and engineering teachers.

As shown in figure 6, the simple vivid animation stories are used in the course Financial Analysis and Decision Making, which is effective to explain the selling and purchasing process and their relationship.

Figure 4. The course History of Chinese Architecture

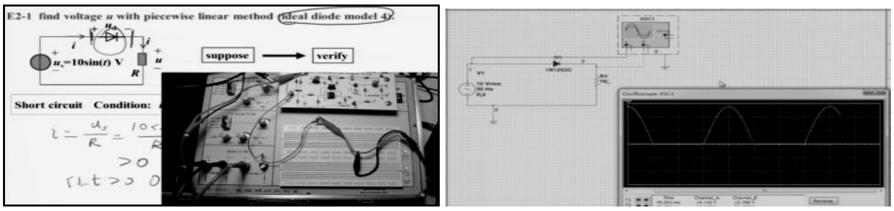


Figure 5. The course Principles of Electric Circuits

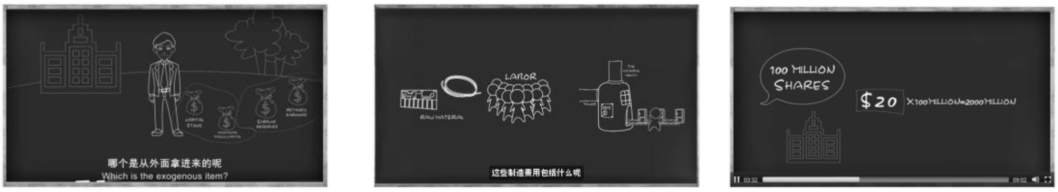


Figure 6.Video of Financial Analysis and Decision Making

2.3 Design of Teaching

2.3.1 Making up a Virtual Learning Environment

Most online courses are divided into semesters on the Internet. Instead of putting all the course videos on the Internet at one time, we upload the new course video weekly. Thus we make up a learning environment where there are semesters, homework, tests, examinations, course credits. The learning environment enables students to have a sense of belongings.

2.3.2 Interaction

Figure7 is about the drawing and writing on the PPT in the course Principles of Electric Circuits, which can attract the students to follow the teacher's ideas to study. Besides, it is much more attractive than just writing knowledge on the blackboard.

Figure 8 is about the quiz between videos. Only by finishing the quiz can the students continue to study, which plays the same role as questioning in the class.

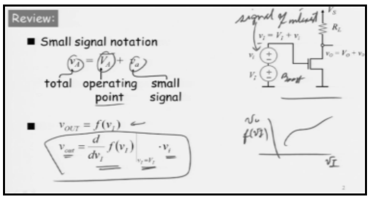


Figure7. Principles of Electric Circuits- Drawing and Writing

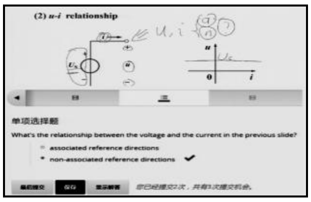


Figure8. Electric Circuits-Test between Videos

2.3.3 Communication

The Xuetangx.com platform provides communication function. Students can introduce themselves to others. Cultural communications among students from different places can also be done. They can share the study materials and information by posting to the platform. Through the online platform, the teacher may ask the students to define a vocabulary and students themselves can modify each other's definitions of the vocabulary. As soon as one student raises a question, other students will begin to discuss it spontaneously before the teacher answers it.

2.3.4 Evaluation

The Xuetangx.com platform also has the function of self-evaluation on which the students can see their course progress and scores. And that is an inspiration for the students.

Figure 9. Communications on the Online Platform

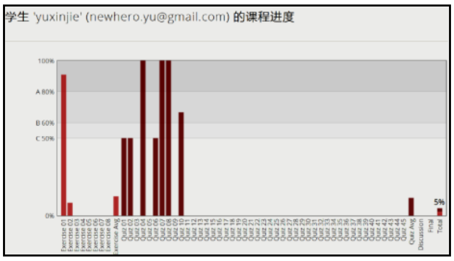


Figure 10. Principles of Electric Circuits-Study Evaluation

In conclusion, every course has the design of teaching, including a virtual learning environment, the interaction, the forum of each course, the function of self-evaluation and resources. However, we can see few online courses which involve in the cooperative learning and research.

3. PRINCIPLES OF CURRICULUM DESIGN

Basing on the analysis and summary of the design of teaching after our experiencing of the online courses, we draw a conclusion of the design principles of the curriculums in the MOOC environment.

3.1 Practical Course Content

The investigation of the learners in e-learning courses shows that the biggest cause of their stopping the learning is that they are not interested in the content. Research shows that examples or problems from our real life are helpful to inspire or maintain the students' interest when learning. The design of MOOC should emphasize on inspiring and maintaining the interests of students. So the key is the practical course content.

3.2 Minimized but Continuous Course Structure

The cognitive resource of the learner is limited according to the cognitive load theory. Once the information is overload, the meaning-construction of the knowledge will be influenced (Rohani Ahmad Tarmizi & John Sweller, 1988). Researchers such as Gerhard Ross from the European brain lab had also proved that minimal content and frequent repetition are the best for study from a neurobiological perspective.

We should follow the principle of modularization, short time, refined knowledge granularity and focusing on the important knowledge. In other words, the course content should be divided into small modules according with the teaching goal, each of which should only have one knowledge point and last 5 to 10 minutes. However, we don't suggest random division ignoring the systematicness of the course.

3.3 Simplified Course Content

Good cases of the online courses can best explain and simplify the content. They are usually characterized by the simple writing performance, graphs and animation stories which can show the relationships.

As to the way of course content presenting, it should follow the cognitive load theory so that the inner cognitive load of the students can be lessened. Therefore, the following suggestions can be adopted: reducing the irrelative information on the screen, explaining the abstract content with graphs. Meanwhile, we should also stress the improvement of learner's relative cognitive load. Marking the key content or setting reminders can promote the efficiency of the learners.

3.4 The Effective Combination of the Media with the Content

Numerous studies show that a combination of various media is conducive to the construction of knowledge. For example, with long-term research, Richard.E.Mayer concluded that it was more efficient for students to be shown with both words and pictures than just the words in the class. Only by being shown both the words and pictures can students form a module of them and establish certain relationship between them. Finally the meaning study is realized.

Hence, a good design of the course should be, basing on what is to be presented, the appropriate combination of the media.

3.5 Learners-Centered

In the MOOC environment, learners are the subjects who choose what they learn and control their own progress. Virtual learning environment should be built to support learners with different learning modes.

The MOOC environment should meet the following requirements: first, the knowledge should be arranged step by step so that learners can do independent learning and complete their knowledge construction smoothly. Second, diversified resources should be provided to meet the individual needs of the learners. Third, platforms for the communications should be offered to support collaborative learning. Last, automatic mechanism for evaluation of students' study together with the homework, tests and examinations should be given to students, aiming at a timely feedback for students' study.

3.6 Stressing Social Construction

In the virtual classes, we should attach great importance to the guidance of students' communication, the efficient problem-solving process for the students, and the providing of various network tools for students to communicate and share knowledge. If so, the students can get their knowledge strengthened and learn something new through the Internet.

4. CONCLUSION AND FUTURE RESEARCH

The curriculum design and development in the MOOC environment is meaningful. The author hopes that this paper can be useful for the future development of the MOOC. With a direct analysis of the MOOC, this paper might be limited in the design principles of the curriculums, which need to be revised and improved in the future.

The future research will focus on the modes of the curriculums in the MOOC environment, aiming at providing a better way for teachers to develop MOOC curriculums and improving learners' efficiency.

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STAKEHOLDERS INFLUENCE IN MALTESE TOURISM HIGHER EDUCATION CURRICULUM DEVELOPMENT

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ABSTRACT

Tourism sector is a key element of the Maltese economy. Therefore, having an appropriately trained workforce becomes a critical factor in ensuring that tourism continues to flourish. In order to avoid skills mismatch and similar problems, it is extremely important to identify the key stakeholders and encourage them to participate in the process of curriculum change in Maltese Tourism Higher Education (HE). A successful stakeholder analysis will determine their degree of influence and as a result devise appropriate mechanisms for their involvement in curricular reform. Failure to do so often results in an unsuccessful reform project.

KEYWORDS

Stakeholder Analysis, Higher Education

1. INTRODUCTION

The current socio-economic scenario presents challenges ranging from aspects of globalisation, work-related migration and in particular the need to be able to engage in an environment that no longer has a homogeneous culture but rather a mix of cultures. This is a challenge that Higher Education (HE) institutions need to redress in the sense that the 21st century student has to be exposed and adequately prepared to operate in such an environment. The OECD (2012), the European Commission (2013) and other constituted bodies are taking diverse research initiatives that are looking at this aspect of a multicultural environment and how to effectively take on the advantages that may be brought by such an environment, yet at the same time mitigating the possible negative consequences arising from culture-based misinterpretation of human behaviour.

The counter argument is that HE graduates do not have the ‘right’ cultural skill set for today’s economic scenario. The gap in students’ skill-set is a cause for concern for the graduates, academics and employers (Times of Malta, 2011) in Malta. Studies from different countries share similar concerns (Constable & Touloumakos, 2009).

This investigation forms part an ongoing research process that is investigating the assessment and accreditation of culture-related ‘soft skills’ through the implementation of an e-learning system within the Institute of Tourism, Travel and Culture (ITTC) at the University of Malta (UoM). The research focuses on undergraduate students reading for the B.A. Tourism Studies who, upon graduation will most probably take up employment in the Maltese Tourism sector. This paper looks at the need of carrying out an adequate stakeholder analysis exercise to ensure a successful project outcome.

2. THE MALTESE SCENARIO

The importance of the Maltese Tourism and Hospitality sector may be seen from its contribution to the Maltese economy. With over 25%[1] of the country's Gross Domestic Product (GDP) it is by far the most significant sector which is well above the EU average of around 8%. (Azzopardi, 2011). The number of persons employed directly in hotels and restaurants alone on a permanent basis, amounts to approximately 6% of the entire country's workforce (NSO, 2013).

At the same time, (NSO, 2013), visitors to Malta are diverse in terms or country of origin, ethnicity, religion, cuisine and scope of the visit itself (sun & sea, heritage, culture, leisure activities, etc.), than before. This has posed a series of challenges in that various operators in tourism, hospitality, culture and heritage management, etc., must be aware of the multicultural environment in which they are now operating. Educators operating in tourism, travel and culture also need to face up this challenge.

In order to ensure a successful implementation, the key stakeholders need to be identified and involved in the process; in this case that of curricular development including the use of e-learning technologies. Bryson (2004) refers to Nutt's (2002), study of 400 strategic decisions that suggest that half of them failed (not implemented or implemented with poor results) because the decision makers did not seek information from and at the same time redress the needs of the stakeholders involved. Chapleo and Simms (2010) refer to the importance of identifying stakeholders their influence as being of fundamental importance to policy-makers. Failure to do so often results in poor performance if not a complete disaster (Bryson, 2004).

3. STAKEHOLDER IDENTIFICATION AND ANALYSIS

Freeman (1994) defines stakeholders as groups or individuals that may affect or are themselves affected by the achievement of an organisation's objectives. Mead and Andrews (2011) discuss stakeholders as being fundamental towards successfully implementing a strategy. They quote David's (1993) definition as individuals and groups of persons who have a special stake or claim on the company.

Maric (2013) makes a direct reference to the role stakeholders may play in affecting HE. Getting to know the stakeholders' perspective is an essential element in order to ensure that universities are able to fulfil their mission.

Bryson (2004) illustrates various techniques that can be used to carry out a comprehensive stakeholder analysis exercise. He suggests that as a starting point, one should employ a grid and map the interest and power or influence of each stakeholder group on a quadrant (Bryson 1995: 71 -5).

Bryson (2004) goes on to indicate Mitchell's et. al., (1997) work that, in order to be able to position the stakeholders along the power/influence quadrant one has to be able to:

1. specify how each stakeholder may influence the organisation
2. determine what the organisation needs from each stakeholder
3. rank stakeholders according to their importance to the organisation (by considering stakeholder's power, legitimacy and attention seeking) (Mitchell et. al, 1997)

3.1 Identifying ITTC Stakeholders

A process involving the detailed analysis of the documentation governing the ITTC (2010) was carried out in order to identify the main stakeholders that may have an interest and possibly have an influence on the ITTC HE curriculum. This first outcome was to look at all potential stakeholders and classify them in two broad categories, external and internal (Lewis, 2006).

For the purposes of this study, external Stakeholders would be those not 'residing' within the UoM and the ITTC. The current governance structure of the UoM (2012), makes it unlikely that they are able to have a direct involvement the development of the ITTC's strategies and policies, including curriculum development (ITTC, 2010). They would however, be affected by the decisions taken within the ITTC. These stakeholders were:

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[1] It is thought that the overall contribution is closer to 40% based upon estimates carried out by the Malta Hotels and Restaurants Association

1. Malta Tourism Authority (MTA) – the principal government agency involved with developing Malta's tourism strategies, policy planning, legislation and enforcement, etc. It is the Maltese government's official representation for the tourism sector.
2. Heritage Malta – the government agency entrusted with the running and management of various heritage sites.
3. Malta Hotels and Restaurants Association (MHRA), representing the vast majority of operators/employers in the Maltese tourism and hospitality sector.
4. Institute of Tourism Studies (ITS) – a state managed vocational college in the field of tourism and hospitality. Students from ITS on completion of Higher Diploma courses may enrol for an undergraduate degree course at the ITTC.
5. The tourists visiting the Maltese Islands.

On the other hand, internal stakeholders are found within the UoM. Although not all be directly involved with the planning and development of ITTC curriculum, their influence and power welding is determined by the administrative and managerial roles that they may occupy within the ITTC and other UoM entities. They are thus in a position to determine whether a proposed curricular change would be, approved, amended and ultimately implemented. The following internal stakeholders were identified:

1. ITTC Director
2. ITTC Academic Staff
3. ITTC Board Members
4. Other UoM Academic Staff
5. ITTC Students
6. UoM IT Services

4. FINDINGS

The official documentation related to the governance of the ITTC (ITTC, 2010) within the framework of the University of Malta's governance (UoM, 2013) was analysed to determine the actual influence that diverse stakeholders have and the power that they may wield in curriculum development and management. Other documentation, internal to ITTC, was reviewed. These included documentation related to the employability of ITTC graduates, ITTC's developmental strategy, annual reports, and ITTC's journal, dissertations, examinations and post-graduate committees. It is significant to note that the ITTC director either chairs or co-chairs each of the above-mentioned committees and the appointment of the other members lies within the Directors remit, albeit subject to the ITTC board approval. Another finding was that the almost all the committee members were in fact academic staff members of the ITTC. In some, isolated cases, other, non ITTC UoM academic staff members were found. As with the previous group, these were also subject to approval by the ITTC board.

This documentation review indicates that the ITTC Director has a considerable amount of power and within the ITTC. However, this is counterbalanced by the ITTC board, whose composition does include other stakeholder categories that do have considerable interest in the ITTC itself. The terms of reference of the ITTC specify clearly (ITTC, 2010) that it is this board that is entrusted with the functioning of the Institute and setting of policies. The ITTC board is made of:

1. Chairman: Rector or his delegate;
2. Vice-Chairman: Director of the Institute;
3. a person appointed by the Council of the University;
4. a person appointed by the Senate of the University;
5. up to two representatives of the academic staff lecturing at the Institute;
6. up to two representatives of the students registered with the Institute;
7. one scholar of repute to be recommended by the Board and approved by Senate;
8. one person actively involved in the field of tourism, travel and culture nominated by the Board and approved by Senate;
9. one person nominated by the Board of Governors of the Institute for Tourism Studies and approved by Senate.

(ITTC, 2010)

In order to gain further understanding of the power and influence that internal stakeholders have over the ITTC, two interviews were carried out with two out of a total of seven full time academic staff members of the ITTC. The first member is a very recent addition to the ITTC academic team. Since the mid-1970's he has held various very high profile tourism management and consultancy positions and has over 30 years of experience within the Maltese tourism sector. The second member is an academic by profession from the mid 1990's occupying various academic and administrative roles. He was on the University Council which is responsible for the general administration of the University (UOM, 2013) and currently a member of the ITTC board which as indicated earlier directs the academic tasks of the Institute, as it determines the studies, teaching and research within the Institute.

The outcome of these interviews was that when it comes to ITTC curriculum design and development, the key stakeholders within the ITTC are the ITTC board and the ITTC Director who ultimately sets the policies. Academic staff are do have some influence and power due to the positions that they may occupy on the ITTC subcommittees, but the ultimate decision making lies within the ITTC board. ITTC students are represented on some of the subcommittees and therefore may bring their views forward; their representation is always of minority. Thus, while some aspects of the ITTC curriculum design would be of interest, their degree of influence is limited.

However, when the issue of utilising ICT/e-learning for teaching and learning within the ITTC, it was pointed out that any decisions taken are subject to approval by the UoM IT services. A simple analogy was made by referring to the current ITTC website, which is hosted on the UoM IT services servers. The website template and layout of the ITTC website was set by the UoM IT services. Amendments are regularly made by the ITTC staff, but all the changes are subject to approval by the IT services supervisory staff. Similarly, any e-learning related initiative is subject to their approval. Hence although not on the ITTC board, the UoM IT services unit has significant influence over curricular development that involves ICT/e-learning.

5. CONCLUSIONS AND FUTURE WORK

This exercise served to identify and determine the degree of influence and power that potential tourism education stakeholders may have had in determining the ITTC e-learning curriculum. The ITTC Director and ITTC board are highly influential stakeholders. Their status set by the ITTC governance rules gives them both influence and a high degree of power as they are the ones determining the policies (including curricular development) and implementing the objectives of the institute. For any reform to be successful it is imperative to have the ITTC director as the main champion as s/he will be sponsoring these reforms with the ITTC board. However, another significant stakeholder would be the UoM IT services section as they determine the mode of engagement with the current UoM IT systems, for any IT-related initiative including e-learning. Being able to engage successfully with these stakeholders becomes a critical factor for the successful implementation of proposed e-learning related curricular changes.

One possible way being considered for engaging with the various stakeholders is through the use of a Soft Systems Methodology (SSM) (Checkland & Scholes, 2004). SSM has been used in order to illustrate the complexity of innovation within an educational setting (Cox, 2010) and get a better view of the stakeholders' position. This should help in devising effective forms of stakeholder engagement in order to ensure the successful implementation of the proposed e-learning curricular reform from a technical point of view and at the same time, addressing the culture skills gap indicated earlier. In practical terms, providing university graduates with the right set of skills and knowledge enabling them to engage successfully in today's globalised, multicultural environment, contribute towards socio-economic growth and fulfil their own personal development.

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ONLINE SOCIAL NETWORKS AND COMPUTER SKILLS OF UNIVERSITY STUDENTS

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ABSTRACT

Currently a large number of college students belong to social networks and spend several hours a week on them. Some sectors of society, like parents and teachers, are concerned about the negative impact on their academic work and in their personal lives. However, because the potential positive impacts have not been explored enough, this research addresses the question: What are the characteristics of online social networks that could facilitate the development of college students skills'? The research was qualitative and was conducted in a private institution of higher education. Twenty-one college students and thirteen college teachers participated. The results show that the characteristics of social networks that favor the development of ICT skills are primarily: 1) environment conducive to learning where students can learn by playing, racing, linking and imitating; 2) rich environment in technology tools, where there are primarily face tools, external tools executed outside the social network, internal tools, and external tools executed within the social network; 3) appropriate environment for the exchange of information, where communication can be: one to one, one to many, one to all contacts and one to all followers.

KEYWORDS

Online social networks, ICT skills, virtual ethnography.

1. INTRODUCTION

Information and communication technology (ICT) development has been enabling communication between people to become simpler and faster. Internet penetrations, emergence of new electronic devices, online social networks, and overall improvements in the area of computing have completely transformed the way we live and communicate. However, the complex environment of today's society requires the development of digital competences. These competences include the skill set that allows managing information effectively and properly utilizing ICT (Wallis, 2005).

For today's college students, developing computer skills is essential for their everyday interaction with the world; not only in education, but in any aspect of their lives. Oblinger and Oblinger (2005) explain that, for the *Net Generation*, technology is not new; they are not surprised by the advances in computer, Internet, and other online resources, because these already existed when they were born.

Online social networks are part of these available tools. While some studies have analyzed the possible negative impacts of the use of online social networks (Silkoset, 2013), it can be assumed that using them will improve computer skills. Online social networks are information systems that allow interaction of millions of people distributed around the world (Kazienko & Musial, 2006). Facebook, Myspace, Twitter, Linkedin are just popular examples of a broad universe of social networking tools that are available to the public through the Internet.

Facebook is the platform selected for the purposes of this study. This selection was made not only because of the overall number of users but for its implications in education. In the past many studies have shown the high participation of college students in the platform, usually around 90% are active members

(Hargittai, 2008, Smith & Caruso, 2010); studies also identify the same frequency of daily use by this population (Christofides, Muise, & Desmarais, 2009; Pempek, Yermolayeva, & Calvert, 2009). In addition, there is an emerging theoretical development in identifying applications of Facebook in learning environments (Mazman & Usluel, 2010; Barczyk & Duncan, 2013) that generally reflects the receptivity of students of the use of this technology in the classroom.

In order to take advantage of the online social networks it is important to identify the characteristics of online social networks that could facilitate the development of college students' digital skills. Given this situation, the question that this study addresses is: What are the characteristics of the environment in online social networks that could develop computer skills?

2. METHOD

This research is qualitative, and is divided into two separate studies which are not dependent on each other. According to Creswell (2008), one of the advantages of qualitative research is the ability to achieve a holistic understanding of the phenomenon under investigation. This is why it was decided to continue the naturalistic paradigm as it provides an overview of the experiences, values and beliefs of the participants. In this type of research theory emerges and develops from the data (Lincoln & Guba 1985).

The first study included thirteen teachers experienced in e-learning and use of Web 2.0 tools. We used the focus group and the formal interview as tools for data collection. Data analysis was performed with the method of constant comparison of Lincoln and Guba (1985). The second study included twenty-one university students. It consisted of a virtual ethnographic design, in which online participant observation was monitored, using Facebook and informal interviews, during a semester. To analyze the data obtained from this observation the Spradley (1980) methodology was followed. The method of constant comparison of Lincoln and Guba (1985) was used to analyze the information from the interviews.

3. RESULTS

Overall results show that online social networks have the potential to encourage the development of skills through its ludic environment, rich in technological tools and plenty of spaces that promote information exchange.

3.1 Favorable Learning Environment

The development of competences involves learning, and social networks provide a learning environment where students can play, imitate linking and even compete:

- *Learning by playing*. In this research, teachers and students considered that the relaxed and ludic environment of these tools is useful for developing skills for using new technologies. According to one participant (teacher): "People normally access a social network, such as Facebook, to socialize. In fact, participating in Facebook for entertainment causes changes in personal attitudes". Even if it seems like you are just playing, "you are actually acquiring some useful skills, in a natural way. Although it is entertainment, these skills will help you in the future".
- *Learning by imitating*. This environment fosters the exchange of information, encourages users to see what others are doing, and it creates a kind of imitative behavior. During research, for example, several practices were initiated and eventually were replaced by others. Although many of these "trends" are mere amusement, some of these help develop skills that can later be used in completely different areas. For example, the logic of *Notes* on Facebook is very similar to that of Blogs.
  - *Learning by linking*. In general college students not only learn by imitating, but they also learn by linking. Students enter online social networks for many reasons, but none of the students said that learning was one of them. However, a user can identify elements of amusement in his network, as well as recognize its utility in academic terms. An example of this is when certain functions of Facebook can be used in other computer systems in academic or professional areas.

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- *Learning by competing*. In this environment, students can learn to compete. In fact, competing with the popularity of a friend or member of the network promotes interest in "making" improving their space (profile). Users like to experiment with new tools, using their creativity. According to one professor: "these tools are used as a kind of competition because an important part in these networks is the profile, and how sophisticated it is... that has helped people to focus more on certain computer competences".

3.2 ICT-rich Environment

Facebook users use different tools in their social practice. The large majority of the tools that they use are supplied by the same platform, but not all. During the observation, four types of tools were identified: presential tools, digital tools external to the network, tools provided by the same online social network and external tools executed inside the social network.

- *Presential tools*. This category includes diverse tools like digital cameras and mobile phones. These tools, although typically not observed in the interaction on the platform, are very important in the culture studied. These devices produce much of the information shared within the online social network, through photos and videos. Furthermore, some of these mobile phones also enable access to the platform immediately, through mobile technology. Therefore, users of online social networks share information asynchronously.
- *Digital tools external to the network*. These are tools very important because users use it for their content preparation or for finding interesting information. For example: photo and video editors to "prepare" the content; video sharing sites like *Youtube*, to share something funny; blogs or webs to share news.
- *Tools provided by the same online social network*. These include different types: wall, mailbox, chat, video calling, photos, video, links, events, birthday.
- *External applications executed within the social network*. External applications are developed by individuals or external companies, but are still valid for use in the social network environment. Many of these apps are games or recreational applications enabling users to play. These applications also generate the interaction network, and some of them allow simultaneous joint participation.

3.3 Information-exchange Favorable Environment

During research, four different types of communication and information sharing options were identified: a) one to one exchange, b) one-many exchange, c) one- all contacts exchange a-d) one- all followers exchange:

Exchange one to one.

- Chat. The function of chat is to exchange information with a user privately. However, group chats can be set up where multiple users can sign up and interact in a conversation at the same time. It works basically like any synchronous messaging tool, but is designed for the same social network platform.
- Private Message. This is the most direct and confidential way to, asynchronously, send information, or have a conversation with a user or group of users. Private message users can send information at any time of day, allowing users flexibility to answer.
- Video call. This is the most direct way of engaging in dialogue, and includes the voice and image. It streamlines the communication process and is more personal, since people can actually see each other. So far, it does not allow for multiple users from different computers to interact simultaneously in a video call.

Exchange of one to many

- Groups. These are spaces that can be open, private or even hidden, depending on the configuration. All Facebook users are entitled to create these social spaces, which are commonly created to work around a topic.
- Events. This is very similar to a group, unless the activity revolves around a particular event with organizer features, guests, date, place and time. This application allows you to create and communicate an event with detailed information about it.

Exchange of one to all your contacts

- Profile´s page. Contains the latest news concernig people that are of interest to the user and that are part of their social network. In this space, for example, the user receives information requests from people who want to be part of your social network, invitations to events and groups, birthday reminders and even promotions.

Exchange one to all followers

- Pages. Facebook pages are usually used by a person or entity when the group activity revolves around him/it. Pages do not require registration, so anyone who gets the address can reach the page without invitation. However, the page has to be created by a Facebook user. Pages have virtually the same spaces and tools as a Group.

It is noteworthy that in addition to these internal applications of Facebook, there are several external applications: games, applications for music, apps to make surveys, and others. These tools involve various types of communication (one to one, one to many, one to all) depending on the nature of the particular application. To summarize, Figure 1 shows the characteristics of online social networks.

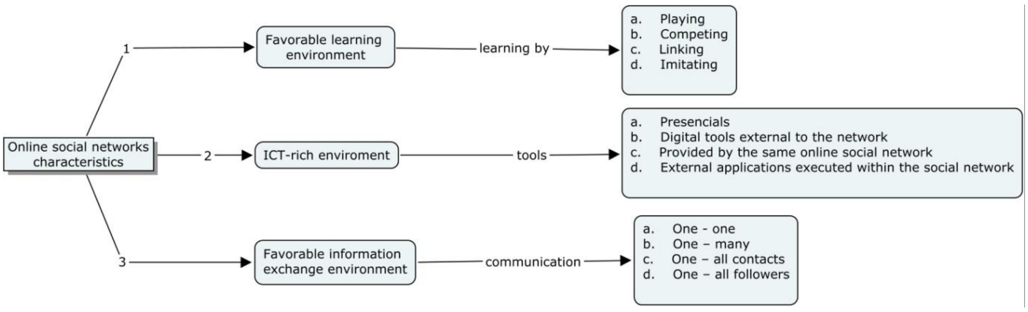

Figure 1. Environment properties of online social networks that favor the development of IT skills

4. CONCLUSION

Online social networks were not created for the development of competences. The business of online social networks does not seem to be in education but in socialization, as pointed out by McLaughlin and Davenport (2010). Users typically access these networks with the sole purpose of socializing, having fun, relaxing. Learning is not one of the most frequent reasons for accessing those sites. However, the process of socialization through these online social networks can encourage the development of computer skills.

Given the characteristics of these social networking platforms, using them can facilitate the development of certain competences that may be helpful professionally in a knowledge-based society. The results of this research demonstrate that the particular situation of online social networks (the structural features of the platform of online social networking, the nature of college students, the activities they perform in the platform, and the tools) enable the use and development of certain competences.

Participation in online social networks favors the development of skills in a relaxed atmosphere, with a largely playful approach which invites users to explore the many tools at their disposal. Online social networks are essentially spaces for moving data through multiple tools (Korzynski, 2013). These spaces of information transfer have the distinction that they concentrate a variety of tools in a single place, (Wattanasupachoke, 2011). These tools are often used separately: messaging tools, mailboxes, collaborative groups, forums, event management tools, calendars, contact directories, photograph management tools, video management tools, link management tools, Web pages and many more.

The combination of a playful environment and access to numerous tools for collaboration and interaction at different levels creates an ideal environment for students to explore, without pressure, many of the tools available. This stimulates college students to engage in activities that are usually perceived as boring or complicated. For example, many of the LMS (Learning Management Systems) used in universities as well as collaborative tools used in the workplace, have similar tools to those offered on online social networks.

However, it is important to note that not all college students use the same amount of tools while they are connected online. Thus, the development of skills does not occur to the same extent. In fact, it is important to point out that we are not saying that the use of online social networks will always have a positive impact on the development of skills. Like all tools, the outcome depends on how it is utilized.

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IMPLEMENTATION OF ARTIFICIAL INTELLIGENCE ASSESSMENT IN ENGINEERING LABORATORY EDUCATION

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ABSTRACT

In laboratory courses, the assessment of exercises and assignments typically is treated as a simple, quantifiable approach. This approach however rarely includes qualitative factors, especially if the grading is being automatically performed by the system, and provides little to no feedback for the students to reflect on their work. The role of the laboratory in engineering education however is very critical and engineering students must possess knowledge that goes beyond mere theory, therefore a diverse and multidimensional assessment of laboratory students is a necessity. In this paper, an educational tool for laboratory students implementing automatic assessment based on artificial intelligence is being proposed, based on a pilot version that has been developed for MATLAB-related coursework. The highlights of the proposed tool is that it is based on a proven cognitive theory, it is easy to compile and or modify its contents, it is based on the same laboratory environment that the students are being trained in, it can include qualitative evaluation and it can save time that the educators would otherwise require to manually evaluate the exercises.

KEYWORDS

Text adaptation; interactive learning environment; student profiling; computer-assisted education; laboratory education.

1. INTRODUCTION

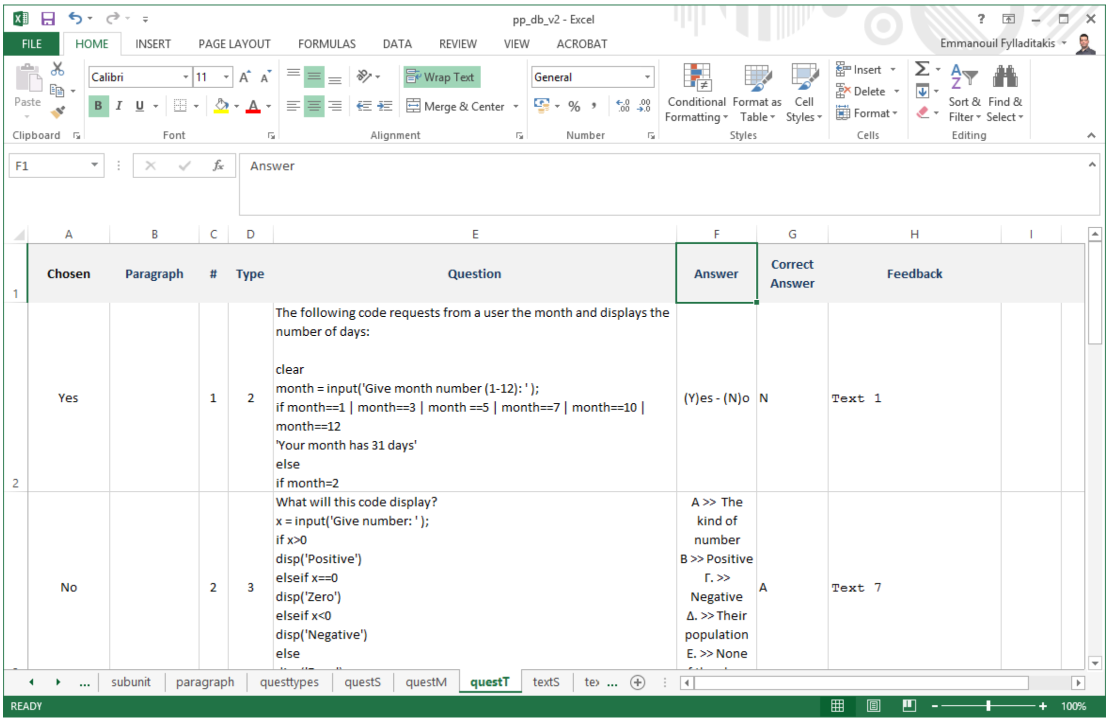
In laboratory courses, the assessment of exercises and assignments typically is treated as a simple, quantifiable approach. The student turns in an assignment and or exercise and the educator or system is expected to grade it. This approach however rarely includes qualitative factors, especially if the grading is being automatically performed by the system, and provides little to no feedback for the students to reflect on their work. This is especially true if the assessment is based on simple questions that have only one correct answer (Bush 1999), or if the assessment is only based on the end result, neglecting the efficiency of the solution (Carter et al. 2003). The role of the laboratory in engineering education however is very critical and engineering students must possess knowledge that goes beyond mere theory (Feisel and Rosa 2005), therefore a diverse and multidimensional assessment of laboratory students is a necessity.

Educators can examine and grade the exercises either manually or by using automated tools. Automated tools significantly reduce the effort required for such a task, especially when there are a significant number of students; however, they are usually limited to a quantitative evaluation and cannot provide specialized feedback to the students (Douce et al. 2005). Depending on the laboratory course, they also may operate outside the actual tool/software that the students are being educated on, in an educational environment alien to the students, frequently treating the examination the same way as that of a theoretical subject (Ihantola et al. 2010).

In this paper, we suggest the creation of an automatic laboratory course assessment tool that can provide personalized feedback to each student, allowing the students to discern their strength and weaknesses. The approach suggests that the tool should operate in the same environment that students have been using during their laboratory course. For this purpose, we chose to present an adapted MATLAB course, as it is the most widely used software in laboratory engineering education and covers a wide range of subjects (Harris et al. 2002, Schmid and Ali 2000, de Magistris 2005). The approach presented in this paper is based on the text comprehension theory of Denhière & Baudet (Denhière and Baudet 1992). This suggests that the texts and assessment questions of the tool should be adjusted into three different versions, R (Relational), M (Transformative) and T (Teleological). Details on the adaptation of material to meet the requirements of the applied comprehension theory can be found in (Samarakou et al. 2013b, Samarakou et al. 2013c).

2. DEVELOPMENT OF THE AUTOMATIC ASSESSMENT TOOL

The main objective of the content management system should be the easy, quick and user-friendly handling of both the educational resources and student data, in order to require little or no experience for anyone with basic computer skills to use it. As such, it is vital to simplify the system as much as possible by implementing widely known tools and resources. As MATLAB is a very flexible software, it is easy to develop an automated assessment tool that the students may use without having to result into another environment. The entire process can be introduced as a set of MATLAB ".m" files, programmed to initiate the assessment process once the student decides to access the software. The use of a spreadsheet file as a database for the educational material is also recommended; as MATLAB is capable of accessing spreadsheet files, it is very easy for the educator to provide the educational material via such a file, which may be very easily updated and or modified by virtually everyone with basic computer knowledge. Such a file can include everything that is required for the coverage of a specific topic, including the questions, technical texts and the data related to the performance of the students (Fig. 1). As such, it is easy for the educator to check the performance of each student and or automatically create a summary file with the performance of any number of students.



Chosen	Paragraph	#	Type	Question	Answer	Correct Answer	Feedback
Yes		1	2	The following code requests from a user the month and displays the number of days: clear month = input('Give month number (1-12): '); if month==1 | month==3 | month ==5 | month==7 | month==10 | month==12 'Your month has 31 days' else if month=2	(Y)es - (N)o	N	Text 1
No		2	3	What will this code display? x = input('Give number: '); if x>0 disp('Positive') elseif x==0 disp('Zero') elseif x<0 disp('Negative') else	A >> The kind of number B >> Positive Γ. >> Negative Δ. >> Their population E. >> None	A	Text 7

Figure 1. Example of a spreadsheet file used as a database for MATLAB

2.1 Specifications and Requirements

In order to develop an automatic MATLAB assessment tool based on the proposed cognitive theory, there are a number of requirements that need to be addressed. The requirements are both technical and educational and can be split into two groups, those intended for educators and those intended for students.

For educators, the requirements are:
1. The ability to create a virtually infinite number of new educational material
2. The ability to input/modify new educational material (texts, questions, etc.) into suitable fields, without restrictions on their number, as well as the number of characters and answers to each question.
3. The ability to designate the kind of text/question entered into the database, according to the cognitive theory.
4. The ability to create activities with appropriate connection to the inserted educational material.
5. The ability to create diagnostic tests for a single section with a selection, random or forced, from the pre-inserted questions
6. Protection of the database file, so that it will not be modified by unauthorized users.
7. The ability to share educational material between authorized authors/users.

For students, the requirements are:
1. The ability to register into the system (Name, Surname, ID Number)
2. User-friendly interface
3. The ability to choose any path after the diagnostic test, regardless of the received suggestion
4. The short and easy explanation of the differences between the different texts and activities offered by the system (R, M and T type in our particular example)
5. The ability to request additional assistance/feedback regarding a question and or text
6. The ability to see the results of the taken tests

2.2 The Student Environment

Once the educator has set up the appropriate files, they can be either inserted into the workstations of a laboratory before the examination or provided to the students via an online portal. If the educational process is taking place into a controllable environment, such as a laboratory, the system can be programmed to deliver and or combine the assessment results of each student to the computer of the educator through the laboratory's computer network. If the files are given through an online portal, the files with the results will have to be sent manually back to the educator and they should be followed by appropriate instructions. It is thus vital for the file containing the results to be protected against unauthorized access, to prevent tampering before it is sent back to the educator.

The MATLAB .m files should be programmed to be able to utilize a simple content database, which is a typical spreadsheet file in our example, and generate a file with the assessment results of each student. In order to do that, the program will ask the student of some basic identification data, such as the name, surname and student ID number. Based on the comprehension theory implemented for our example, there should first be a diagnostic test, assessing the prior knowledge of the student, followed by a recommendation to access further educational material. This educational material may be of either R, M or T type, depending on the cognitive profile of the student generated from the results of the first test (Samarakou et al. 2013c).

Once the diagnostic test is completed, the student is provided feedback on particular strengths and weaknesses. The software will automatically assess on which type of cognition the student is the least competent on (R, M or T) and will offer feedback to the student, alongside with the suggestion to supply additional educational resources. It is vital to allow the student to choose resources of any type, regarding the results of the text, or even skip the additional material entirely and proceed to the final test. After the student completes the final test, the system should generate a file with the student's answers, profile, results and other data of relevance that may be recorded during the test, such as the time taken to answer each question and the number of times the student requested additional assistance from the software. Such data may be used to add a qualitative portion into the evaluation process (Samarakou et al. 2013a). After the completion of the educational process, the student should be clearly informed of his/her progress by the system in detail, which includes his/her detailed performance on every (diagnostic, feedback, final) stage of the process.

The students should be using MATLAB during the entire process, working in the same environment that they were being taught during the course. The tool should provide questions and problems by automatically and possibly randomly extracting them from the content database file. These questions can range from typical "True - False" type to simple problems. It is also possible to add the ability for the student to request additional help during the process. In our example, this ability has been implemented, as it is a recommended part of the cognitive theory that the proposed system is based on, and the student can request additional help at any time by simply typing a command.

2.3 Evaluation Results

A preliminary evaluation of the proposed system took place in the Informatics laboratory of the Technological Educational Institute of Athens, during the course "Introduction to MATLAB". A group of 40 students has been asked to use a preliminary version of the tool and then provide feedback through a short questionnaire. The students are expected to take at least ten laboratory classes per course, accompanied by ten laboratory tests. The laboratory tests are normally given and assessed manually by the educators, but one test has been skipped and the students have been asked to use the proposed tool instead. The questionnaire and the results of the survey are displayed in Table 1.

Table 1. Survey Feedback

Question	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
The tool was straightforward and easy to use	80%	15%	5%	0%	0%
The instructions were clear and helpful	70%	12.5%	15%	2.5%	0%
The tool has helped to improve your comprehension on the subject	75%	15%	2.5%	5%	2.5%
The time required to complete the process was reasonable	40%	40%	15%	2.5%	2.5%
You believe that the automatic assessment via the tool was fair	50%	35%	20%	5%	0%
You would like the tool to replace all standard laboratory tests in the future	5%	40%	30%	20%	5%

As it can be seen from the results of the survey, the students reacted very positively and generally enjoyed using the proposed tool over their typical manual assessment. As the students were given the exact same time to complete the tests of the tool as their common manual tests, most found the tool faster and easier to use than the manual test, despite the fact that additional educational material was being given to them during the process, and they generally found the assessment process fair and transparent. When asked if they would like all of their manual tests to be replaced by the automatic assessment tool, the results were generally favorable but more diverse than those of the previous five questions; this indicates that a slower adoption process should take place, in order to both resolve any problems prior to completely automating the process and to quell the worries of the students.

3. CONCLUSION

In this paper, an automated evaluation tool for the laboratory training of engineering students has been proposed. The proposed tool has been based on the well-known text comprehension theory of Denhière & Baudet, forming a cognitive profile of the student via a diagnostic test and offering personalized feedback and assistance based on the results of this test. This helps to overcome the "one size fits all" approach, which is dominant in engineering education today. Similar tools can also be developed based on other comprehension theories as well.

The system proposed in this study has multiple advantages. From an educational point of view, the greatest advantage is that the student continues to use the same tool he has been receiving training on, without having to result into a classic "pen and paper" type of test or an alien eLearning environment. For educators, the advantages of the proposed approach are that it is simple and effective. By making use of typical computer files, such as spreadsheets, the modification and or addition of new educational resources is a simple and straightforward matter for anyone with basic computer skills. The time that it would require to develop such a tool should be less than the time required to manually assess the exercises of a single course.

Assessment via the proposed tool can be multidimensional, implementing both quantitative and qualitative factors. Depending on the cognitive model used, aside from the number of correct, wrong and unanswered questions, qualitative factors can also be implemented into the assessment. These can be the choice of the additional educational material, if the user skipped the additional material entirely and proceeded to the test, the time required to complete each question and the entire test, the number of times that the user requested assistance, etc.

The proposed tool can also be used for online and distance training, provided that the student will be instructed to return the file with the results to the educator or informed that the file will be automatically sent to the educator once the test has been completed. The only drawback of such an approach is that the computer of the user must have a licensed version of the software tool used for the educational process, as the system is based on the actual tool itself.

ACKNOWLEDGEMENT

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AN EXPLORATION OF THE ATTITUDE AND LEARNING EFFECTIVENESS OF BUSINESS COLLEGE STUDENTS TOWARDS GAME BASED LEARNING

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ABSTRACT

This study aimed to explore the attitude and learning effectiveness in game based simulations from college students' perspective. The participants included 189 business college students in Taiwan. The main instrument employed in this study was McDonald's video game. Additionally, participant selection, data collection and analysis; and results relevant to the research questions of this study are presented.

KEYWORDS

learning effectiveness; digital game, game based learning, attitude toward game based learning

1. INTRODUCTION

New generation students are so different from past learners and it seems they cannot live without computers technologies. Digital games have a considerable impact on students' life and learning. Games have been defined as an immersive, and enjoyable activity in which a challenging goal is pursued (Freitas & Oliver, 2006; Kinzie & Joseph, 2008). It is more attractive for students to learn the complex knowledge via digital simulation game for college students (Prensky, 2003; Bayliss, 2007;). Generally, games are designed more visual, interactive, and focused on problem-solving (Mitchel & Savill-Smith, 2004; Pasin, & Giroux, 2011). Games usually include clear objectives, and they provide tasks with multiple difficulty levels to adapt to the prior knowledge and skills of learners; therefore, games are considered an effectiveness educational tool (Gentile & Gentile, 2008). Moreover, many research have found that game based learning can enhance learning motivation and learning outcomes (Dickey, 2011; Sung & Hwang, 2013).

Thus, this study used college students as participants and aimed to explore what their learning effectiveness and attitudes are during the game based learning.

The following research questions were proposed in this study:

1. What are the college students' attitudes toward game-based learning?
2. What are the college students' learning performance regarding the subject content knowledge after game-based learning?

2. LITERATURE REVIEW

Game Based Learning (GBL) is a widespread application teaching or learning strategy in Education, especially for teachers to connect learning content and reality that make learners stay in a simulation world. In the beginning, the learning potential generated through games has been examined in university classrooms since the 1950s, particularly by business schools (Gros, 2007; Lichtenwalter & Baker, 2010). With the technology developed, the computer game was developed and applied for educational purposes from 1960s (Wolfe & Crookall, 1998). Nowaday, digital GBL courseware has been utilized as an instructional tool in cross disciplines ranging, such as international relations, engineering and biology to nursing and social work (Lichtenwalter & Baker, 2010). Research also indicated that the use of gems to teach educational content raises students' learning and motivation (Gee, 2005, Prensky, 2003; Sung & Hwang, 2013).

3. METHOD

3.1 Participants and Procedure

All experimental tasks and data collection were conducted via a computer system. One hundred and eighty-nine business major undergraduates (50 males and 139 females) participated in this study. The participants' mean age was 18.9 years. All participants filled out an informed consent form before the experiment.

Tests and questionnaire were conducted with regard to the learning effectiveness and attitude toward game based learning. This study conducted pre-experimental design to process one-group pre-test and post-test design. Before the participants played the McDonald's video game, the pre-test was given in the class. The participants were request to playing the played the McDonald's video game at least half hour per day. After a week, the post-test and questionnaire were given to participants in the class.

3.2 Instrument

3.2.1 The Framework and the Characteristics of the Simulation Game

The main instrument employed in this study was the McDonald's Video Game. In this study, the Mcdonald's was developed by the Italian company La Molleindustria, a free download of Flash games (website: http://www.mcvideogame.com/downloads-eng.html). The researchers also translated the English version of tutorial guidance in Traditional Chinese version for participants. There are four scenarios in McDonald's game, including natural breeding farm, artificial breeding farm, McDonald's store, and Head office (Fig. 1-4).

Figure 1. McDonald's Store

Figure 2. Artificial Breeding Farm

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Figure 3. Natural Breeding Farm

Figure 4. Head Office

3.2.2 Learning Content Test

In order to know the learning effectiveness of college students' content knowledge of business and management subject, the researchers gave two set of multiple choices tests, developed by 2 subject experts, for participants. Two set of 30-item multiple choice tests were considered the same difficulty and gave college students for their pre-test and post-test. The total score of each set test is 30- points.

3.2.3 Game based Learning Attitude Questionnaire

One of the goals of this study is to explore the college students' perception about simulation game based learning. To achieve this goal, this study examined how the students perceived the learning experience with the simulation games in the course.

The researchers developed the questionnaire of game based learning attitude to measure the responses of participants following completion of the simulation game. This questionnaire comprised a total of 12 questions. Questions were ranked on a scale of 1 to 5 with 1 representing "strongly disagree" and 5 representing "strongly agree".

4. RESULTS

4.1 Result Analysis for Learning Content Test

After the experiment, the t-test result ($t(188) = 35.827$, $p<.01$) showed the significant difference between the pre and post tests (Table 1). The mean score of the pre-test was 6.429 and the mean score of the post-test was 18.452. Hence, business college students gain better scores regarding the subject content knowledge of business and administration after game based learning.

Table 1. T Test of learning content tests

	n	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
pre-test	162	6.429	2.643	.179	35.827	161	.000**
post-test	162	18.452	4.364	.296			

**p<.01

4.2 Result Analysis for the Questionnaire toward Game Based Learning Attitude

The questionnaire was meant to determine how the subjects felt about game based learning. For the 12 question items, the average score was 4.18 (SD=0.77), as shown in Table 2. Overall, the participants has positive attitude toward game based learning.

Table 2. Mean score of the questionnaire toward game based learning attitude

Item	Mean	SD
Q1 The Chinese instruction provided makes it easy to use the “game-based simulated learning materials.”	4.29	.94
Q2 This “game-based simulated learning materials” is easy to use.	4.00	.71
Q3 Overall, I’m satisfied with the interface design of this “game-based simulated learning materials.”	4.06	.66
Q4 This “game-based simulated learning materials” could help me learn the knowledge of productivity management in business administration.	4.13	.72
Q5 This “game-based simulated learning materials” could help me learn the knowledge of human resource management in business administration.	3.91	.87
Q6 This “game-based simulated learning materials” could help me learn the knowledge of marketing management in business administration.	4.21	.69
Q7This “game-based simulated learning materials” could help me apply what I learned.	4.06	1.03
Q8 This “game-based simulated learning materials” could extend my knowledge about business administration.	4.35	.93
Q9 Overall, I’m satisfied with the way of learning through this “game-based simulated learning materials.”	4.53	.72
Q10 I will be more motivated on learning with game-based simulated learning materials.	4.30	.68
Q11 It will be more interesting than lectures only in class if instructors apply game-based simulated learning materials on their teaching.	4.20	.58
Q12 I hope that instructors could utilize game-based pedagogy to assist general instruction in the future.	4.10	.70
Total mean	4.18	.77

5. CONCLUSION

Overall, Business college students felt positive toward the McDonald’s video game based learning material. Business college students will be more motivated through game based learning from their perspectives in this study. Based on the research results, the business students also have better performance on learning content

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after game-based learning. These results can tell us two things: a) as other studies claimed that GBL can promote students' learning performance (Blunt, 2006; Gros, 2007; Lichtenwalter & Baker, 2010); b) GBL can help students link learning content and authentic world. In the future, the researchers might explore how student's learning motivation effects their performance through game based learning.

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APPLICATION OF E-LEARNING TECHNOLOGIES TO STUDY A SCHOOL SUBJECT

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ABSTRACT

This paper reports on the introduction and use of e-learning technologies to help students study a school subject. The research intervention is located within a relatively resourced school in South Africa with students largely coming from one racial group. The choice of the school enabled the researchers to focus on investigating the effects of computer-based study methods on students skills of studying and their perceived learning experience without the necessity of controlling a lot of variables such as socio-economic status, language competence, and so on which have been shown by previous research in South Africa as impacting heavily on teaching and learning and student performance.
This paper describes how technology is used in similar schools as the sample school under investigation, how pedagogy has changed practices in the school and how study methods are used. Based on the results of the literature review an intervention of introducing free open source software to investigate study practices of school learners was introduced. The results of the intervention are reported.

KEYWORDS

Study methods, mind mapping, learning experience, constructivism, school learners, computers.

1. INTRODUCTION

Student performance remains one single problem in the South African school system. Up to half the number of students who enter primary school do not sit for the final school examination that provides certification. Of these students who sit for the national examination only a small proportion qualify to continue their studies in higher education institutions. According to the South African National Development Plan, "… we have not yet overcome the inequities in educational provision created during the apartheid era. An enormous difference in capacity and resources exists in different areas of the country and sectors of society … we have undergone serial curriculum changes at school level, which, while well-intended, have destabilized the pre-tertiary education system and placed great strain on teachers. Pressure placed on schools and education departments to meet quantitative performance targets is increasingly resulting in teachers spending a large proportion of their time drilling learners on how to pass examinations instead of developing learners' intellectual capacity" (CHE, 2014).

In order to enable school students to achieve other educational outcomes (e.g., critical thinking, problem solving and application of knowledge) emphasis should be placed on learning as opposed to mere drilling for examinations. Learners need the skills to know how to study a particular field of work and as such exposure to a variety of study methods is instructive. This paper describes the intervention made with a group of students to improve their study methods through introducing e-learning technologies. First, however, is the description of the theoretical framework guiding the intervention.

The theoretical framework informing the investigation is based on the literature of cognitive science and on the literature of the development and application of technology. The theoretical framework thus encompasses a focus on cognition and learning, study skills, and e-learning.

2. LITERATURE REVIEW

In order to improve the educational outcomes of students at school, we considered the espoused benefits of e-learning in improving the study habits of school students. E-learning is content and instructional methods delivered on a computer (whether on CDROM, the Internet, or an intranet), and designed to build knowledge and skills related to individual or organizational goals (Clark, 2002). The American Society of Training and Development defines E-Learning as a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. Mallinson provides an expanded definition of e-learning as including the use of all digital resources, systems, computers, and electronic communication in the support of education (Mallinson, 2013). This study therefore explored the use of a software product in changing the study habits of a group of school students.

The software product used in the investigation had to support how students learn and mediate this process. We thus considered learning theory to inform the introduction of e-learning technologies for use by school learners for study purposes. Learners need to process the information they receive during the teaching encounter and make sense of it. To do this learners make use of cognition. Matlin (2005) describes cognition as a mental activity which includes the acquisition, storage, transformation and use of knowledge. Cognition can also be described as the mental processes of knowing which will include aspects such as awareness, perception, learning, memory, thinking, reasoning and judgment (Train, et al., 2007). These cognitive processes are at play when a learner studies a school subject. The pedagogic strategy we employed was to help learners think about the cognitive processes and strategies they use when studying. Employing such metacognitive strategies to the learning process has been found to enhance learning (Foster, Sawicki, Schaeffer and Zelinski, 2002; Matlin, 2005; Jaeger, 2007). Foster et. al. (2002) distinguishes between metacognitive and non-metacognitive learners. The main difference between these two types of learners is that metacognitive learners are aware of how they learn best and that they evaluate and regulate each learning experience. Non-metacognitive learners use monotonous learning skills.

Metacognitive learners use a variety of activities (e.g., cognitive maps) to evaluate their learning. The pedagogical strategy used in this investigation was to teach learners about using cognitive maps (mind maps) as a study method and to use e-learning technologies to support this process. According to Merritt (2008) teaching study skills to a learner is an essential part of the education process. Effective study skills are an outstanding characteristic of all high achieving students. Using effective study skills enable learners to adapt to various teaching methods and instructional approaches and thus enhance student performance.

Learners develop their own study strategies during schooling. Teachers need however to support learners and help them to learn independently. Exposure to various methods of studying therefore provides a learner with a repertoire of methods to use in alignment with their study preferences. The group of students used in the investigation were provided with the variants of the SQ3R study methods but specifically taught to use mind mapping. Mind mapping facilitates active and collaborative learning, enables the learner to make use of their full range of cortical skills, and facilitates the conceptualization of richer and broader associations that enhance learning (Budd, 2004; Smith, 2008).

3. RESEARCH METHODOLOGY

The participants in this research study were learners in Grade 11 in the secondary school where the first author teach. All the learners that are participating have Business Studies as one of their choice subjects. A total of 93 Grade 11 learners (52 females and 41 males) took part in the research. Learners who took part in the investigation are predominantly from one racial group (table 1). Consent from both the principal of the school and the parents of the learners were sought before requesting learners to participate in the investigation.

Table 1. Composition of participants in the investigation.

Grade	White	Black	Coloured	Total
11	239	1	4	**244**

All learners in table 1 were taught how to use study methods and mind mapping whilst they were in grade 10. This cohort of students was randomly divided into an experimental and control groups. The experimental group was taught after school hours to use a free mind map software package (FreeMind) for a duration of ??. To espouse collaborative learning and metacognition, learners were provided with tasks of working in groups and to reflect about the methods and tools they use for studying.

The research design involved administering a pre- and post-test instrument on both experimental and control groups. The post-test was administered after introducing the use of e-learning technologies on the experimental group. Both pre- and post-tests made use of the Learning and Study Strategies Inventory – High School Version (LASSI-HS) (Weinstein & Palmer, 1990). The LASSI-HS is a 76-item self-report instrument constituted by 10 subscales (see table 2). The LASSI-HS has appropriate validity and reliability for use to determine the study methods of school learners (Tinsley, 2000; Everson, Weinstein & Laitusis, 2000). The data of the pre- and post-tests were analysed to provide an indication of whether the use of e-learning technologies had an impact on the study skills of the learners or not.

Table 2. Subscales of the LASSI-HS scale

Nr.	Subscale	Description
1	Attitude	Attitude measures the learners’ attitude and interest in education and school.
2	Motivation	Students’ diligence, self-discipline and willingness to work hard is measured with this subscale
3	Time Management	This scale examines the students’ use of time and management principles.
4	Anxiety	Anxiety address the degree to which students worry about school and their performances.
5	Concentration	Concentration is the ability of a student to pay close attention to academic tasks.
6	Information Processing	This scale measures several aspects such as the use of mental imagery, verbal elaboration, comprehension, monitoring and reasoning.
7	Selecting main Ideas	The ability of the student to pick out important information for further study.
8	Study Aids	This is the scale that examines the degree to which students create or use support techniques or materials to help them learn and remember new information.
9	Self-testing	Self testing is the scale that measures the students’ ability to review and prepare for classes.
10	Test-strategies	This scale focuses on students’ approaches to preparing for and taking quizzes and tests.

4. RESULTS OF STUDY

Tables 3 and 4 provides the results of the pre- and post-tests for the experimental and control groups.

Table 3. post-test LASSI-HS: experimental group.

	ATT	MOT	TMT	ANX	CON	INP	SMI	STA	SFT	TST
Before the intervention										
Mean	31.0	27.6	20.6	22.4	24.6	26.4	16.2	23.7	23.6	25.1
Mode	32	34	24	25	29	27	15	22	22	29
Median	32	27	21	23	26	27	15	24	22	26
After the intervention										
Mean	31.4	28.0	23.3	20.1	25.5	28.2	18.9	25.9	23.8	25.2
Mode	28	34	22	20	29	29	18	28	22	29
Median	32	27	25	20	26	28	18	26	22	26

Table 4. post-test LASSI-HS: control group.

	ATT	MOT	TMT	ANX	CON	INP	SMI	STA	SFT	TST
Before the intervention										
Mean	30.4	27.1	21.4	23.6	23.4	27.8	16.7	24.1	24.6	24.4
Mode	35	18	16	18	27	30	17	24	24	20
Median	32	27.5	21	22.5	25	28.5	17	24	24	25
After the intervention										
Mean	28.6	26.7	20.9	23.4	23.1	27.4	16.7	23.6	24.1	24.1
Mode	35	18	16	30	33	22	17	24	23	30
Median	30	26.5	21	22.5	25	28	17	24	24	25

Both these tables provide a better indication of the differences in the scores of the individual scales before and after the intervention. The central measures of tendency can be used to determine certain aspects regarding the experimental group. Before the intervention took place, the learners in the experimental group had a mean score of 26.4 regarding the information procession scale. After the intervention the mean score for the same scale was 28.24. The selection of main ideas scale of the LASSI-HS also increased from 16.28 to 18.88. The score on the use of study aids, such as computers, also increased from 23.72 to 25.88. Using the data from the control group, the mean from the information processing scale decreased from 27.8 to 27.4. The scale for the selection of main ideas indicated that the score also decreased from 17 to 16.4. Finally the scores for the use of study aids scale decreased from 24 to 23.6. Based on these results, it shows that there are slight increases regarding the central tendency measurements for the experimental group. The central tendency measurements regarding the control did not show any increases between the pre- and post-tests.

5. CONCLUSION

Analysis of the results of the control group indicates no increases in measures of the ten subscales of the LASSI-HS. On the other hand, all the measures within the experimental group, except anxiety, show slight increases. These increases could be attributed to the intervention introduced in this investigation.

The use of structured approaches to inculcate improved study habits amongst school learners is therefore supported by the results of this study.

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POSSIBILITIES OF IMPLEMENTATION OF SMALL BUSINESS CHECK - UP METHODOLOGY IN COMPARATIVE ANALYSIS OF SECONDARY SCHOOLS AND UNIVERSITIES IN SLOVAKIA

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ABSTRACT

The paper is aimed to evaluate the possibility of applying new methods and tools of more effective educational processes, with an emphasis on increasing their quality especially aimed on educational processes at secondary schools and universities. There are some contributions from practice for the effective implementation of time management, such as reducing unnecessary delays, in order to increase the efficiency of education from the perspective of the provider of educational services – secondary schools and universities, as well as from the state as evaluating authority (accessibility of educational services, costs savings, time, etc.). The Small business check - up methodology can be the right and cheaper way for completing or replacement of actual monitoring system provided once per year in paper form and only in selected groups. The basic idea of this approach is to establish an appropriate system for exchange of information between individual schools and also among the state schools and institutions. The paper also deals with differentiation between quality level of schools across individual regions in Slovakia.

KEYWORDS

Educational process, e-learning, small business check - up, evaluation

1. INTRODUCTION

The importance of information and communication technologies is associated with various aspects of life of modern society. Their application can be found in almost every segment of the work. The secondary education is not an exceptional segment, in which there is increasingly growing importance of e-learning support for education. There is an increasing demand for improvement of educational process at secondary schools and universities, as well as the ever increasing demands of external companies for graduates who master the latest technology require continuous innovation in the educational sphere and they need to be sure that every school with similar branch of study has the same level in quality of education.

From this reason the former approaches are not appropriate anymore because losing any chance for flexibility moreover the evaluation period is too long what causes delays in counter measure actions which have to be implemented as soon as possible. The most possible and reachable changes in these systems can be founded in base of some methodologies running at information technologies such as the method for development support in small companies “Small business check - up”.

2. SMALL BUSINESS CHECK - UP TOOL METHODOLOGY

Diagnostic tool for enterprise "Small business check-up" was developed by the Council for leadership and management development in British Columbia, in abbreviation LMDCBC ("The Leadership and Management Development Council of British Columbia"). LMDCBC saw in the tool "Small business check - up" (further SBCH) a crucial initiative to improve leadership and management capacity of small and medium-sized enterprises because the tool has increased awareness of the possibilities of innovation in society and the present investment costs that are spent on these innovations.

SBCH by its structure belongs to the so-called Business diagnostic tools (questionnaires or checklists) that provide a framework to help business managers and consultants in reviewing the activities of the company and identify potential areas of improvement. There were developed plenty of diagnostic tools over the years. These tools are mostly aimed at larger companies and associated with the sale of specific services such as consulting services or products, such as accounting programmes.

Therefore, the main aim in developing SBCH was to go beyond that what is currently available and create a new diagnostic tool with the following particulars:

- to be available on Internet with no additional cost for the user,
- to be aimed primarily at small and medium-sized enterprises,
- to be action-oriented, and not only to determine the current state of society, but also to establish a clear plan as currently identified condition innovate to improve the functioning of the enterprise.

As it was mentioned above the SBCH tool is fully available on free version through a web browser. Under the program the user is advised to answer firstly on many questions about the focus, background, objectives, strengths and weaknesses and management practices in the company, as well as the skills of the managers and the employees. Subsequently the tool allows user to compare his answers with other companies (of course in an anonymous way). It also provides a framework for reviewing company operations and identify opportunities for improvements. Once the user selects a number of priorities for improvement, SBCH will help to prepare a strategy and action plan for their implementation. Illustration of instrument SBCH web environment is shown in the following Figure1.

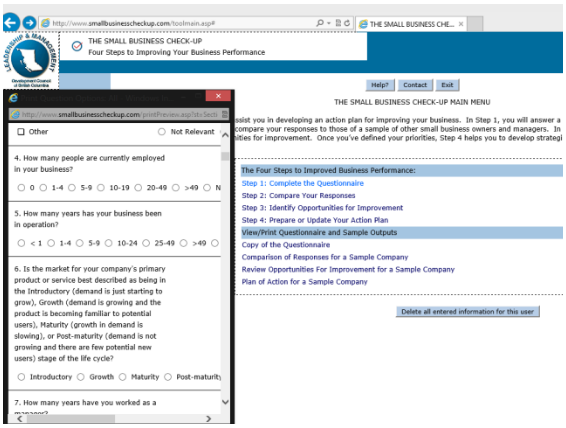

Figure 1. Web environment of „Small business check-up“ tool (Source: www.smallbusinesscheckup.com)

The instrument was designed to serve as a guide for improving management capabilities and efficiency of operational processes. Therefore it works only as a supplement in the strategy management and it should not be regarded as a substitute for commercial diagnostic tools such as accounting programs mentioned.

3. CURRENT METHODOLOGY FOR COMPARISON OF SCHOOLS

Regarding the evaluation of secondary schools in Slovakia it is currently carried out in the form of testing the knowledge level of students in the schools concerning basic subjects such as: Slovak language and literature, mathematics and foreign languages. Based on the results from individual subjects there were subsequently evaluated the average success rates for all schools and then in a county. In previous years, testing has shown that there are considerable differences in the educational level of individual students of secondary schools, as well as in 8 self-governing regions in Slovakia.

There are more than 720 secondary schools present in Slovakia with average grades ranged from 8.1 to 6, the disparities occurred in the level of secondary education according to various region. In the following figure 2 (MAT-mathematic, SL-English language) we can see that the biggest difference in the level of knowledge is in mathematics. This fact is a negative indicator from the point of view of

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further educational process mainly because of differences in knowledge level and preparedness of secondary school students in continuing their studies at university.

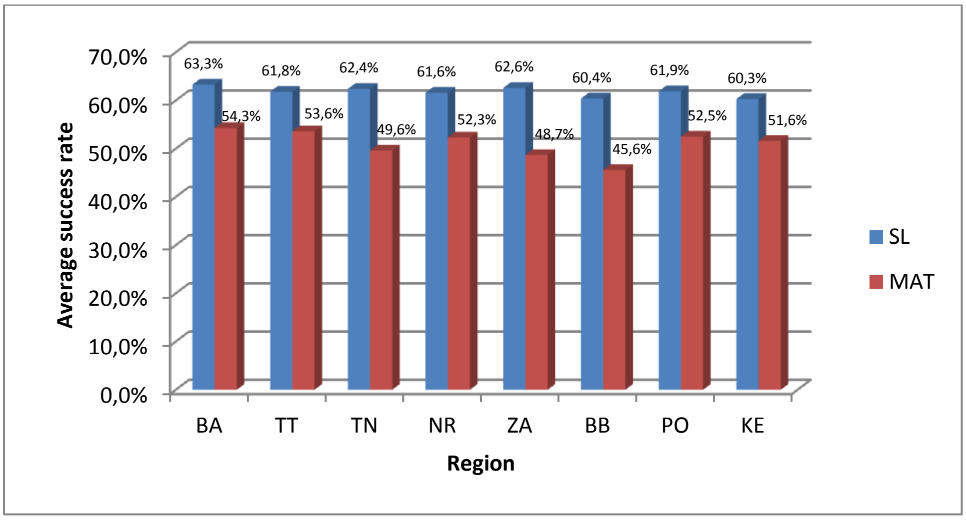

Figure 2. Average success rate in knowledge of Slovak language and mathematic on secondary schools by region(Source:http://www.nucem.sk/documents//25/maturita_2013/vysledky_analyzy/Pr%C3%ADloha_k_Spr%C3%A1ve_o_priebehu_a_v%C3%BDsledkoch_EC_a_PFIC_MS_2013_final.pdf)

Higher difference in the level of knowledge occurred when we compared schools according to their study program (figure 3) where we can see deeper knowledge gap between the level of mathematics knowledge as well as Slovak language and provider (figure 4), where we can see between students of different types of schools. This trend is caused to some extent due to the quality of educational staff (teachers and teaching aids), which the types of schools have in diposal.

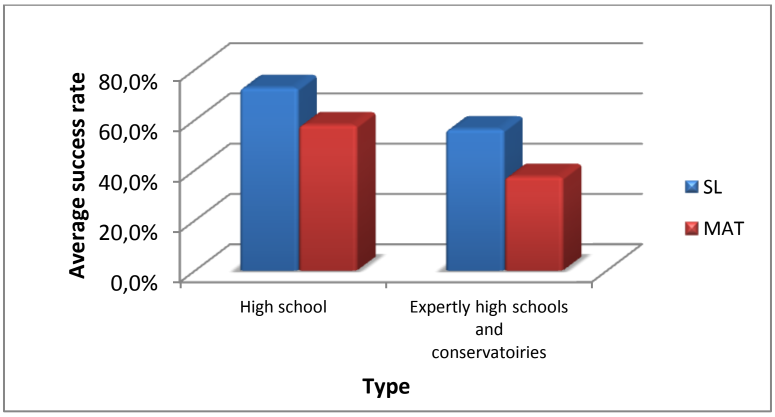

Figure 3. Average success rate in knowledge of Slovak language and mathematic on secondary schools by type(Source:http://www.nucem.sk/documents//25/maturita_2013/vysledky_analyzy/Pr%C3%ADloha_k_Spr%C3%A1ve_o_priebehu_a_v%C3%BDsledkoch_EC_a_PFIC_MS_2013_final.pdf)

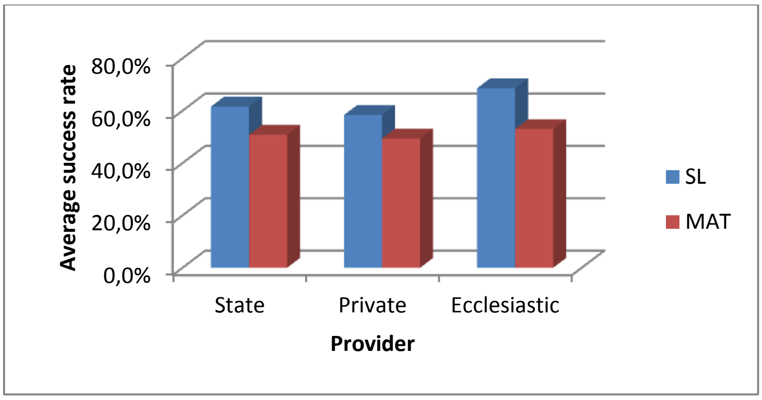

Figure 4. Average success rate in knowledge of Slovak language and mathematic on secondary schools by provider (Source:http://www.nucem.sk/documents//25/maturita_2013/vysledky_analyzy/Pr%C3%ADloha_k_Spr%C3%A1ve_o_priebehu_a_v%C3%BDsledkoch_EC_a_PFIC_MS_2013_final.pdf)

The basic principle of assessment does not change over the years - publicly available quantitative data are divided into five groups: 1) education (number of students, teachers, quality of teaching staff); 2 attractiveness of study (interest in the study, the proportion of foreign students, mobility, unemployment); 3) research (numbers of publications and citations, average citations); 4) PhD (proportion of graduates share of the student population, the scientific performance ratio of the number of PhD students); and 5) the grant percentage (domestic grants, international grants, the total income from grants for creative worker).

As we can see according to these criteria, many similar study branches at universities it do not reflect the level of knowledge that students should achieve in these fields of study. Evaluate mainly the number of students, teachers and the level of scientific activity or ability of graduates to get job after study. Therefore, for this reason it would be appropriate at least on some types of schools to establish informative comparison of the level of students' knowledge for example in the same fields as economics, management, mathematics, etc.

4. HOW CAN SMALL BUSINESS CHECK- UP SUPPORT EVALUATING SYSTEM

As it was mentioned above in major systems and methodologies for comparing in secondary schools and universities are not very time and cost-saving. They can be carried out only once a year and evaluation criteria are mainly in universities focused on performance and not on knowledge and skills of students and teachers. Implementation should be carried out as a main directive from ministry and basic tool built on SBCH methodology should be available on-line by web page based on web form application.

Secondary schools - with using the SBCH methodology thus developing an online form with the output to. NET graphical presentation of the results could be easily and quickly controlled the current level of preparedness of students at individual secondary schools. It would also be possible to carry out testing several times a year for example at the beginning of the individual grades, the bi-annual evaluation and year-end reviews. This form of continuous assessment could provide schools and government institutions timely with information about the progress of students in the tested subjects. Secondary schools would also receive a tool for continuous evaluation of their performance compared to other schools in the state and thus would have the opportunity to take corrective action even during the course before final assessment.

University – the modified SBCH instrument would be more effective as an additional evaluation tool in universities. On the one hand it could be used as a classic online tool to assess the knowledge level of students in similar branches of study and related theory. By these means the theoretical base could be effectively evaluated for individual universities. On the other hand the instrument could be used for testing the practical knowledge level of students in solving practical examples from business practice through case studies (in form of test questions). Also such testing would be possible to evaluate not only students but also teachers of universities and their ability to provide students with relevant information necessary for practice. With this could be better described a point from universities ranking regarding graduate unemployment (why they are unemployed). Universities could reach by such testing a continuous image of balance between theoretical knowledge and practical training in the followed subjects. For university to be on the bottom of the list the annual evaluation could be test resource of the data in areas in which they could improve continuously during the year.

Pedagogical perspective - SBCH methodology could help predominantly to teaching staff in schools. Because its original purpose was to measure, benchmark and improve the skills of strategic management, this procedure can be applied also to improving the skills of the teaching staff. Staff of universities don't need to have examinations of pedagogical minimum and thus their teaching methodology resulting from their own approach and personality. By succession of well-chosen comparative test questions they could find potential week points in their teaching practices and thereby improve their skills and could better interpret knowledge to students.

5. CONCLUSION

The effort of many developing countries mainly in the European Union is focused on the development of the school systems. The number one priority is to prepare graduates for their immediate application in practice after graduation. Graduates taking up practice often encounter problems due to lack of preparedness for the position in the company even if their field of study was aimed the position they were applying for. Due to varying degrees of preparation from different schools with the same fields many requests from candidates are filtered according company´s experience with concrete school. It can thus be said that an equivalent degree in the same field does not necessarily guarantee equal chances in the labour market. Of course it is a relatively wide area where this issue is concerned but in its successive solving can also help testing methodology and continuous deeper comparison of results and teaching methods which we have presented in the paper. The SBCH methodology has been successfully implemented as a cheap and fast support for improving the skills of strategic management in smaller companies. If we take these small businesses as individual schools where appropriate departments and subjects taught to them and teachers as responsible managers we reach clear picture of options that this methodology could contribute to improve the level of secondary schools and universities not only in developing but also developed countries.

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DIGGING THE VIRTUAL PAST

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ABSTRACT

In this paper we will investigate the way that the technological progress and the Informatics contributed greatly to the field of Archaeology. There will be analyzed the terms of virtual archaeology and virtual reality in archaeology and there will be an extended reference to the applications and the computer graphics that archaeologists could use for their own scientific purposes. It will be attempted to be shown the way that computer graphics can create not only an authentic copy of an archaeological find but can function also as a useful tool of learning for new archaeologists and the broader public that is interested in the ancient past.

KEYWORDS

Technology VR, virtual archaeology, simulation, virtual environment, learning outcomes

1. INTRODUCTION

In the field of culture the new technologies offered new potentials of management and presentation of the cultural heritage and redefined the role of the cultural organisms and institutions that deal with the documentation, the preservation and the promotion of the cultural asset. The archaeologists used the new technology, the computer graphics, in order to visualize the archaeological data in a way, easy to understand, not only for themselves but also for the public that was interested in the archaeological finds. The "virtual reality in archaeology" or the "virtual archaeology" as it was named, could open new ways in the scientific community concerning the research and the presentation of the ancient remains. It created various applications of simulation, depiction and representation not only of the excavated finds but also of the modus vivendi of the ancient civilizations. The images that were created for the reproduction of the ancient past or the monuments, constituted a subject of skepticism concerning the authenticity of the archaeological information included in these images. The effort to represent the ancient past with the new technology poses new, controversial problems over the documentation and the credibility, arising new issues and speculations (Molyneux, 1997:1). This paper presents the created virtual environments based in archaeological data that can constitute a new, contemporary and potential learning environment developed for future professionals in archaeology. The new virtual environment can be used also for learners of all ages as a new method of informal education in cultural organizations and spaces such as in the museum.

2. THE 3D REPRESENTATION

The 3D graphics consist one of the major achievements in the field of Informatics. In order to be created the contents of a "scene" or for the synthesis of a three- dimensional representation, there are followed methods of calculations that derive from the exact sciences like mathematics and geometry for the rendering of the texture (texturing), the illumination of a 3D scene or in the case of motion (animation). From their presence and then, the 3D graphics have seen a rapid development, even in an artwork's display (Polymeropoulou, 2010). With the new technology, many sciences wanted to use the 3D graphics in order to visualize objects, ideas or situations that so far it was impossible to be represented. This technical and hypothetical element that forms the imitation of the real created the meaning of "virtual".

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2.1 What is Virtual or "Qu'est que le virtuel"?

The new trend of visualizing elements, data or ideas had a broad effect answering not only recreational purposes but as well as scientific and educational. The exact meaning of the word "virtual/ virtuel" is defined as the potential, something that can exist but at the same time is not real. The word derives from the Latin virtuelis>virtus which means power, force. The philosopher Gilles Deleuze uses the word "virtual" so to describe something that every object carries with it that is not its reality, nor only that it could be but rather what it is supposed to be. The "virtual" is used to indicate a possible situation that it could be substantial (Deleuze, 1968). According to the French philosopher, the virtual reality is understood as the possible reality with two reverse meanings of the real. Since, from one hand the VR consists of a simulation of the natural environment, on the other hand whoever simulation from her nature simulates a real object or fact, the experience of a possible reality that depends on the visual effects of the computer, creates a environment with double character. And here is the oxymoron: The environment of virtual reality is real meaning it exists and is operative, but on the other hand is not real since it is a simulation of the reality (Levy, 1999:26). Due to the fact that the word "virtual reality" and "virtual" puzzled many philosophers and researchers, many prefer other terms for the rendering of the word. So they rather talk about "compound experience" (Sánchez et al., 2001; Beroggi et al., 1995; Loomis,1993) or "compound environment" (Durlach & Mavor,1995; Jayaramb et al.,1997), "simulation technology" (Psotka,1995), "artificial reality" (Biocca & Levy,1995) or just "cyberspace" (Hayles,2001). Nevertheless, the word "virtual reality" has been prevailed almost generally.

2.1.1 The Virtual Archaeological Environment

The introduction of the computer in the documentation, the depiction and the presentation of the archaeological data changed the archaeologists' way of thinking, arising new urgent questions about the methodology of the research, the knowledge and the spread of the culture. The technological achievements, depending on the needs and the archaeological theories that come up in every time period, come to cover the needs of the archaeological and excavation survey and methodology. We observe the gradual transition from the simple observation through comparison and the data analysis to the visualization and the reconstruction or/and the simulation of the ancient pasts, by using the continuously evolving programming languages and the artificial intelligence. The 3D graphics were used especially for the simulation of a virtual archaeological dig. Since Archeology is a scientific field that is based on excavation and the field survey, the majority of the applications are focused on simulating the archaeological dig with realistic problems that an archaeologist may have to deal with (Fig.1). A virtual dig consist of an excellent instructive tool for the new, future archaeologists since the excavation is a destructive method (Polymeropoulou, 2014:45) without allowing for a margin of erroneous decisions and movements. The new archaeologist is placed virtually in the environment of the excavation and deals with challenges such as how to interpret the elements of the ancient human behavior that the soil reveals during the dig (Slator and Associates, 2006:71). For the best possible simulation of the virtual dig, the user – excavator should be in a virtual excavation field where the data are based on real excavation scenarios. Moreover, the faithful depiction of a dig offers multiple searching potentials to the archaeologist himself for the detailed analysis of the archaeological particulars.

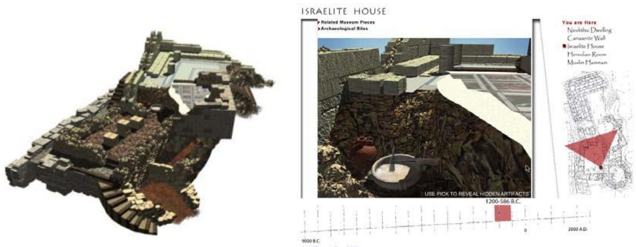

Figure1. Simulation of an archaeological dig (Dunn, 2002:122 – 23)

The technology VR permits the archaeologists to use a relevantly economical equipment so to accelerate the excavations and to preserve more analytical, accurate and accessible geometrical data of the archaeological finds and the location where there were found (Leymarie et al., 2000:3). In a virtual environment all the elements are comparative, dynamic and interrelated (Forte & Pescarin, 2006:4). The archaeologist in a virtual learning environment is able to have access in virtual copies (models) that bear the same information as the authentic and can study/ process data with no restraints or without the fear of destructing an ancient object. Even more, he is given the opportunity with the virtual environment to return in it long time after and to re-examine his data, making new interpretations and assessments in order to strengthen or to refute his theories. As a result, the creation of realistic 3D models synthesizing a virtual environment, according to the data recorded in situ during the dig, is of major educational importance. In this virtual environment, the new archaeologist learns how to excavate, to study, to interpret and finally to understand the ancient past by optimizing his methods and techniques in the excavation field. Besides, the real dig is a non reversible procedure and every datum is of crucial importance so to fulfill the image of the distant past.

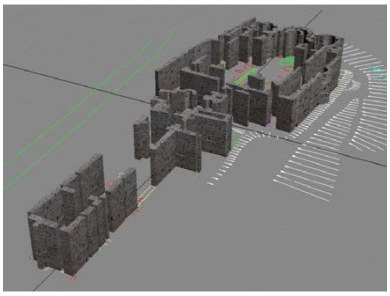

Figure 2. The case of virtual representation of the monument according to real archaeological data. The Laconia Acropolis Virtual Archaeology project (LAVA) (Getchell et al., 2006:6)

The archaeologists used the 3D graphics so to represent the ancient monuments (Fig.2). More specifically, they attempted, through the control of different hypothesis and conjectures, to experiment with the texture, the illumination, the location of observation or the form of the model (Godin, 2002). During the representation of the ancient monument the 3D graphics can depict the different phases of life of the monument and the procedure of its discovery. The scientists have been aided substantially in the field of conservation and restoration of finds, movable and non movable (Velios & Cummings, 2001:10) (Fig. 3).

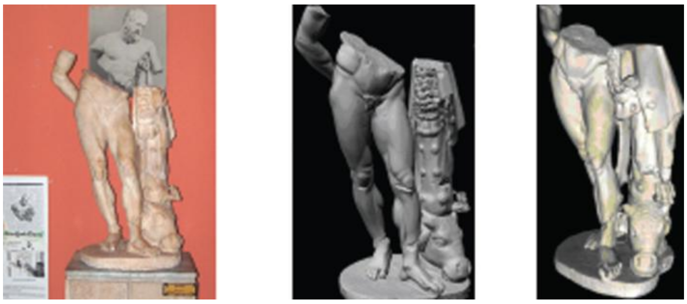

Figure 3. The case of the digital conservation of the so called statue of "harassed Hercules". Modeling of the down half that stands in Attaleia Museum in Turkey and the completed up half in the Fine Arts Museum in Boston, USA.(Gruen, 2009:302)

During the digital conservation, the conservator has no longer direct contact with the object and the conservation can be done virtually. In this environment, the conservator can be educated since there are proposed different solutions for the conservation of a broken vase or the restoration of a monument and can calculate all the possible versions (Forte& Pescarin, 2006:4). The digital completion and the aesthetical restoration have a low cost. That means that the heavy, fragile and immovable objects can be easily and equally conserved as the small and light objects. In the field of visualization, the 3D graphics convert the created or selected data to visual representations. In a virtual environment the user can experience a completed integration of data and information. The new technology put on a small revolution on the way that the information could nowadays be stored, retrieved and presented.

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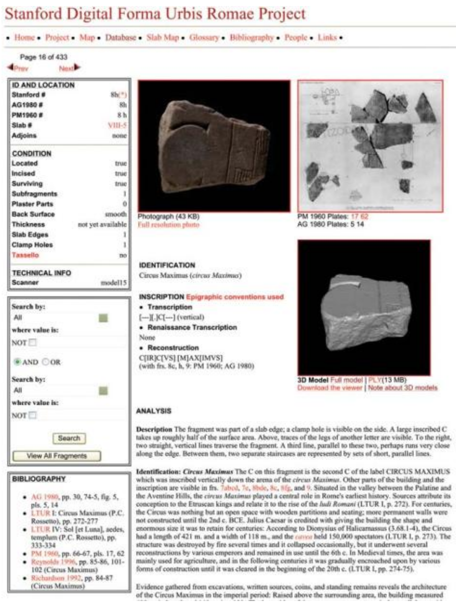

Figure 4. The internet data base of archaeological content. The example comes from the project "Stanford Digital Forma Urbis Romae Project" under the auspices of Sovraintendenza ai Beni Culturali del Comune of Rome. (Koller, 2008: 158)

The systematic storage of natural and chemical characteristics, descriptions of typology, historical information and cultural data for the objects of the cultural heritage leaded to the creation of cultural data bases (Fig.4). These cultural data bases contain information about the cultural assets, monuments and museums, that are open to the public via internet. The power and the multiple potentials of the internet in collaboration with the 3D technology resulted to the creation of virtual museums. The virtual museum in the website or the virtual environment in the museum, addressing to the museum visitors, differs towards the structure and the purpose of existence, from a system of virtual reality that is used by the scientists.

3. CONCLUSION

The applications of virtual archaeology are based on the narration of a simple, realistic and interactive system. The participant – visitor, immerses and gain an enjoyable experience while he learns through his participation in the application. On the contrary, the scientists rely on the complicated Data Bases that are constantly renewable and are used by the community. The aim of the scientists is to study and to research their data, following trustworthy methods and techniques. The purpose of the virtual environments is not to imitate the reality but rather to contribute in order to understand the reality (Barceló, 2001:231). As a result, the issue is not in what way virtual reality can become reality but rather how the virtual can enhance in a novice and alternative way the experience of reality (Gillings, 2002). Even though many objected and discredited to the meaning of the term "virtual archaeology", the need of a scientific integrity and credibility of the applications of virtual reality whether for a broader public or the scientific community, raised major issues of documentation and standardization. Towards this, the London Charter in 2006 enacted the purposes and the principles of using the methods of 3D visualization in regard to integrity, reliability, transparency, documentation, standards, sustainability and access. It becomes clear that in both professional, scientific applications and in those for the museum visitors, the virtual environment can be seen as a means that will help to bring home the knowledge. A part of this knowledge can be achieved if there will be presented the sources, the methods, archaeological and technical, that aided to the visualization (Ryan, 2001:245).

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TECHNOLOGY ACCEPTANCE OF E-LEARNING WITHIN A BLENDED VOCATIONAL COURSE IN WEST AFRICA

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ABSTRACT

Replacing lecture-based learning content with online information can augment learner-content interaction and facilitate greater mastery over a subject. The success of online delivery will depend on the readiness of learners to use and accept technology as well as the readiness of the organizational infrastructure to support a learner-centric learning culture. Successful implementation and adoption of online learning can be indicated by technology acceptance. In this project, lecture-based learning content for a healthcare vocational training course in West Africa was replaced with e-learning and applied to learners who had little or no prior computer experience. E-learning content was combined with practical and peer-based pedagogy to provide a blended learning course. This paper describes the acceptance of technology-assisted learning during the project.

KEYWORDS

Blended learning; Technology Acceptance Model (TAM), medical fieldwork, Africa

1. INTRODUCTION

E-learning can provide flexibility and cost benefits over traditional teaching methods (Bouhnik 2006) by increasing the quality of learner-content interaction (Anderson 2003). A buffet of online and offline pedagogies is increasingly expected from vocational learners as learner-centric quality control becomes more important (Hood 2013). Employing learner-centric blended vocational training allows strategies to increase learner control and engagement (Johnson et al. 2010), circumvent learning degradation through cost-effective refresher training (Chizmar 1999) and reduce attrition (Salmon 2004).

The prevailing paradigm for fieldworker development in The Gambia before this project was classroom-based, lecture-driven teaching incorporating information delivery and practical skill-based pedagogy. Refresher training was rarely possible due to time and cost constraints. This paper details the application of blended learning to vocational training in the context of Gambian medical fieldwork, changes in IT confidence in new IT users and subsequent technology acceptance. During this project the course content was unchanged, but the format of delivery was altered from classroom-based delivery to online delivery, with practical pedagogies unchanged. During implementation of the course, fieldworkers were asked about their perception of the course to determine technology acceptance.

2. TECHNOLOGY ACCEPTANCE

The Technology Acceptance Model (TAM) (Davis 1989) with subsequent adaptations (Venkatesh et al. 2003, Liaw et al. 2006, Venkatesh 2010) is the most widely cited and validated model of determinants to acceptance and subsequent successful adoption of technology. TAM adapts the Theory of Reasoned Action (TRA) which indicated that intention precedes behaviour (Ajzen 1980). TAM can be applied to technology-assisted learning: perceived ease of use and perceived usefulness (Lee 2005, Liaw 2008) of e-learning indicate intention to reuse e-learning, and therefore acceptance. Learner self-efficacy affects perceived ease of use and engagement (Ong 2004). Perceived enjoyment also serves as a motivator, incorporating flow, playfulness and enjoyment which affect intention to reuse e-learning (Byoung-Chen et al. 2009, Padilla-Melendez et al. 2013).

2.1 Method

The existing core vocational syllabus for fieldworkers was modified to replace lecture-based content delivery with e-learning modules and online examination. Interactive diagrams, audio, video and text were used online to enhance learner-content interaction within each e-learning module. Problem-based offline assignments for self-regulated study accompanied each e-learning module. Peer interaction was facilitated through the addition of scheduled group discussion workshops using real case study examples for each module. Practical training and marking procedures remained unchanged in the new syllabus. The UK control group consumed e-learning modules only.

Participants were 195 medical fieldworkers native to The Gambia who participated in both online and offline components of their vocational training. A paper-copy questionnaire was provided to all fieldworkers before (with 21 questions, n=110) and after (with 31 questions, n=140) learning was undertaken, including demographic information and questions on satisfaction and technical functionality which are not included in this paper. 74% of respondents were male, and 71% of the group had no experience with online training. A comparable front-line operational group in the UK was given the same questionnaires before and after their vocational training, with 10 questionnaires returned. This control group was 57% male and 74% had experienced online training before.

Participants responded to items on perceived usefulness and perceived ease of use on a 5-point Likert scale ranging from 1 – strongly disagree to 5 – strongly agree. All questions were in English and were adapted from published sources with advice from the fieldworker manager. Pearson correlation was completed to determine relationship strength and direction.

2.2 Results & Discussion

Preference for online training was much higher in the Gambian fieldworker cohort than the UK front-line group, and fieldworker preference for online training increased through the use of online training (Figure 1). Reported preference remained low (below the response midpoint of 3) in the UK group, and remained positive in the Gambian group. All mean responses from Gambian Fieldworkers were over the midpoint of 3, indicating positive satisfaction.

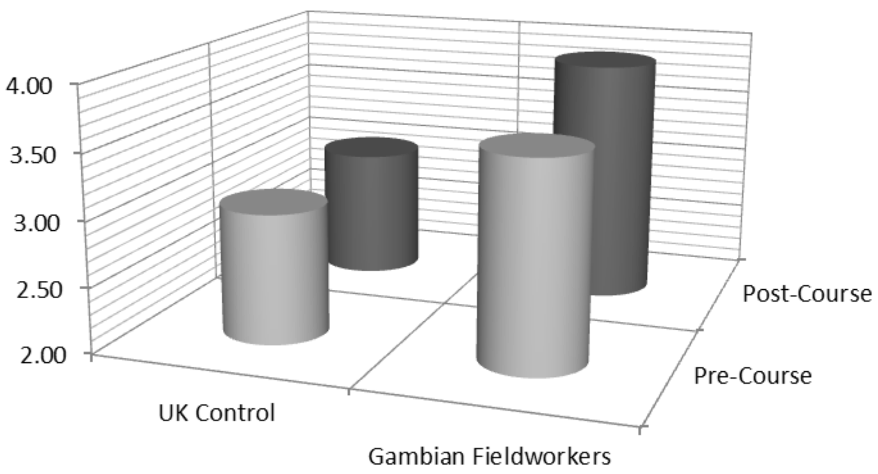

Figure 1. Preference for online training

Reported confidence increased in the fieldworker group through the consumption of e-learning, whereas the high level of confidence reported by UK workers remained unchanged through the project (Figure 2).

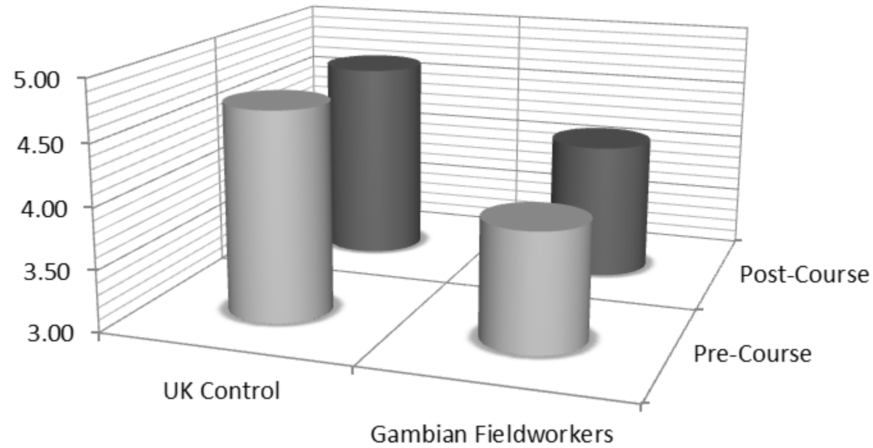

Figure 2. Computer self-efficacy changes through the use of technology-enhanced learning

Table 1. Reported technology acceptance determinants

Question number	Mean Pre-learning Score	Mean Post-learning Score	Question wording	Correlation (Post-course answers only)								
				3.2	4.1	2.3	6.1	7.5	7.4	7.2	6.7	7.6
3.2	**3.59**	**3.88**	**I prefer online training to classroom training**	-	0.4	0.3	0.3	0.4	0.2	0.1	0.2	0.1
4.1	**3.96**	**4.13**	**I feel confident using computers or mobile devices**		-	0.3	0.1	0.3	0.1	0.0	0.4	0.2
2.3	*****	**4.10**	**The method of delivery was easy to use**			-	0.4	0.4	0.5	0.4	0.4	0.5
6.1	*****	**4.07**	**The module was easy to access**				-	0.5	0.5	0.4	0.4	0.5
7.5	*****	**3.99**	**The module was easy**					-	0.5	0.4	0.4	0.5
7.4	*****	**4.47**	**The module was enjoyable**						-	0.7	0.5	0.7
7.2	*****	**4.47**	**The learning was relevant**							-	0.5	0.6
6.7	*****	**4.02**	**The content** was useful**								-	0.5
7.6	*****	**4.40**	**I intend to reuse the module for information purposes**									-

* Question was only asked in the post-course questionnaire
** Content was specified as glossary and reference materials

E-learning enjoyment correlated moderately with ease of use and ease of access, but not with preference for online delivery or with self-efficacy (Table 1.). All responses for perceived usefulness and perceived ease of use were above the midpoint, indicating technology acceptance, however, the strongest correlations was between relevance and enjoyment. Intention to reuse online learning correlated strongly with perceived ease of use and perceived usefulness responses but not with preference or self-efficacy, supporting the technology acceptance model.

Self-efficacy correlated strongly with computer usage outside work which correlated strongly with use at work (Table 2.), indicating that fieldworkers confident with computers use them as part of their daily lives, either inside or outside work; those who are less confident are less likely to use computers. Self-efficacy had little effect in this study, as participation was mandatory (as part of vocational training) and fieldworkers reported enthusiasm for the blended learning course, therefore observations based on participation or engagement were not possible.

Table 2. Reported computer self-efficacy

Question number	Mean Post-learning Score	Question wording	Correlation (Post-course answers only)		
			4.1	4.2	4.3
4.1	**3.96**	**I feel confident using computers or mobile devices**	-	0.7	0.4
4.2	**3.68**	**I use a computer outside work**		-	0.6
4.3	**3.43**	**I use a computer at work**			-

3. CONCLUSION

Introducing technology-enhanced learning as part of mandatory vocational training for Gambian fieldworkers provided a blended-learning outcome, which was accepted by fieldworkers. Fieldworkers reported preference and self-efficacy increases during the project, and reported technology acceptance as a positive intention to reuse e-learning correlated to perceived ease of use, perceived usefulness and perceived enjoyment, supporting Davis' technology acceptance model. Further research is needed to determine the variables that influence perceived ease of use, enjoyment and usefulness within the fieldworker community, the social influences on technology acceptance in West Africa and the effect of infrastructure on perceived ease of use.

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DEVELOPMENT OF AN E-LEARNING PLATFORM FOR VOCATIONAL EDUCATION SYSTEMS IN GERMANY

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ABSTRACT

This paper describes an existing web-based learning platform named "Third Place of Learning" (TPL) - "Dritter Lernort". This project's aim is to connect the system of vocational education with digital media by a web-based learning platform. TPL supports student's digital learning by means of interactive examples and exercises. Learning material is produced along a didactical concept. The technical structure is as well developed along a didactical concept as the learning content.

KEYWORDS

Vocational education, web-based learning, technical product designer

1. THE THIRD PLACE OF LEARNING

Germanys current shortage of skilled personnel evolves to a barrier, which negatively affects the national economic potential. The project "Third place of learning" (TPL) [TPL14] aims to qualify more trainees in stopping this negative trend and tries to optimize the quality of vocational education. Exploring the potentials of digital media for vocational education is a further aim of this project. The collaboration partners develop a concept for a web-based platform, which provides training content and e-learning tools for technical product designer. These e-learning tools can be used by vocational schools, business companies and trainees [HeLM14.2]. Using digital media to provide teaching and learning material with an e-learning platform for trainees and business-instructors has a huge potential. It is fact that more than 70% of young people between 10 and 18 years use the internet to search for job and trainee information [HeLM14.2].

1.1 Digital Media and Dual Vocational Education

The dual vocational education system exists in three European countries: Germany, Switzerland and Austria. It consists of schooling and training on the job as concurrent activities. Trainees learn basic information or skills in the classroom and the practical implementation while working for associated companies. In general, this dual system of vocational education is regarded as a very effective way to train young people. However, there is potential for improvement. Current disadvantages of the dual system of vocational education are [BIB01]:

- Limited technological infrastructure of small companies.
- Different points of time for the transmission of specific knowledge from the curricula in schooling and job training.
- Lack of communication between the teacher of a vocational school and business companies.

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Using e-learning tools supports trainees and teachers at the same time. Furthermore, these tools help to improve the named disadvantages above. TPL offers the possibility to collect data of individual learning rates. Further, TPL supports the transmission of knowledge across different locations and learning times [TPL14]. Basic information like the basic functions of a computer-aided-design (CAD) program, for example, can be taught in a new way with tutorials, practices and self-learning modules. Incidentally, trainees and teachers can create their own learning content as well as specific learning modules. During the project TPL will provide learning material specialized for technical product designer.

2. CURRENT STATUS OF THE PROJECT

The aim of an initial survey stage is to identify topics and available educational material in cooperation with the vocational schools and business companies. The result of this project's stage is to develop a catalogue of requirements about how to develop a technical structure, didactical content design and content topics.

2.1 Applied Survey Methods

Professional training in Germany is based on (national) training regulations for vocational schools and business companies. Within the first stage, training regulations are analysed to detect suitable topics for e-learning. During the second step, interviews of teachers and business-instructors are conducted to gather information about didactical ideas and proposals for the platform's technical structure.

2.2 Results of the Training Regulation Analysis

The training regulations for the technical product designer consist of 18 learning sections. The two learning sections shown in Figure 1 are part of the training content for the first and second year. By doing a survey with the teachers about the training regulation for vocational schools the results show that 100% of the learning topics within the first learning section are suitable for e-learning modules. The survey additionally results showed also that the fourth section contains only 75% of suitable topics for e-learning materials.

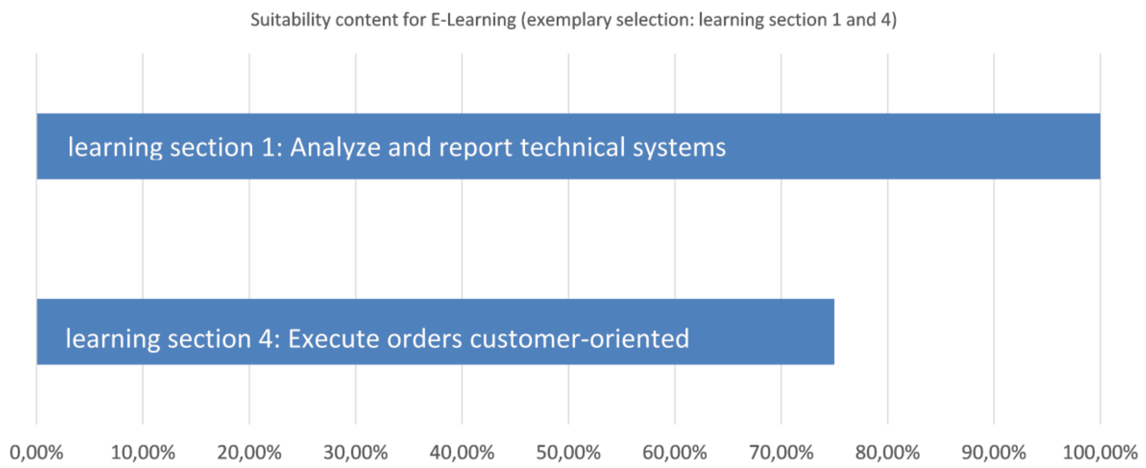

Figure 1. Training regulations for vocational training, learning section 1 and 4

During the first learning section trainees learn basic tasks and skills, for example free-hand drawing or the usage of CAD-systems. These are basically single handed learning tasks with a PC. In contrast, learning section 4 requires teamwork while working on a customer order. At the end of this section the trainees have to compare their results with the results of other teams. The necessity of intensive personal communication is the reason that this learning section has a lesser e-learning potential.

The results indicate that all 18 learning sections are similar. 15 learning sections were assessed as 100% suitable of developing e-learning content for their topics. Main topics of the developed modules are: engineering drawing and documentation, virtual construction, materials science, manufacturing processes and project-quality management.

2.3 Structured Interview Analysis' Results

The analysis of structured interviews pointed out that teachers and business-instructors recommend content oriented developing during the working process. Therefore, didactic conception of teaching and learning modules will challenge trainees in collecting self-reliant information, planning the execution, create a product and checking results. According to specific topics of the learning sections, new material includes learning content, learning objectives, exercises, tests and also provides a learning video. To summarize, the didactical conception of all materials and the design of the user interface support self-organized learning.

The communication structures of TPL have to ensure a secure and easy way of communication between teachers, business-instructors and trainees of all participating business companies in all directions. A multidirectional communication tool will be developed.

Three internal working spaces, one for the vocational schools, the business companies and trainees, will be provided by the e-learning platform. The working spaces of vocational schools and companies create the possibility of working with the trainees at internal topics, exercises or test. The working space for teachers and business-instructors provides functions for developing new teaching learning materials and store internal documents.

The working space for the trainees contains the self-learning materials, the possibility to establish learning groups between trainees, a glossary and a link collection to support the learning processes. The following section describes the further steps of the development.

3. NEXT STEPS

The next steps during 2014 include the realisation and implementation of the platform. Generating learning content for technical product designers and taking account of the didactical concepts is also planned.

3.1 Designing the Web-Based Platform

Developing the platform includes technological realisation and creating its content. The first stage consists of designing a platform and its implementation. After installing basic elements, e-learning modules will be added to the platform. This implies a parallel execution of developing the web-based platform and creating the content.

Learning and teaching material should be provided in hypermedia, which are different kinds of media formats. This allows teachers, business-instructors and trainees to work with the content on- and offline. The content is presented directly on the platform in a PDF file and as a presentation; this will be supported by videos. The modules will also include different tests to control the individual level of knowledge.

Therefore, TPL uses an open-source learning platform "Moodle" [TPL14]. "Moodle" can completely be adapted to the demands of a given project and area of work, for example, the different working spaces for teachers, instructors and trainees. With the user's help of a role system "Moodle" users have the opportunity to decide which information, topics and the amount of detail are visible to other user. Furthermore, it supports self-organized learning like basic information of gradually explaining an engineering drawing [TPL14]. For example, a learning module starts with an introduction about free-style drawing, then sets out line widths and completes with standards [HeLM14.1]. Additionally "Moodle" supports different forms of tests like multiple choices tests, free text questions or self-learning packages. "Moodle" evaluates the used learning modules automatically. The results of an evaluation will be used within the project to improve the developed platform.

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3.2 Developing Teaching and Learning Content

Preparing content for the dual training of technical product designers is the key task of the project. The next step before developing learning and teaching content is to gather learning and teaching materials, which are used in vocational schools and business-companies. The dual vocational education is subdivided into stages, which could be reused as a general procedure for the training. The materials on the platform will be arranged to this periods. Using the didactical concept as a basis the collected teaching and learning content can be rewritten and used to create new content. Vocational schools and business-companies are involved during this step. Business companies assess the new materials and support the development of material for future users. The results of this assessment will be evaluated and used to revise the platform.

4. CONCLUSIONS

The results of the first project stage will be used to build a concept for a web-based platform and to realize it within TPL during the rest of the projects period [TPL14]. The next months will be used to create target-group-specific e-learning content which should be used to support lessons during schooling and job training. Realising a digital and modern learning place is the main objective of the project TPL [TPL14]. The designed platform will consider the results of interviews made with vocational teachers and business companies so that the platform will be designed as practical as possible for all users.

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FACEBOOK MEDIATED INTERACTION AND LEARNING IN DISTANCE LEARNING AT MAKERERE UNIVERSITY

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ABSTRACT

This paper reports on an investigation of the use of Facebook as a tool to mediate learning amongst distance learners at Makerere University, a dual-mode institution offering both conventional and distance learning programs. While conventional courses take 17 weeks in a semester, the distance learners come in for two residential sessions, each lasting for two weeks. The study focused on Bachelor of Commerce (External) students doing an Introduction to Information and Communication Technology course. This course was run through face-to-face sessions and the use of Facebook to increase interaction among learners. Out of the 650 students on the course, 621 joined the Facebook class page. In this paper we report on the students' perceptions about using Facebook for teaching and learning, and specifically if it mediated interactive learning. The Facebook class page was used as a discussion board. The questionnaire on which this evaluation was based was uploaded two months after the course ended. Interactive feedback through posts, 'likes' and comments were received from students. Results show that learners appreciated the use of Facebook for interactive learning, hence fostering meaningful learning. We also tried to match the affordances of Facebook for modeling, contingency management, feedback, instructing and questioning. Feedback and questioning were well received on Facebook during the course, indicating that Facebook mediated interaction and learning. We contend that if Facebook is to be used for meaningful teaching and learning, then there must be an appropriate and systematic mechanism for integrating educational activities in the platform.

KEYWORDS

Facebook, Distance Learning, Mediation, Interactive Learning

1. INTRODUCTION

World over Distance Learning has been presented as a viable alternative to traditional methods of teaching and learning for addressing the massive demand for higher education (Mayende, Divitini & Haugalokken, 2006). Uganda introduced free universal primary and secondary education in 1997 and 2007 respectively. This has led to increased demand for university education (Aguti, 2002). According to Aguti and Fraser (2006), in distance learning, the learner spends most of his/her time away from the university studying on their own using learning materials which are either print, electronic or both. Makerere University distance learners come to the University for residential sessions twice a semester. Most of the remaining time, they are at their work places or homes. Distance learning at Makerere University is still in the first generation, relying on print materials and occasional face-to face sessions. Students are distributed across the country in places where access to electricity and Internet is a problem (Aguti & Fraser, 2006). The distance learning materials are designed to be interactive; that is, they act as the teacher to the learner, thus enhancing independent learning (Oliver & Herrington, 2003). However, even if distance learners have well developed learning materials, they require additional support away from the University. Various distance education practitioners have advocated for the use of ICTs in the teaching and learning (Aguti & Fraser, 2006; Muyinda et al, 2010; Kajumbula, 2006). They have for instance advocated for and undertaken research in the use of mobile phones for teaching and learning on distance learning programs (Muyinda et al, 2010).

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Facebook is a social networking site that allows students to interact with one another informally (Rambe & Ng'ambi, 2011). However, little research has been done to find out if Facebook can be used as a tool to mediate learning. This paper investigates how Facebook mediated learning amongst distance learners at Makerere University. Mediation, according to Vygotsky (1978), is the guidance given to the learner to acquire unique human knowledge or moving a learner from their current knowledge level to the point of knowing.

2. LITERATURE REVIEW

2.1 Inter and Intra-Psychology and Facebook

This paper explores the use of Facebook for interactive learning. Continuous interaction among learners breeds inter- and intra-psychological learning (Vygotsky, 1978). Inter-psychology begins as a social interaction between individuals and, as this interaction goes on, it is internalized hence intra-psychology (ibid). When knowledge is internalized as a result of continuous interaction, it becomes part of us. In order to get to intra-psychology one must be guided/assisted (Vygotsky, 1978). Since intra-psychology arises from inter-psychology, which begins with social interaction, therefore, social networking sites like Facebook can afford or mediate inter- and intra-psychology.

2.2 Mediation of Inter- and Intra-psychology

Mediation is a fundamental concept of human development. Mediation can be defined as a process of supporting a learner to learn new concepts by the tutor or by more capable peers. Facebook comes in handy in mediating the interaction and learning among distance learners, hence potentially leading to inter- and intra-psychology. Mediation can guide the learner to acquire his/her accessible knowledge, which we refer to as the zone of proximal development (ZPD). Vygotsky (1978) believes that language is the primary mediator. However, Gallimore and Tharp (2002) have argued that, it is not only language that develops the mental cognition. They proposed five means of assistance to learning: modeling, contingency management, feedback, instructing, and questioning. Our analysis of the affordances of Facebook as a teaching tool is based on this framework.

Modeling is a process of assisting through imitation. Usually learners (most especially young learners) learn by imitating. Although it is clear that modeling can assist learning, Facebook does not fully support modeling as a mode of assisting learning. However, in circumstance where pictures and videos are uploaded on the Facebook class page, learners can learn through imitation.

Contingency management "is the means of assisting performance by which rewards and punishments are arranged to follow behavior, depending on whether the behavior is desired or not." (Gallimore & Tharp, 2002: 179). Gallimore and Tharp (2002) further assert that effective teaching and learning depends more on positive rather than negative rewards. That is why we are encouraged to use only positive rewards. However, since contingency management does not introduce new behavior, a teacher who is interested in introducing new behavior should use other methods of assistance. Contingency management on Facebook can be supported by positive comments and by using the 'like' functionality. Teachers or students can 'like' each other's comment or post, thus giving positive feedback. Likewise, they may share positive and constructive comments.

Feedback is the process of responding to what someone else has done. To Gallimore and Tharp (2002: 180), "[s]imply providing performance information is not feedback; there will be no performance assistance unless the information provided is compared to some standard". In distance learning, instructors are encouraged to give feedback on assignments to help learners improve their learning. When using Facebook, teachers should avoid giving performance information that does not assist the learner.

Instructing is the process of assisting the learner through telling him/her what is supposed to be done. Instructing is a behaviorist approach to learning (Saul and Patti, 2008). Instructing is still a common practice with tutors who deal with large classes like those on the distance learning programs at Makerere University. For instruction to be effective, it must be blended with other methods of assisting learning, like contingency management and feedback, where applicable. Although Facebook does afford for instructing, we did not use it much for instructing on this project.

Questioning is a very important method that assists performance although many teachers confuse assessment questions with assisting questions. It should be noted that not all questions assist performance. Assessment questions are aimed at finding out the ability of the learner to perform without assistance while assistance questions are used to provoke the thinking of the learner to the level the learner would not have attained by himself/ herself. If the tutor understands how to question, then Facebook offers that possibility.

The discussion above has elucidated that learning can be teacher or fellow learner or technology mediated. The rest of this paper zeroes in on technology (Facebook) mediated learning.

2.3 Technology Mediated Learning

Technology mediated learning refers to using technology to assist learning (Oliver & Herrington, 2003). Recently, there has been increased use of new technologies in teaching and learning (Daina Laurillard, 2006). Collis (1977) cited in Oliver and Herrington (2003) argues that when using technology for learning, there is need to re-engineer the entire learning design rather than just re-packaging content electronically. Usually, we design learning environments that mimic the teacher in a traditional class (Oliver & Herrington, (2003). This is common in the distance learning classes because of the large class sizes. Oliver and Herrington (2003) have suggested three important components for improving online learning design, namely: tasks to engage and direct the learner, supports for the online learner, and the learning resources. They also believe that we should have authentic tasks which help learners to learn so that the learner mimics the real working environment. They indicate that “flexible and online learning environments need learning supports to be designed as integral parts of the learning process” (p. 14). They further contend that when dealing with a learning support component, there is need to work carefully on the supportive tutor role which should provide learners with feedback and guidance on requests and most especially at critical points in the learning process. These are affordances inherent in Facebook since it can be ported on multiple platforms, including mobile phones.

2.4 Facebook as a Mediator of Learning

Vygotsky (1978) argues that social interactions are seen to play a critical role in the processes of learning and cognition. We also realize that learning support can help mediate learning through providing guidance and feedback to the learners (Oliver & Herrington, 2003). Facebook can ensure that guidance and feedback is achieved. Rambe and Ng’ambi (2011) believe that the use of Facebook reinforces the rights to inform and be informed and such interaction leads to rich knowledge resources based on multiple voices. Vygotsky (1978) says that development can be achieved through the collective nature of human consciousness manifested through social interaction. Rambe and Ng’ambi (2011) identified the need for the active presence of the learners and tutors on social media for the learners to have someone to interact with at any time. This can then help reduce the feeling of isolation characteristic of distance learning.

There are also challenges involved when using Facebook. It is estimated that online teachers spend 90% of their planning and development time creating content and online learning resources (Oliver & Herrington, 2003). Mediation is the guidance that goes beyond online content. Rambe and Ng’ambi (2011) identified challenges of using social networking sites as redundant postings, limitations of collective responsibility, subtle negotiations of power between educators and learners, and confusion of roles among novice learners. They observed that some of the challenges of using Facebook as a pedagogical tool are both the educator gaining access to Facebook spaces of all learners and ensuring that every member of the class is a friend of everyone. They argue that Facebook violates personal privacy, and some students may be skeptical about participating in academic activities that invade their personal lives and “comfort zones”.

Different scholars have suggested the use of different activities in online learning design. Online learning mainly supports activities designed to involve peer cooperation and collaboration (Oliver & Herrington, 2003). This is eminent in social networking sites like Facebook. Anderson (2003) argued that if any of the interactions, namely, teacher-to-learner, learner-to-learner and learner-to-content are increased, then meaningful learning can take place. Rambe and Ng’ambi (2011) found out that Facebook could be accessed anywhere, anytime by students using mobile phones. This is also evident in the research done by Muyinda and Mayende (2013), which showed that the majority comments and posts on the class Facebook page were from mobile phones.

3. MATERIALS AND METHODS

Facebook was used in conducting the Introduction to ICT course taught to third year Bachelor of Commerce (External) students at Makerere University. This course was run in the second semester of academic year 2012/2013. The class capacity was 650 students but only 621 joined the Facebook page. The course ended in May 2013 with the students sitting end-of-semester examinations. Two month later, we posted a qualitative questionnaire on the Facebook class page to find out how students felt about Facebook as a tool to mediate interactive learning. The questionnaire and the comments were read by every member who visited the page. This provided interactive feedback and verification of the students' comments. We also interviewed two students to get a better insight into how students used Facebook and how it could mediate learning. These students were randomly chosen from the students who had responded to the questionnaire.

4. FINDINGS

Most of the posts on the page vividly indicated that Facebook as tool for mediating learning could not replace the teacher. One of the comments read, "Seeing a teacher in class is more important, practical and effective. The explanations were better understood than on Facebook." Students provided various reasons to support their stance. For instance, some students felt that it was difficult to explain complex concepts using Facebook. Other students felt more confident listening to a human teacher than reading Facebook text and most especially when the majority of text was coming from their peers. Student's numbers were very big as mentioned earlier. It was therefore difficult for the course facilitators to read the different posts and comment on each one of them. Also Facebook has no affordance of enabling teachers and learners see each other's facial expressions. Facial expressions sometimes help the learners to comprehend complex concepts. It can also help the teacher to read from learners' faces whether or not they are confused. In support of this imperative, one of the students said, "Seeing a teacher in class is more important, practical and effective". Explanations were better understood in the physical classroom than on Facebook. This also relates to another post which indicated that the gestures made by the teacher during the face-to-face sessions, caused the students to understand better than on Facebook. Students preferred discussing their minds with their teacher face-to-face than on Facebook. Some students felt that their Facebook page had too much text and required them to read all the time. Ideally, this means that despite the affordances Facebook offers, students did not enjoy reading too much and, sometimes, repeated text from multiple learners.

With the above negativity, one would be left to wonder whether Facebook mediated learning at all. The negativity was attributed to the newness of this mode of support. It was the first time learners were using Facebook for learning support. It is hoped that as time goes by, learners' perceptions could change. Already, numerous positive perceptions were registered.

Some students felt that Facebook was very important and they explained how it mediated learning. "Facebook gave me access to lecture notes through the upload functionality on the Facebook group page," said one of the students. Another said, "Facebook gave me the opportunity to access the class from anywhere and anytime via my mobile phone". Another said, "Facebook gave me opportunity to learn while out of class and in a more convenient way".

Some students suggested that both face-to-face and Facebook are vital and can complement each other. The teachers were able to find out areas where students were finding problems so as to give further explanation during residential sessions. So Facebook helped teachers to know the ZPD of their learners. The students also said that Facebook was good for interaction. This interaction is what Vygotsky (1978) says begins as inter-psychology and leads to intra-psychology when it is internalized. Anderson (2003) argues that if there is increased interaction either between learners and learners or between teachers and learners, meaningful learning occurs. This shows that Facebook as a tool can mediate learning since it afforded students the possibility to interact. Students shared and discussed ideas with teachers and with their peers. Students also said that Facebook helped them to be guided on how to do certain things in the right way by asking their peers or the teacher. This suggests that guiding learners caused them to learn, hence Facebook mediated learning.

Students also reported that the teacher was able to ask them questions on Facebook and the learners responded, which created interaction. Gallimore and Tharp (2002) say that questioning is one way of assisting learning. Students felt that prompt answers made by the teacher made the learners learn better. Feedback is a key aspect in assisting learning. However the type of feedback matters as mentioned earlier. Students felt that Facebook helped them do revision. This means that they found content which could be discussed on the class page. Content is vital to the learning process. By providing access to content, Facebook mediated learning. Students said that some of the content discussed on Facebook appeared in the final examinations, meaning that the content was relevant and the students learnt it. Students said that Facebook enabled them to read widely; whenever they found new concepts of Facebook, they researched further into them. Therefore, it is clear that Facebook mediated learning through questioning that made the students look for more information. Students also felt that Facebook was vital for the students who did not attend face-to-face sessions. Students felt that Facebook enabled them to receive frequent updates about the course. This administrative support is equally important for learning. Students also appreciated the experience of using Facebook in the class room environment. They also gained confidence in using computers during the course unit since some of them had never used computers for learning before.

In using Facebook for mediating learning, several challenges were registered. Some students indicated that they failed to download the notes which were uploaded on Facebook. This was common because the majority of students were using mobile phones some of which did not support the download function. Also some students did not know how to download content from Facebook, which calls for basic training of the learners in using Facebook before the course starts. Another challenge related to limited access to Internet-ready computers, hence limited access to Facebook. Some of the students had access to the computers at the main campus; but these too were too many for the few computers at their disposal. Students said that Internet access was a problem and hindered their usage of Facebook. Given that there is a cost attached to accessing Internet both through mobile and computers, students found a problem accessing Facebook. Some students also said that they found problems with mobile network coverage when they travelled. Also, some students did not have Facebook accounts and others had mobile phones which did not have capability to access Facebook. Such learners were thus disadvantaged.

Students' suggestions for improving Facebook usage in teaching included: providing constant feedback from the teacher so that the students continue to be engaged and guided in the process of their learning, and increasing participation of the student peers so as to increase interaction.

5. CONCLUSION

The possibility accessing Facebook on mobile phones gave distance learners an opportunity to access the class. Given that the majority of the distance learners have no access to computers and Internet from their places of aboard, mobile phone access to Facebook offers the best alternative. The use of Facebook in the teaching and learning helped to support modeling, contingency management, feedback, instructing and questioning. Modeling and instructing could be supported through videos uploaded on the class page. For contingency management, students felt that they were not sufficiently rewarded with positive comments. Facebook allowed students to easily give feedback to each other through 'liking' peers' comments. Facilitators were called upon to increase interaction and give timely feedback to comments. Students also said that Facebook helped them to get guidance. Facebook supported feedback as mentioned in the results. Therefore, Facebook mediated learning through feedback and questioning. It was established that questioning was possible through Facebook but teachers were cautioned to be careful not to confuse assessment questions with assisting questions. There is need to systematically integrate the activities in the teaching and learning using Facebook in order to achieve meaningful mediated learning.

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ASSESSING THE PURPOSE AND IMPORTANCE UNIVERSITY STUDENTS ATTRIBUTE TO CURRENT ICT APPLICATIONS

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ABSTRACT

In this study we surveyed students in a mid-sized university in Ontario, Canada to explore various aspects associated with their use of computer-based applications. For the purpose of analysis, the computer applications under study were categorized according to the Human-Computer-Human Interaction (HCHI) model of Desjardins (2005) in which interactions between users and digital technology are categorized into four classes of interaction, namely, Technical Interactions (interactions with the digital devices themselves), Social Interactions (interactions with other users through digital devices), Informational Interactions (interactions with information through digital devices), and Computational Interactions (interactions with data processing software through digital devices). The survey attempted to assess the following four aspects of computer application use (in the context of the HCHI model): importance, purpose, frequency, and confidence. In this paper we report on preliminary findings regarding the purpose and importance students attributed to the applications under study. Frequency and confidence studies were reported elsewhere— Partosoedarso, DiGiuseppe, vanOostveen, & Desjardins (2013). Preliminary findings indicate that, in general, students in this study tended to engage in technical, social, and informational interactions primarily for personal purposes and computational interactions for school purposes. In terms of importance, students ascribed the greatest importance to social interactions, followed by technical, informational, and computational interactions, in that order.

KEYWORDS

Information Communication Technology, higher education, digital technology

1. INTRODUCTION

Information and communication technology (ICT) is rapidly becoming a pervasive and highly valued resource in all endeavours, including post-secondary education. Laptops and mobile devices, including smartphones, tablets, which enable ubiquitous Web surfing, video conferencing, and social networking have for some time now been deemed necessary tools in higher education (Melton & Kendall, 2012). Furthermore, highly interactive—and highly motivating—applications such as serious games, augmented reality, and massively open online courses (MOOCs) are making greater inroads into post-secondary schooling (Dede, 2013; Johnson, Smith, Willis, Levine, & Haywood, 2011). Almost three-quarters of these institutions offer online courses and almost one quarter of all post-secondary students having taken at least one online course in 2011 (Parker, Lenhart, & Moore, 2011). Currently, most North American post-secondary institutions offer online courses in which geographically distributed students and instructors learn together in virtual classrooms. These developments have placed great pressure on students and instructors to keep up with the trends, assess the value of these new technologies, determine their most appropriate uses, and develop essential skills.

It can be assumed that university students are likely exposed to a variety of computer-based devices and applications in their personal lives, work lives (if gainfully employed), and studies, especially given the pervasiveness of ICT in today's (Canadian) educational milieu. It may also be assumed that as students gain experience with various devices and applications, they will gain confidence in their use and will likely begin to find some devices and applications more useful than others for various purposes. In other words, they may attribute varying levels of importance (i.e., value) (Wyse, 2011) to the devices and applications they use.

Thus, in the broader study on which this paper is based, we assessed—via an online survey—the following four aspects of computer-based device/application use: frequency, confidence, purpose, and importance. In earlier papers (DiGiuseppe, Partosoedarso, vanOostveen, & Desjardins, 2013; Partosoedarso, DiGiuseppe, vanOostveen, & Desjardins, 2013), we reported on findings regarding the frequency with which a group of university students employed a particular inventory of common devices and applications, and the level of confidence they developed in using those technologies. In this paper, we extend the findings of that study by reporting our findings on the purpose and importance students attributed to the same inventory of computer-based applications discussed in the papers noted above.

1.1 Frameworks

In this study, we employed a survey instrument adapted from Desjardins & Bullock (2012) in which Human-Computer-Human interactions (HCH interactions) are categorized into the following four types: *Technical Interactions (TI)* (users interact with digital devices for basic operations), *Social Interactions (SI)* (users interact with digital devices for social purposes), *Informational Interactions (II)* (users interact with digital devices for information), and *Computational Interactions (CI)* (users interact with digital devices for creative and computational purposes). Table 1 provides some examples of these four types of interaction.

Table 1. HCH Interactions (adapted from Desjardins & Bullock (2012))

INTERACTION	DESCRIPTION
Technical (TI)	Employ basic devices and applications; Create/edit documents/multimedia
Social (SI)	Communicate via email, video, text, audio; Use social networking systems
Informational (II)	Search for and exchange articles, video, music, books, etc.
Computational (CI)	Create concept maps, plans, diagrams, pictorials, graphics; Process data

Survey responses provided by the participants in this study regarding their interactions with ICT were analyzed in relation to the four types of interactions of the HCHI Model summarized in Table 1.

2. METHODS

In this study, we surveyed a sample of university students in a mid-sized university in the province of Ontario, Canada to assess their use of a variety of current computer-based technologies. The survey questionnaire employed three Likert scales for assessing “Importance of Use,” “Frequency of Use,” and “Confidence of Use,” and a nominal scale to assess “Purpose of Use” (Table 2).

Table 2. Scales used to assess importance of, purpose of, frequency of, and confidence in using computer-based technology

Importance of use	Purpose of Use	Frequency of use	Confidence of use
1 = not important 2 = somewhat important 3 = very important 4 = indispensable	personal studies work	1 = never 2 = few times a year 3 = few times a month 4 = few times a week 5 = daily	1 = do not know how to use 2 = not confident 3 = confident 4 = quite confident 5 = very confident

A total of 423 students (n = 423) were invited by email to complete the online survey in February-March, 2013 and 157 students (n = 157) voluntarily completed the survey, for a 37% completion rate. The segment of data pertinent to this paper were analyzed in Microsoft Excel using descriptive statistics for students’ self-assessments of the purpose for which the students used various devices and applications and the importance they attributed to those technologies. Survey responses were then coded, categorized, and analyzed in relation to the four types of HCH interactions of the HCHI Model summarized in Table 1.

3. FINDINGS AND DISCUSSION

3.1 Purpose for using ICT Applications

Figure 1 indicates that, in general, students in this study most often employed ICT applications involving technical, social, and informational interactions (Desjardin, 2005) for personal purposes. This is demonstrated by the relatively high proportion of responses indicating personal use of social interactions such as texting, audio recordings, social media, and sharing ideas with others.

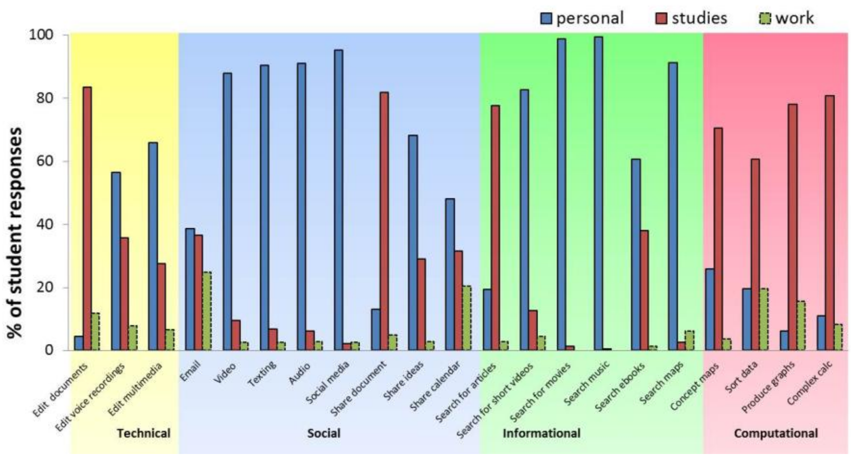

Figure 1. Purpose for using various computer applications.

With the exception of emailing (a social interaction) and sharing calendar information, sorting data, producing graphs, and performing complex calculations (computational interactions), very small proportions of participating students employed most of the other applications assessed in this study for work-related purposes. This may be an indication that small numbers of the students had jobs, or if employed, their jobs did not require significant use of these other applications. However, the chart also indicates that more equal proportions of students employed email—a principal means of communication globally (Robinson, 2012)—for personal, work, and study purposes. This suggests that while emailing was not as popular a way of interacting socially for personal purposes as texting, audio, video, and social media were, significant proportions of students indicated that they used email for all three purposes assessed in this study (personal, work, and studies), further suggesting that these students considered email to be a more versatile and more broadly applicable form of social interaction.

Figure 1 also shows that a majority of students engaged in a minority of technical, social, and informational interactions for study purposes. For example, only editing documents (a technical interaction), sharing documents (a social interaction), and searching for articles (an informational interaction) were employed by a majority of students for study purposes. However, a majority of students engaged in most of the computational interactions for study purposes, not personal or work-related reasons. Computational interactions include activities such as concept mapping, sorting and processing data, graphing, and calculating. These findings seem to align with the sorts of applications students commonly employ in completing school assignments, especially in contemporary universities in which the use of ICT is becoming increasingly pervasive (Lai, 2011). Interestingly, however, is the generally low proportions of students who indicated use of social interactions such as video, texting, audio, and social media, and the very limited use of some of the informational interactions, such as searching for music and movies, for educational (study) purposes—findings consistent with those of Selwin (2007) who maintains that "many university students and faculty make only limited formal academic use of computer technology …. use of computer technologies in many areas of higher education could best be described as sporadic, uneven, and often 'low level" (p. 84).

These findings seem to suggest that highly social interactions (video, texting, audio, social media) and informational interactions with social affinities (searching for movies and music) may still not be highly integrated in post-secondary teaching and learning as they could be, suggesting further research in this area.

3.2 Importance attributed to Various ICT Applications

Figure 2 is a bar graph illustrating the levels of importance participating students attributed to the various computer interactions studied in this project.

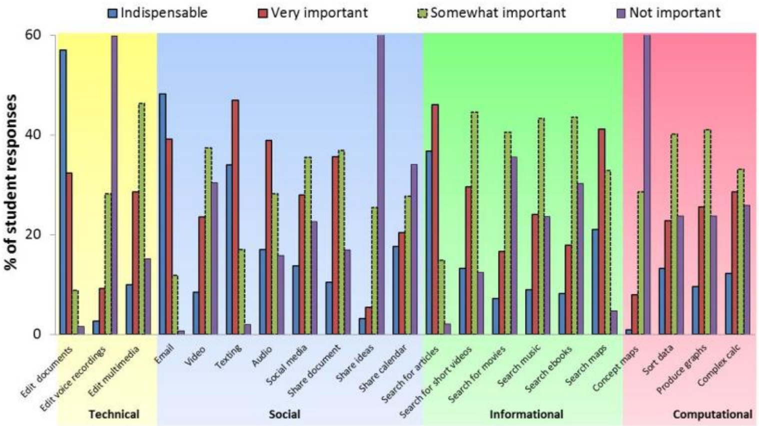

Figure 2. Level of importance students attribute to various computer applications.

Some interesting patterns may be discerned in Figure 2. For example, within the category of computational interactions, a majority of students attributed relatively low importance to all of the applications in this category, including concept mapping, sorting data, graphing, and performing complex calculations—with the least importance ascribed to concept mapping. When comparing these results to the purposes described in Figure 1, it is obvious that the majority of students claimed to have used these applications for study purposes, not for work or personal reasons. Within the social and informational interaction categories, the importance ascribed to the various applications is highly variable; however, some interesting results are noticeable. For example, a very large proportion of students valued email very highly—an application which the results in Table 1 showed was employed by approximately equal numbers of students for personal, academic, and work related purposes. This tends to indicate the importance and pervasiveness of email in virtually all aspects of these students' lives.

Another notable result is that within the category of technical interactions, a very large proportion of students considered editing documents (an application most students performed for educational purposes) to be a very important activity while editing voice recordings and multimedia (applications most students performed for personal reasons) not to be so important. A similar pattern is evident within the informational interaction category where searching for articles is highly valued by a majority of participating students and used by a majority for educational purposes while searching for video clips, movies, music, and e-books are not highly valued by a majority of the students and used by a majority for personal purposes. This seems to indicate that in a number of cases, participating students valued applications used in their studies more highly than applications employed primarily for personal purposes. This may simply be an indication that the participants were students at the time the survey was conducted, and, as such, more of them tended to value applications required for achieving success in their studies more than those used in their personal and/or work worlds. Nevertheless, this was not a consistent finding. For example, texting (a highly valued social interaction) was employed by a large majority of students for personal purposes while sharing documents (a moderately valued social interaction) was employed by most students for educational (study) purposes.

4. IMPLICATIONS AND CONCLUSIONS

The small number of analyses reported in this brief paper tend to indicate that in many of the technical, social, and informational HCH interactions assessed in this study, participating university students tended to value more highly those ICT applications employed in their studies more so than those employed for work or personal purposes. However, this was not a consistent finding, for there were cases in which the reverse was true. In general, however, it was found that none of the interactions (i.e., applications) assessed were used for the purpose of employment (i.e., work). This, however, was likely a reflection that only a small proportion of the participating students held a job at all, or one that required them to use the assessed applications. In terms of the computational category, most students employed these applications for educational purposes, but did not value them highly in large numbers. Interestingly, in a paper on another aspect of this study, Partosoedarso, DiGiuseppe, vanOostveen, and Desjardins (2013) reported on the “frequency” and “confidence” with which students used these computational applications, and indicated that the students tended to use these applications infrequently, and possessed relatively little confidence in their use. Taken together, these and the current findings suggest the need for more research in this area, including qualitative case studies to help determine why students tend to value such potentially academically useful ICT applications so low; why they tend to use them so infrequently; and why they tend to have such little confidence in their use.

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E-LEARNING SYSTEM FOR DESIGN AND CONSTRUCTION OF AMPLIFIER USING TRANSISTORS

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ABSTRACT

This paper proposes a novel e-Learning system for the comprehensive understanding of electronic circuits with transistors. The proposed e-Learning system allows users to learn a wide range of topics, encompassing circuit theories, design, construction, and measurement. Given the fact that the amplifiers with transistors are an integral part of almost all the electronic equipments, a fundamental knowledge of the design and construction of transistor circuits is highly imperative in the field of technology education. To this end, the proposed system serves as an effective educational tool for learning practical electronic circuits. The usefulness and effectiveness of the proposed system were evaluated by 10 university students in an actual class. The positive responses provided by all the students indicate the usefulness of the proposed system.

KEYWORDS

Electronic circuit, bipolar transistor, e-Learning, circuit construction, SPICE simulation

1. INTRODUCTION

Teaching and learning electronic circuits are important elements in the field of technology education. Recently, several education systems have been developed to improve the students' understanding of the concepts of electronic circuits. These so-called e-Learning systems for electrical circuit analysis (Weyten et.al, 2009) and the circuit design of the amplifier with a bipolar transistor (Assaad et. al, 2009) facilitate understanding of the fundamental theories and analysis of simple circuits. A learning kit to help beginners understand the functioning of various components in the electrical circuit was developed (Reisslein et. al, 2013). However, these conventional systems are based on all-purpose or ready-made learning tools and are suitable for only specific circuits within a subject area. Moreover, these systems are not designed to promote the learning of circuit construction and experiments, although the ability to understand and construct electronic circuits is highly imperative for acquiring extensive knowledge of the technologies. The educational support system, which was proposed to overcome the disadvantages of the conventional learning tools, involves experiments on the circuit construction of an active filter and a simple sound processor with operational amplifiers (Takemura, 2013). However, the abovementioned system has the following disadvantages:

- The system is suitable for constructing only simple circuits with operational amplifiers.
- It is necessary to provide comprehensive studies for the users to acquire deeper insights on the process.

In general, understanding of transistor circuits is difficult for beginners, as the designing of the circuit demands knowledge of complicated theories and analysis. Given the fact that the amplifier with a transistor is an integral part of almost all electronic equipments, a comprehensive understanding of transistor circuits is essential in the field of technology education. To this end, this paper aims to develop an e-Learning system that is capable of providing comprehensive studies on electronic circuits in terms of (a) circuit theories, (b) analysis, (c) design, (d) construction, (e) measurement, and (f) evaluation.

2. TECHNICAL FEATURES OF THE PROPOSED SYSTEM

Figure 1 shows the schematic illustration of the proposed e-Learning system that aims to provide comprehensive studies in the aspects of (a)–(f) described in Section 1. This system consists of individual computers of the users and a remote education system that runs online. The individual learners in the network learn the comprehensive topics of circuits described in Subsections 2.1 and 2.2.

2.1 Web-based Learning of Circuit Theories and Design

This section describes the new functionality of the proposed system that performs an important role in the designing the construction of the circuit. First, learners download the manuals and the datasheets necessary for understanding the theories and analysis methods for designing and constructing circuits. The datasheets of the circuit devices, which are necessary to grasp the characteristics and rated values of devices, are provided by the manufacturers. Based on the required circuit design, the learner uploads the details of the designed circuit (e.g., the components used in the circuit and calculated parameters) to the remote education system. The remote education system evaluates the designed circuit and specifies the errors in the circuit by comparing with the details and specifications of the designed circuit prepared by an instructor.

2.2 Circuit Construction and Experiments

Based on the circuit design using the technique described in Subsection 2.1, the learner constructs the actual circuit on a breadboard and transmits an image of the constructed circuit to the remote education system. The remote education system performs image processing to recognize the circuit construction and translates its structure into a general circuit description language (Simulation Program with Integrated Circuit Emphasis; SPICE) (Rabaey, 2012). This SPICE translation technique simulates the working of the circuit and enables virtual measurement without real measurement equipment. Furthermore, it can also identify the incorrect components in the circuit (Takemura, 2013). Moreover, the circuit translation and simulation techniques adopted in this system are important for improving the efficiency of experiments and preventing the occurrence of serious accidents, such as electric shocks and fires. Depending on the required purpose and environment (e.g., virtual laboratories and e-Learning), individual learners can choose a preferred mode from the following learning modes: (1) virtual circuit making (VCM), (2) real circuit making (RCM), and (3) the mixed mode (Takemura, 2013). To construct the virtual circuits with transistors using VCM, this study added new virtual circuit components to the database of the remote education system. In addition to these features that are available in the preceding systems, the proposed system includes new functionalities for performing web-based experiments using virtual measurements. Using this function, a user can learn the characteristics and the working of the constructed circuit. The remote education system also evaluates the characteristics of the circuit constructed by the user, such as the amplification ratio and frequency bandwidth.

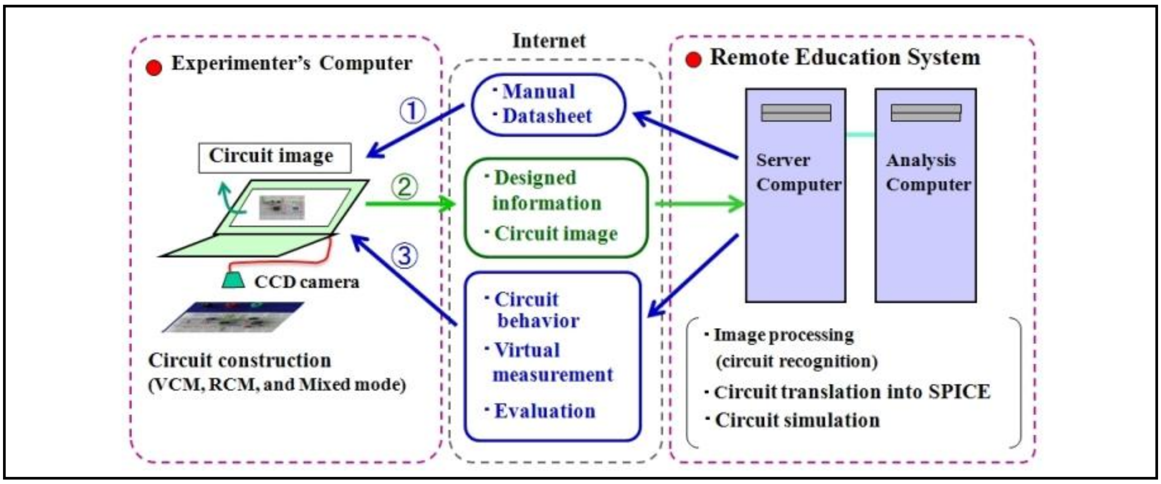

Figure 1. Schematic of the proposed e-Learning system.

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3. METHODOLOGY FOR EVALUATING THE PROPOSED SYSTEM

The effectiveness of the proposed system was evaluated by 10 undergraduate students, who do not have much knowledge and experience of circuit making, in an actual class at the Tokyo University of Agriculture and Technology (TUAT). Each student learned the comprehensive topics of a transistor amplifier according to the steps described in the following subsections.

3.1 Preliminary Learning of a Transistor Circuit

An NPN transistor consists of two N-type semiconductors separated by a P-type semiconductor, forming three terminals, namely, emitter, collector, and base. As shown in Figure 2(a), the currents to the base and collector are symbolized as I_B and I_C, respectively. The learner constructs the circuit shown in Figure 2(a) using an NPN transistor (2SC1815). By selecting the preferred mode of virtual measurement (VCM, RCM, or the mixed mode), the user can measure the V_{CE}–I_C characteristics shown in Figure 2(b). The learner studies the following features of the transistors using the virtual measurements of the proposed system:

- When a voltage V_{CC} is applied between the collector and the emitter and a current I_B flows to the base, an NPN transistor allows a current I_C.
- The amount of I_C depends on the amount of I_B.

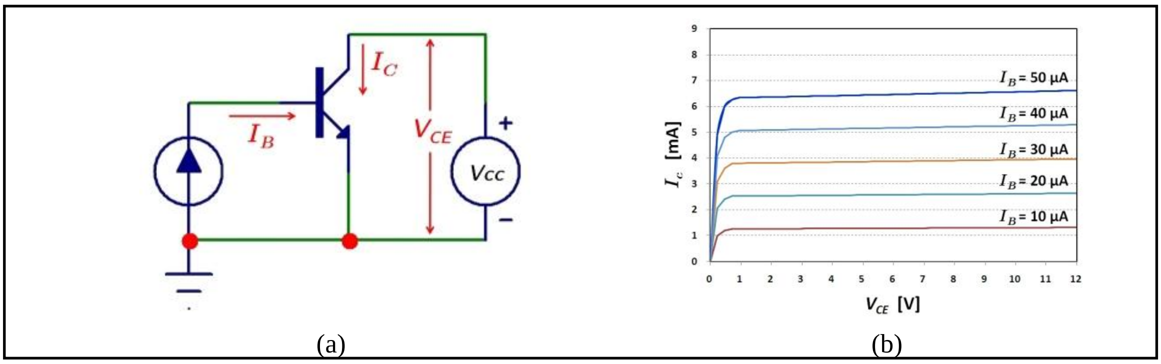

Figure 2. Static characteristics of an amplifier with a transistor; (a) circuit diagram, and (b) V_{CE}–I_C characteristics.

3.2 Learning of an Amplifier with a Transistor

To design and evaluate the usability of the functionalities provided in the proposed e-Learning system, individual students learn the comprehensive topics (described in Section 1) of the amplifier with the transistor (2SC1815) shown in Figure 3(a). Figure 3(b) indicates the components and currents necessary for designing the amplifier. To acquire comprehensive knowledge on the working of the amplifier, individual students were required to complete the topics (1)–(6), where a part of the manual to design the circuit, the characteristics to find the operating point of the amplifier, and a part of the web-based input form for evaluating the designed circuit are shown in Figure 4(a)–(c), respectively:

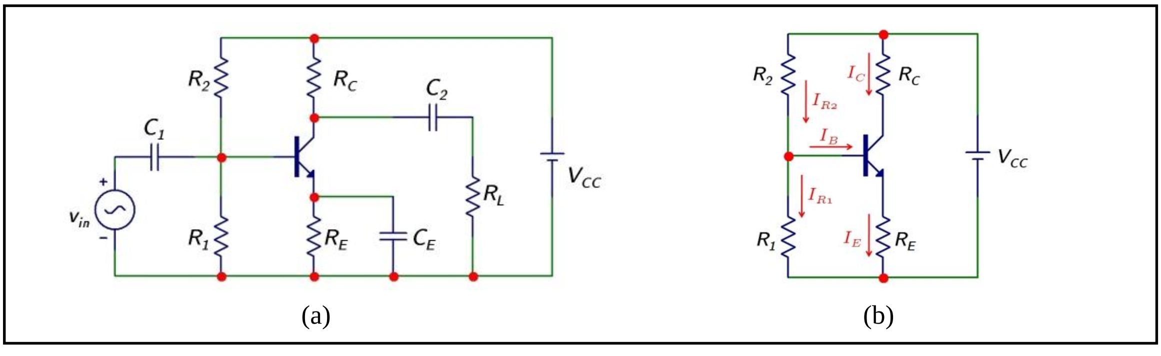

Figure 3. Small signal-amplifier with a transistor: (a) circuit diagram, and (b) DC equivalent circuit.

(1) Let the collector current I_C and the current amplification degree h_{FE} be 5 mA and 125, respectively. Using the manual and the datasheet, calculate the necessary currents and determine the operating point P.
(2) Upload the designed information to the remote education system using the web-based input form and check the correctness of the designed circuit based on the evaluation scheme included in the proposed system.
(3) Construct the circuit using the preferred mode (VCM, RCM, or the mixed mode).
(4) If the system indicates wrong parts on the image of the constructed circuit, make the necessary changes.
(5) Using the function of virtual measurements, plot the input and output voltage signals and the frequency characteristics of the constructed circuit.
(6) Using the function of virtual measurements, measure the voltage amplification ratio, gain, and bandwidth of the constructed amplifier and evaluate them using the system.

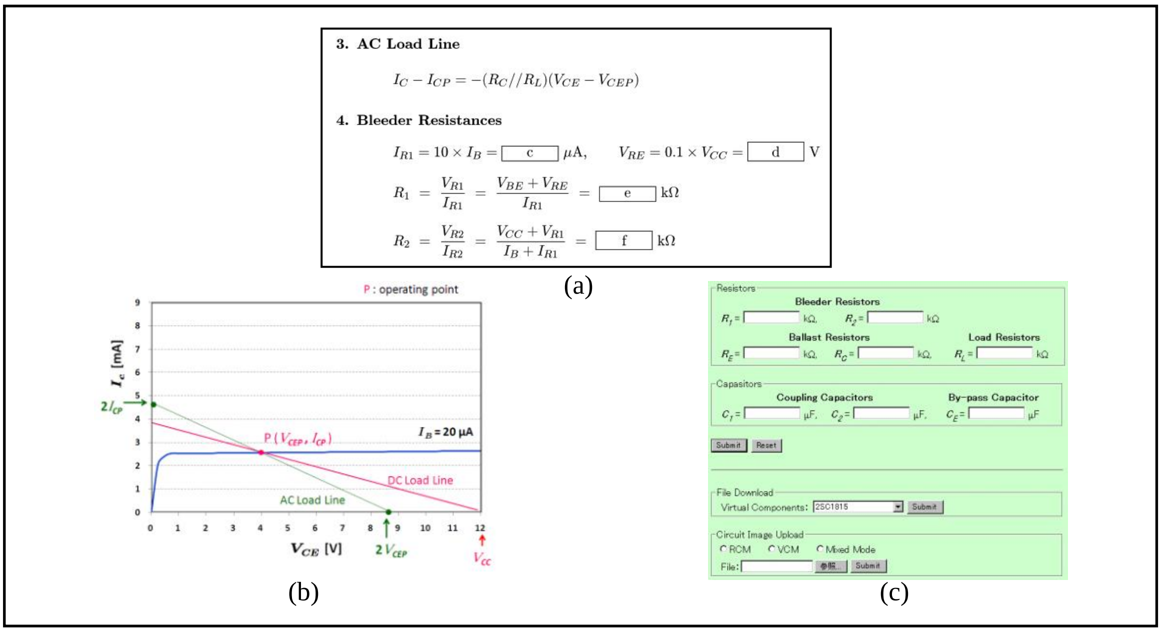

Figure 4. (a) Operating point and load lines that are indicated on V_{CE}–I_C characteristics, (b) manual to calculate the circuit parameters, and (c) input forms to submit the information of the designed circuit.

4. RESULTS AND DISCUSSION

Ten undergraduate students at TUAT evaluated the proposed system through the experiments described in Section 3. Figures 5(a) and (b) show the virtual circuit constructed using VCM and the physical circuit constructed using RCM, respectively. The remote education system of the proposed e-Learning system provided the SPICE information for constructed circuits that were obtained from the circuit translation technique. As shown in Figures 5(c) and (d), individual students learned the working of the circuit designed by them, in terms of the output signal and frequency characteristics, through the virtual measurement technique. Moreover, the system allowed the experimenter to construct the large-scale circuit (multistage amplifier) using the mixed mode of the system. Figures 5(e) and (f) show the constructed multistage amplifier and the working of the amplifier, respectively. Individual students submitted their opinions to the remote education system. The following positive responses, validating the usefulness and effectiveness of the proposed system, were obtained from all students:

- The web-based learning of circuit theories and analysis of transistors were effective because the complicated calculations pertaining to the circuit design were instructed explicitly.
- The comprehensive studies of transistor circuits using the e-Learning system were instructive because the system allowed learning of both theories and experiments.

- The choice of three modes of circuit construction (VCM, RCM, or the mixed mode) provided by the e-Learning system enables users to select a preferred mode depending on the environment.

However, the following technical suggestions were suggested for the improvement of the system:

- The usefulness of this e-Learning system would be much greater if the circuit translation technique is also made applicable to the circuit constructed on a printed circuit board.
- Improvements are expected in the e-Learning system for learning digital circuits.

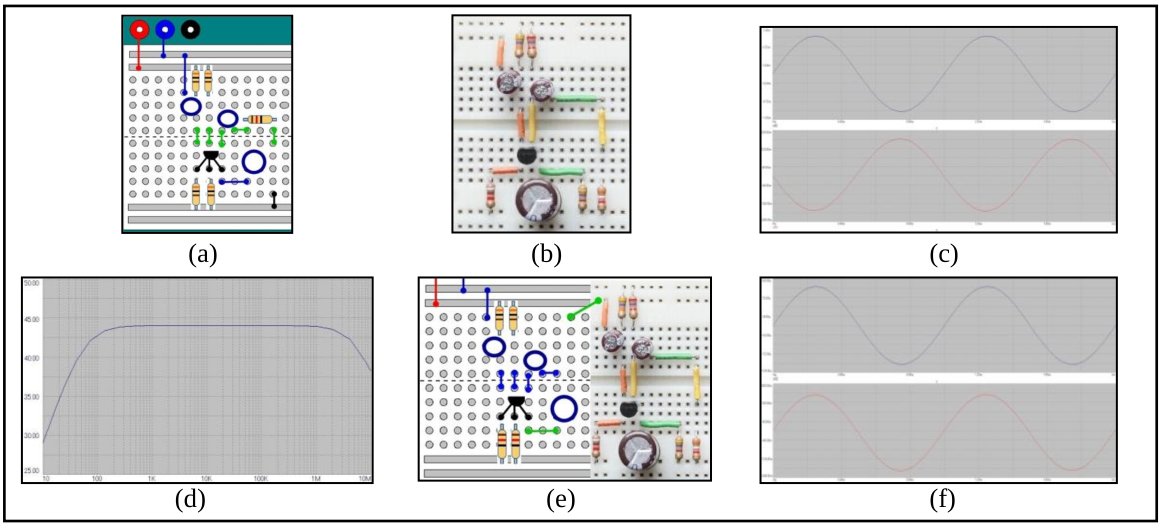

Figure 5. (a) Virtual circuit constructed using VCM and (b) physical circuit constructed using RCM. (c) Results of the virtual measurements of the constructed circuit showing the input and output signals and (d) frequency characteristics. (e) Constructed multistage amplifier and (f) its working.

5. CONCLUSION

This paper proposes a novel e-Learning system that aids in the learning of electronic circuits with transistors. The proposed system enables users to understand the comprehensive theories and experiments pertaining to electronic circuits. The usefulness and effectiveness of the proposed system were verified by 10 undergraduate students, who served as experimenters on the system, in an actual university class. Positive responses, which pertain to the effectiveness and efficiency of the proposed system, were obtained from all the students. The technical suggestions from the users (Section 4) are necessary for improving the usefulness of the proposed system.

ACKNOWLEDGMENT

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TECHNOLOGY, GENDER ATTITUDE, AND SOFTWARE, AMONG MIDDLE SCHOOL MATH INSTRUCTORS

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ABSTRACT

Technology has gained a firm stronghold in society as well as modern classroom. Students are assumed to have a natural aptitude for computers. Over the past decades, educational websites have appeared to be “interactive” and “to make learning fun”. This study employed quantitative method of research using 8th grade instructors from South East Dallas Texas school district. Data was collected via Microsoft Excel and SPSS computation. The survey instrument tested for internal consistency and reliability. The seven Likert scale items tested nine variables for Pearson correlation. A t-test detected non-significance at the $p > .05$ level of probability indicating that male teachers seldom use technology to teach math than their female colleagues. A second t-test showed a significant difference at $p < .05$ level for difference between younger math teachers (male and female) versus their older counterparts.

KEYWORDS

Technology Attitudes, Teacher Attitude, Teacher Technology Use, Technology Integration

1. INTRODUCTION

The pervasiveness of technology in society has highlighted the need for schools to prepare students to take advantage of emergent technology tools (Keane, J. (2002). For this to occur, (Otero & Peressini, 2005) opined that “today’s classroom teachers must be prepared to provide technology-supported learning opportunities for their students” They also add that “being prepared to use technology and knowing how that technology can support student learning must be integral skills in every teachers’ professional repertoire”.

Technology has changed the role of teachers from “masters” to “facilitators” for students in the learning process. As facilitators, teachers introduce tasks, answer questions, prompt discussions, and summarize/present outcomes (Yank, 2004).

Middle school teachers have differing views on the use of technology in their classrooms. For instance, 54% of teachers see technology tool as a communication tool; 40% say technology is for productivity; 34% posits that technology is for research purpose while only 23% say it is for problem solving (ISTE, 2007).

Jaradat & Hoagland, (2009) notice three important advantages of using technology in mathematics. First, dynamic media (video, audio and multimedia) offers better learning and knowledge opportunities than static media by giving learners opportunities for dynamic interactions and inquiries with different components of the product. Second, new representational infrastructure offers opportunities to reintegrate previously achieved knowledge. Third, new systems of knowledge might be designed by employing infrastructure based on technology.

2. GENDER ATTITUDE

Attitude is everything. Teachers’ attitude (male or female) towards technology makes the difference. This assumption confirms the commonly accepted belief that attitudes affect behavior (Albirini, 2004). Existing variables such as access to equipment, administrative support, and time to mention just a few have strong effect on the use of technology (Demetriadis, et al., (2003), in a longitudinal study, (5 years) reported that teachers’ use of laptop, confidence level and skills improved remarkably but computer use with students in the classroom remained relatively low. Thus knowledge and skill acquisition depends on teachers’ attitude and their readiness to use technology (Koszalka, 2001).

3. GENDER AND TECHNOLOGY

Many studies have been carried out to investigate the question of gender and technology Bame, Dugger & Sharp, (2005). A commonly cited reason for many teachers limited use of technology is lack of skills. Batane, (2004), posits that both new and veteran teachers feel inadequately prepared to use computers in their classrooms. Most researchers in the early studies found that attitude towards technology differed significantly between males and females, with males indicating greater knowledge and interests (Liao, 1999; Meelissen, 2008; and Young, 1999).

Other researchers like Boxer, Palmer & Daudgerty, 1998; Krendi & Broihier, (1990) found that females perceived technology as more difficult and less interesting than males did. According to Linn, (2002), this could be as a result of dominant culture of males in technological fields. Other possible reasons, for gender differences could be violence in computer games that appeal to the male population (Sharp, 2005).

Recent studies however show that gender differences are no longer different. According to the American Association of University Women /educational Foundation, females perform as much as males if not better except that they just see them differently than males (Bain & Rice, 2006).

4. THE PURPOSE OF THIS STUDY

1. To explore the effectiveness of technology as perceived by male and female math teachers compared to the traditional approach that most teachers favor in South-East Dallas Texas.
2. To explore teachers' attitude (young versus old) towards the use of math technology (software)

4.1 Two Research Hypotheses Were Formulated

1. Male math teachers are less satisfied in the use of math technology (software) than female teachers.
2. Younger math teachers are more open to the use of math technology (software)

4.2 Scope

This study was targeted to a select section of a school district located in South East Dallas Texas. A sample from ten middle schools, drawn across the district was used.

4.3 Methodology

Only a select section of schools located in South East Dallas Texas district was used for this study. This includes a population sample of 21 Math teachers drawn from the 10 sampled middle schools. All of the teachers took part in the survey and that represented 100% participation.

Out of this number, (21), the males teachers were nine (9) and their female counterparts twelve (12) representing 43% and 57% respectively. The participants' age are in two groups. 39 and under was considered "young" while 40 plus was taken as "old". The decision to have two main groups became imperative after the response showed the age bracket (18-22) isolated leaving two age brackets (30-39) and (40 and above) standing strong.

4.4 Scales

The survey instrument held fifteen questions; including demographics, multiple choice, and Likert scale items. SPSS 18.0 was used to analyze the data. The seven Likert scale items tested for Pearson correlation (table 1).

Table 1. Pearson correlations on seven variables using the Likert scale items.

		evaluation	accessibility	recommendation	assessment	mastery	integration	performance
Evaluation	Pearson Correlation	1	.102	.203	.581**	.234	.384	-.084
	Sig. (2-tailed)		.661	.379	.006	.308	.085	.717
	N	21	21	21	21	21	21	21
accessibility	Pearson Correlation	.102	1	.110	.142	.412	.452*	-.253
	Sig. (2-tailed)	.661		.635	.540	.064	.040	.268
	N	21	21	21	21	21	21	21
recommendation	Pearson Correlation	.203	.110	1	.188	.161	.316	.042
	Sig. (2-tailed)	.379	.635		.414	.487	.163	.857
	N	21	21	21	21	21	21	21
assessment	Pearson Correlation	.581**	.142	.188	1	.257	.476*	.199
	Sig. (2-tailed)	.006	.540	.414		.261	.029	.387
	N	21	21	21	21	21	21	21
Mastery	Pearson Correlation	.234	.412	.161	.257	1	.377	-.088
	Sig. (2-tailed)	.308	.064	.487	.261		.092	.704
	N	21	21	21	21	21	21	21
integration	Pearson Correlation	.384	.452*	.316	.476*	.377	1	.319
	Sig. (2-tailed)	.085	.040	.163	.029	.092		.159
	N	21	21	21	21	21	21	21
performance	Pearson Correlation	-.084	-.253	.042	.199	-.088	.319	1
	Sig. (2-tailed)	.717	.268	.857	.387	.704	.159	
	N	21	21	21	21	21	21	21

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

The strongest correlations were evaluation and assessment at 0.58; integration and assessment at 0.48 and integration and accessibility at 0.45.

Male (gender code 1) math teachers are less satisfied than female (gender code 2) math teachers with the use of math technology – a t-test was run. There was no significant difference between male and female teachers in this population. The achieved value for equal variance assumed -1.682 – does not reach up to the table look-up value given for rejection of the null hypothesis (1.729). Therefore the null hypothesis cannot be rejected. The hypothesis that male teachers are less satisfied in their use of technology to teach math does not hold in this sample.

5. CONCLUSION

In this study, there is a distinct difference between math teachers that are young (39 and under) versus math teachers that are old (40 and above). Male (gender code 1) are less satisfied than female (gender code 2), but there was no significant difference between gender. Secondly, a 2.637 exceeded the value where the null hypothesis significant tests (NHSTs) can be rejected. Further, there is no significant difference between male and female math teachers in the use of technology software. The achieved value for equal variance assumed -1.682 does not meet the table look up value given for rejection of the null hypothesis (1.729). Therefore the null hypothesis was not rejected.

A follow-up study may perhaps be a comparative study on the effectiveness of technology in teaching math among male and female students.

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STRUCTURING LONG-TERM FACULTY TRAINING ACCORDING TO NEEDS EXHIBITED BY STUDENTS' WRITTEN COMMENTS IN COURSE EVALUATIONS

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ABSTRACT

A comprehensive adjunct faculty training program is described, whose aim is to improve student perceptions of courses and programs in a private, not-for-profit MBA and Law degree granting university in San Francisco, The program is somewhat novel in that it uses (a) student input from open-ended responses on course evaluations to determine faculty to be addressed, (b) it uses in-place online learning platforms and processes to deliver training, and (c) it includes a plan for monitoring faculty improvement, through hopefully improved course evaluations, mentoring, and course championing by full time faculty members.

KEYWORDS

Teacher training, faculty development, student evaluations, online, face to face

1. INTRODUCTION

Faculty training and development remains difficult and diffuse for some higher education institutions. The many inherent boundaries (between academic schools, departments, and programs), coupled with resource-scarce school environments, often relegate faculty development to one-off or inconsistently presented events, with little accountability on the part of both organizers and attendees. Yet the higher education community understands full well that improved teaching results in a higher quality educational experience for students, and that perceived higher quality teaching and learning can result in improved word-of-mouth "marketing" for programs, as students and alumni discuss their educational experiences among themselves in in their communities of influence. This is evidenced in the current dialogues on assessment tools as indicators of course and program quality (Aston & Antonio, 2012).

In the author's institution, these dynamics have long been acknowledged. Until now, there were not resources available to address the teaching quality situation in a positive way. Recently, a position titled "Director of Teaching Excellence" has been created in our private not-for-profit university, and a faculty member with interest and background in pedagogy is charged with creating a visible and sustainable faculty training program. The program integrates institutional resources into an ongoing, reproducible set of teaching/ learning interventions that address negative student perceptions and concerns about their course and instructor experiences with our university. In short, the premise is that a primary, actionable set of assessment products are the actual words of the students themselves, discussing their particular course experiences, utilized as indicators in the structuring of faculty training.

2. THE RATIONALE FOR THE PROGRAM

The institution has much in-house and regional, state and national data about student perceptions of their educational experiences. Most if not all of those data are reported statistically, meaning that we nave numerical interpretations of our students' responses. What these data invariably do not have are actual student comments. Thus, we end up with data featuring little context and no interpretation. Additionally, as part of our accreditation (Western Association of Schools and Colleges; see http://www.acswasc.org/), we are on a consistent path to provide program reviews based on various standard and traditional assessment tools and processes. While there is much dialogue on the various support activities faculty need for teaching improvement, (What Types of Support Do Adjuncts Need? 2012) there appears to be less discussion of the role that actual student qualitative data, that is the actual written comments of students on course evaluations, can provide as guidance for teaching interventions that can improve student perceptions of their educational experiences

3. THE DESIGN OF THE PROGRAM

To address that situation, and to provide a solid grounding for the training program, actual student comments from open-ended questions provided on course evaluations are gathered, analyzed and categorized, and used to shape teaching interventions. This somewhat novel approach allows for targeted adjunct teacher training activities. It is understood that all faculty may benefit from training, but given that a large majority of our courses are taught by adjunct faculty, that group is thought to be the logical starting place for our program.

4. COMPONENTS OF THE PROGRAM

Institutional resources: one sometimes overlooked dynamic in designing teaching/learning interventions is existing institutional resources. It may be thought that "we don't have the resources" to design and deliver workable faculty training and development activities. It's a precept of this paper, and the teaching excellence approach, that institutions may have sufficient resources, considering in house systems and the easy availability of web-based tools. Our use of existing resources is described in other parts of the paper.

Our university features a mature education-delivered-online entity named Cybercampus (https://elearning.ggu.edu/) through which we deliver 22 fully accredited degrees in Management, Information Technology, HR, Tax and Accounting as well as various ad hoc courses and programs. The site is also used as a portal for various institutional, school and department resources. This entity is used as a portal for information about the training program discussed here, as well as an archive for materials. It also supports group and individual email contact, and has a WIKI-like structure, which provides for easy group input and communication.

Course evaluations; using course evaluations to identity courses and instructors in need of assistance: All courses offer a formal student evaluation opportunity once during the semester, to be administered in the latter part of the semester. These evaluations are given in person in face to face courses, and administered online in the online learning environment. Scaled questions about students' experiences with the course are asked: course administration, course management, as well as questions specific to the instructor and his/her presentation of the course. Various administrative questions are asked also, that have no application to the training program.

In addition to the scaled responses, open ended questions are asked. It is here that rich data are often found, but until the program under discussion was put in place, these comments represented only anecdotal data. Over the years, there has been, though, a clear sense that those written comments have represented a form of truth about our courses and instructors that remained untapped.

The Process: It can be said that the process outlined below follows a systems model, (input = course evaluation written comments; process = analysis of those comments; output = training based on data) with feedback being provided by an instructor's performance in subsequent courses.

Overall course evaluation scores (5 point scale) for a control semester were ranked and placed into quartiles. Evaluations falling into the top and bottom quartile were chosen for analysis. The rationale is that we need to understand satisfaction factors among both high-performing and under-performing instructors in order to create appropriate training activities. Results were also divided between face to face and online courses, so as to make evident similarities and differences in responses between the two instructional modes.

Overall, student evaluation scores in our university are high, with an average of 4.3 on a 5 point scale. An important irony is that this remains generally (not always) true, even when written comments about a course are negative.

Findings: students' comments for high-scoring teachers and courses are, not surprisingly, the obverse of comments for lower scoring teachers and courses. In high-scoring course/instructor evaluations, students feel that positive factors are

Teacher engagement

Teacher enthusiasm and curiosity

Effective course management

Effective use of outside resources in a course: guest speakers, use of media (TedTalks, YouTube for example)

Content Expertise (in all modes and courses, content expertise is not often mentioned)

There is a direct connection between course content and the student's professional life. (This type of response is important, given that our institution features "practitioner-based instruction" that is applicable in professional business environments).

In low-scoring course/instructor evaluations, students report

Performance expectations are not clear

Course is managed poorly

Lack of teacher engagement

Lack of preparation

Lack of respect for students

Course uses dated materials; materials not updated from a previous semester

Lack of understanding of the diverse classroom (we have many international students as well as our "target" student, the working business professional).

Faculty are arrogant, egotistical and/or disrespectful

Gradebook is not up to date (most often reported in online courses)

Faculty are unprepared to teach in the online environment (online courses)

Faculty are not present in the course; faculty enter activities rarely, or not at all (online courses)

5. UTILIZING THE FINDINGS

The findings are being used to design training interventions, to occur prior to a teaching semester, to provide the instructor time to make suggested adjustments.

Within this time frame, a session is held for low-scoring adjunct faculty instructors, in face to face and online (Adobe Connect) modes. The sessions are intended to be archived. Instructors are highly encouraged to attend, both "as-needed" instructors and mentor faculty. Given that adjunct faculty are hired at will, improved course evaluation scores are seen as an attractive outcome.

The outcomes from the previous recent evaluations will be used to direct content for the training events. In initial sessions, importance is placed on the design of the syllabus, as a course management document, as an organizing principle for the instructor and students, and, perhaps most importantly, as a visible contract containing implicit and explicit course management and performance expectations for both the instructor and students.

In addition to design of the syllabus, faculty are acquainted with the results of the student comments, and various activities are presented intended to address those specific concerns.

What has not been done yet is to present separate trainings for adjunct faculty teaching online courses. Student comments re online courses fall into distinct categories, but we have not yet been able to undertake training specific to online courses.

It should be said that our online learning entity has highly skilled course designers who are active in the design of online courses, and who engage faculty throughout the design process as to effective online teaching. However, it is clear that some teachers who teach poorly online are requiring the additional impetus of training presented by peers in the teaching community.

As to tracking and subsequent interventions, we are at the beginning stages of our next steps. We will monitor the evaluation scores and student comments from courses the next time a "trained" faculty member teaches a course. This will be somewhat difficult, given that courses are not offered consistently across semesters. Another mitigating factor is that faculty may receive "lower quartile" scores when teaching one course, but not when teaching another. If an instructor continues to receive low evaluation scores, further intervention may be required, via other trainings, mentoring, through interactions with Course Champions, and perhaps by not being rehired.

6. SUMMARY OF THE PROCESS; CONCLUSION

A characteristic of this program that separates it from ad-hoc training is the use of actual student comments as input to shape training activities.

We intend that this program results in an ongoing, reproducible faculty training process that will over time become enculturated, that will move among the other entities in the university, and that will survive personnel changes. Much of the management of faculty data can easily be managed by support staff by slight adjustments to formal and ad-hoc enrollment and faculty reports, easily generated by university data systems, leaving the implementation of training to the Director of Teaching excellence and mentors as well as Course Champions.

The technology issues have proven relatively easy to manage. We use a combination of face to face / Adobe Connect session, and the sessions are archived. The online learning "portal" for the training program is easily accessible by all faculty in our School of Business.

The content of the trainings can, we feel, remain generally the same over time. It is our experience that student comments about the perceived high and low points of their courses are consistent. Faculty who are successful teachers exhibited the same characteristics in the past as the do now, and probably will in the future. Likewise, weak points in teaching have been the same in the past as they are now.

While several aspects of this program may be innovative, it is the use of course evaluation data over time, to both identify needs and track progress, that differentiates the program from others.

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INTEGRATION OF PBL METHODOLOGIES INTO ONLINE LEARNING COURSES AND PROGRAMS

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ABSTRACT

Problem-based learning (PBL) challenges traditional views of teaching and learning as the learner determines, to a large extent with support from a skilled facilitator, what topics will be explored, to what depth and which processes will be used. This paper presents the implementation of problem-based learning methodologies in an online Bachelor's program in adult education and digital technology. The processes of PBL in the online environment and the subsequent roles of learners, teaching assistants and instructors in the co-construction of the learning environment are examined. Implications for the institution and other research underway are discussed.

KEYWORDS

Problem based learning, online program, adult education, digital technologies

1. THE BA AEDT PROGRAM CONTEXT

1.1 BA AEDT Program Description

The Bachelor of Arts (BA) in Adult Education and Digital Technology (AEDT) program recognizes the growing importance of formal and informal lifelong learning as seen in the expanding professional development needs of post-secondary instructors. Similar requirements are apparent in corporate, community-based, professional and public sector workplaces. As the instructional demands of these large institutions and organizations continue to grow outside the traditional university and college-based education system, and as human resources departments turn their attention to the economic benefits of just-in-time online learning opportunities, there is an increased need for individuals with the knowledge, competencies and skills associated with teaching and learning in adult education environments in the digital age. The AEDT program intends to prepare a new kind of expert who is essential to the knowledge-based economy because they possess a broad social understanding of adult education and a specialized knowledge and competency-base of the use of digital technologies for learning. Current students in the AEDT program represent early – mid career adult learners who are working full time in higher education, healthcare, finance, government and manufacturing sectors.

The AEDT program is designed for advanced entry by those with a post-secondary diploma. A typical 36 hour (3 credit) course in the AEDT program is articulated in 12 weekly modules that include: (1) a collection of curated online resources comprised of a combination of 3 - 5 video clips of 5 – 10 minutes in duration and associated online readings which outline the contexts and/or situations within which problems can be identified; (2) online synchronous tutorials in Adobe Connect that are 60 minutes in duration. These are moderated by a Teaching Assistant (TA) and/or the course instructor and draw upon the analysis and synthesis questions posed in the video clip as the starting point for discussion; (3) online discussions in Blackboard or other asynchronous tools; and, (4) independent and group work on problem based learning (PBL) tasks as defined and negotiated by their collaborative teams. The 2014-2015 academic year represents Year Two for intake into the AEDT program. There are currently approximately 50 full time AEDT students with over 100+ students from other university faculties choosing to take one or more AEDT courses as electives.

1.2 AEDT Program Structure

In keeping with the need for access to information age courses and programs, problem based learning (PBL) is central to the design of the AEDT program and is defined as "a curriculum model designed around real life problems that are ill structured, open ended or ambiguous… PBL engages students in intriguing, real and relevant intellectual inquiry and allows them to learn from these life situations" (Fogarty, 1997, p.2). In each of the courses in the AEDT program, students or learners are working in teams on a variety of problem scenarios or contexts that combine to make up a unit or section of the course. Learners are expected to work collaboratively to initially identify or create a problem as presented in the situations or contexts and then subsequently to propose solutions to the problem using any and all synchronous and asynchronous tools available (Savin-Baden, 2007).

As further described in the AEDT Course Development Model (vanOostveen, 2013a), the PBL orientation of the program requires the setting of a context in which problems can be identified for students to investigate as part of the course work. Typically 2-4 PBL modules varying in length from 1 session to 4 or 5 weeks are incorporated into each course (Savin-Baden, 2007). The activities, assignment and assessments in the course then become the vehicle for the creation of solutions to the problems. Assessment tasks are authentic and focused on process rather than content (vanOostveen, 2013b). Each course in the AEDT program has used one or more aspects of several of the five models of problem based learning outlined by Savin-Baden, (2000) as part of its design philosophy. In addition, the following PBL design principles (Engel, 1991) inform every course in the program: 1) active learning; 2) integrated learning; 3) cumulative learning; 4) consistency in learning and, 5) learning for understanding.

The AEDT program design philosophy is informed by the Technology Competency and Use (TCU) framework which builds from a Community of Inquiry (COi) model (Garrison, Anderson and Archer, 2000) and "considers that a technology object serves as an interface between the user and: 1) other users, 2) stored information and 3) information processing tools or software" (Desjardins, 2014, para. 1). The TCU framework identifies four orders of technological competencies (technical, social, informational and epistemological) which are examined through the TCU survey instrument. The TCU survey has been used "to collect data in a variety of higher education settings and work is progressing on the analysis to explore trends in use as well as the associated competency and skill development" (Desjardins, 2014, para. 1).

1.3 AEDT Program Facilitators

Program instructors are drawn from the faculty ranks and augmented with sessional staff. There are also numerous teaching assistants working in the AEDT courses, all of whom are current graduate students in the Faculty of Education. The online pedagogical structure that underpins the AEDT program postulates that students, instructors and teaching assistants should be viewed as learners in the learning community that is instituted, each with equal standing from a power perspective but with different goals and responsibilities. Some of these learners (instructors and teaching assistants) primarily function as facilitators, stepping in to scaffold and support the community. While each facilitator diverges in different areas of content knowledge, each is committed to high standards of professionalism and aiding to the growth and expansion of knowledge for AEDT program learning community. Facilitators are required to possess and employ characteristics such as: empathy, intuitive awareness, introspection, and analytical skills. These combined with a collaborative team mentality appear to foster an effective online PBL environment (Hmelo-Silver, 2004; Hmelo-Silver, Duncan, & Chinn, 2007; Savin-Baden, 2007).

Facilitators who have personally experienced the processes of PBL generate integrity as they tend to be genuinely empathetic towards students and show high levels of affective support to nurture learners (De Grave, Dolmans, van der Vleuten, 1999), leading to the establishment of stronger relationships. Facilitators in the AEDT program who display a genuine interest in learning collaboratively as a team with the other learners, remove the power dynamic from their role and instead integrate into the community of learners as equals. Facilitators can then model and encourage introspection and analytical skills with others and foster engagement in the co-creation of knowledge. Facilitators essentially become cognitive apprentices by modeling reflection, questioning strategies and critical thinking (Collins, Brown, Newman, 1989). Effective online PBL facilitators must also display an intuitive awareness (Hmelo-Silver, Duncan, & Chinn, 2007) when guiding others in the construction and integration of knowledge (De Grave, Dolmans, van der Vleuten, 1999). Expert facilitators who exhibit an instinctive awareness of each learner's zone of proximal development (ZDP) and observe learners' non-verbal or subtle cues challenge learners in a non-aggressive manner (Vygotsky, 1978). Therefore facilitators who integrate themselves as a member in the community of learners build robust relationships that allow all learners involved to prosper in the PBLO environment.

The AEDT students, as equal members in the online learning community, also play an important role in the facilitation processes of PBL. As co-constructers of knowledge, the students need to be motivated intrinsically, communicate their conjectures with openness to constructive criticism and show perseverance with the desire to learn outweighing the discomfort that accompanies PBL (Hmelo-Silver, Duncan, & Chinn, 2007). As students move away from extrinsic motivation of grades, towards an actual desire to grow and expand their knowledge, this shift empowers learners to take responsibility and cognitively engage in their learning (Mayer, 2004). Once they have accepted their responsibility within the community they begin intellectual play with other members by communicating and defending their ideas, thoughts and conjectures and scaffolding other learners ideas through rebuttal and questioning (Puntambekar & Kolodner, 2006). In the AEDT program the process of experiencing PBL initially can accompany feelings of frustration for each member of the learning community as learners adjust to the new freedom afforded to them when the walls and constraints of traditional learning have been removed. Learners within the community (students, instructors and teaching assistants) need to embrace this cognitive dissonance in order to experience a critically reflective "aha" moment (Bencze, 2014). Habermas (1971) explains this reflective moment as the knowledge experienced that leads to a transformed consciousness. It is during this moment that the learner may ultimately emancipates their entrenched constructs of traditional learning while both recognizing and accepting the new liberties and boundless options possible. In the AEDT program it is usually after this "aha" moment when all learners in the community may arrive to a deeper understanding of the processes of PBL and the roles and responsibilities of each member in the community.

2. PBL USAGE IN THE AEDT PROGRAM

2.1 What is PBL?

PBL tends to challenge traditional views of teaching and learning since PBL, in essence, takes control of learning processes out of the hands of the teacher/expert and places it squarely on the shoulders of the learner. The learner determines, to a large extent with support from a skilled facilitator, what topics will be explored, to what depth and which processes will be used. Working from a video based case study which presents a real life context (Fogarty, 1997), learners create a problem or a set of problems which will become the basis of subsequent inquiries. PBL is organized around the contexts from which problems are drawn. The contexts then must be relevant and authentic in order to provide links that the learners use to make connections to their own experiences and interests (Hmelo-Silver, Duncan & Chinn, 2007).

A wide variety of problem orientations are used within the AEDT program. 'Given' problems, using the phraseology of Watts (1991), proceed from tightly constrained contexts within which the goal or desired situation and the strategies to be used are provided to the learner. Given problems are viewed in similar ways to Savin-Baden's (2000) Model I scenario. Learners operating in these scenarios are expected to apply predefined information to the differential between the current situation and the desired situation (S_D-S_C) and in so doing produce a solution to the 'problem'. The emphasis is on 'how to' rather than constructing new understandings or knowledge. Another way to conceptualize these scenarios would be to view them as 'projects' with a focus on the application of concepts to the focussed issue or 'problem'. At the other end of the continuum, constraint-free, 'blue-sky' type problems are also represented in a number of courses in the AEDT program. Watts (1991) talks about these as 'own' problems or problems in which neither the goal/desired situations nor the processes to be used to reach the desired situations are provided. These aspects are then left to the learners to determine and decide. Savin-Baden's (2000) Model V scenarios are similar in that they are characterised by providing learners with occasions to develop their own learning autonomy including "multiple models of action, knowledge, reasoning and reflection, along with opportunities for the students to challenge, evaluate and interrogate them. Students will therefore examine the underlying structures and belief systems implicit within a discipline or profession itself, in to not only understand the disciplinary area but also its credence" (p. 133). For example, when issues such as the juxtaposition of technological and sociological determinism when effecting tool choice and use is considered, students must be given opportunities to explore the implications for their own lives as well as for society at large. It is important for educators to be able to anticipate the beneficial and detrimental effects of a particular technology on students and for educators to determine how student groups will react to certain technological tools and affordances.

2.2 Strategies used in the AEDT Program

The PBL continuum manifests itself regardless of the type, complexity or features of the situations that are represented in the AEDT program. Contexts are presented in the form of publically (Creative Commons Attribution Licenced) available YouTube video clips. YouTube was chosen as the platform of choice due to its easy to use features, as well as its relative reach in that it seems to be ubiquitously accessible through an Internet connection from anywhere in the world. Each of the clips was purposefully created by instructional developers and in ways that are designed to be viewed by individual learners prior to coming together to discuss the created problems. Discussions between and among learners about the problems are conducted as tutorial sessions that are held in browser based virtual audio/video conferencing rooms. During these sessions learner work groups are initially established around similar problems. The learners then proceed to clarify the problem setting, gather the knowledge and resources that will be required to work towards creating solutions. The instructor and/or teaching assistant (TA) facilitates the collaborative discourse by interposing questions that are designed to serve as scaffolded supports enabling the learners to remain within their zone of proximal development (Hmelo-Silver, Duncan & Chinn 2007; Vygotsky 1978).

A third venue for interaction within the AEDT programs is centred on tasks and assignments which the learners undertake. Typically learners collaborate on these tasks and assignments within small groups of 3 or 4. The work itself is done using a vast array of mostly open access/source tools that are currently available. This is provides freedom of choice for adult learners rather than confining them to work specifically within the constraints of closed systems such as a learning management system (LMS). The only stipulation that is placed on the choice of tools is that it needs to be sharable with the rest of the class and the location of the work be known by providing the URL. The tools used include: Skype, Google Drive, Prezi, TodaysMeet, Blogger, etc. In most courses, learners will be asked to post regular metacognitive reflections and progress reports in some type of discussion board.

Since each of the courses in the AEDT program may use different definitions or models of PBL, the types of activities in which learners are engaged will also vary. In some courses, learners will engage ‘in explorations and analyses of data’, activities that are reminiscent of scientific investigations or inquiry learning and in others they will identify problems and ‘consult various resources to solve them’ (Hmelo-Silver, Duncan & Chinn 2007, p. 100) using processes that are very much PBL oriented. Therefore, for the purposes of the AEDT program, it is assumed that PBL and Inquiry Learning (IL) are similar as both require learners to collaboratively participate in ‘sense making, developing evidence-based explanations, and communicating their ideas (Hmelo-Silver, Duncan & Chinn 2007, p. 100). Frequently in IL, learners will be required to pose questions, collect data and then to test hypotheses or conjectures regarding answers to the questions.

3. IMPLICATIONS

3.1 Redefining HE Degree Pathways

By definition the AEDT program is situated to take advantage of the current interest in leveraging the potential of digital technology affordances in adult education contexts. It does this by providing alternatives for employment opportunities outside the Kindergarten to Grade 12 education system and capitalizes on the recent success of pathway programs, allowing qualified students with a college diploma to receive a university degree, while simultaneously decreasing the time required for completion. The AEDT program affords careers in HR management and training in the industrial, commercial and various other sectors by offering adult educators opportunities for professional development and advancement in adult education and human resource development.

With the course content numerous opportunities are presented to investigate the juxtaposition of prevalent but competing concepts, such as technological and sociological determinism. In addition, PBL allows for cognitive transformations, such as those described above, as learners explore adult education and the influence of digital technologies. Many of these transformations may be seen through a variety of theoretical lenses, such as the Puentedura's (2003) SAMR Model.

3.2 Institutional Implications

In addition to the individual transformations that occurred as a result of the implementation of PBL in online environments, a wide variety of key institutional requirements which are necessary to support this type of program emerged from the development of the AEDT program. Work done by vanOostveen, Partosoedarso & Robertson (2013) identified nine areas requiring attention at the institutional level in order for the AEDT program to be supported in a manner that could be considered comparable with competing programs. These include: (1) promoting effective communication about online programs within the institution; (2) determining a fee structure that respects online learners and the institutional needs; (3) enhancing online student life; (4) creating online orientation sessions; (5) creating online practice and learning communities; (6) providing access to formal administrative functions such as the registrar's office and program administration; (7) promoting the program and recruitment of learners; (8) increasing faculty flexibility and capacity through transformed understandings of pedagogy and learning; and, (9) developing and implementing specific online course and program evaluation processes. For an institution that is working to further establish its online presence, the ability for the AEDT program to help to elucidate areas requiring further attention has been critical to both the success of the program and the expansion of online offerings at the institution.

In addition, work is currently underway that builds on the initial experiences of the AEDT program and the TCU instrument itself, to examine the differential in what Watts (1991) would deem "given" and "own" and Savin-Baden (2007) would deem as "Level V PBL" performance assignments and personal profiles generated by the TCU instrument. The outcomes of this research will aid in the further refinement of the AEDT thesis exit courses and lay the preliminary groundwork for two larger research studies focused on the experience of program and elective students respectively in the AEDT online synchronous PBL learning experience. Taken together, these research projects and institutional implications have the potential to further the understanding of the intellectual, social and academic engagement of students in online synchronous courses and the supports required for them to be successful.

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IMPROVING TEACHER-STUDENT CONTACT IN A CAMPUS THROUGH A LOCATION-BASED MOBILE APPLICATION

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ABSTRACT

This paper presents a new mobile micro-broadcast (or near-me) Location-Based Service designed to promote face-to-face communication among users located within a given geographical area such as a University campus. Because the communication services provided are time dependent, the application decides whom to contact based on the geographic distance between the active subscribers of the service and the sender. The paper also presents some preliminary results of prototype evaluation.

KEYWORDS

Mobile computing, location-based services, face-to-face promotion, prototype evaluation.

1. INTRODUCTION

The current increasing penetration of smartphones in our society is a visible and undeniable fact (Canalys, 2012; Ismail & Razak, 2011). According to data revealed by the IDC European Mobile Phone Tracker in Marques (2012), smartphones market penetration may be related to the current capabilities of these "small computers", often nicknamed "pocket computers" (Sánchez *et al.*, 2011). Also according to Sánchez *et al.* (2011), this phenomenon is even more evident in our Higher Education campuses: "The students, due to their age, are the main users and purchasers". This current horizontal increasing penetration of smartphones can also be related to the inclusion of multiple sensors[1]. In this sense, the Global Positioning System sensor (GPS) has become the most used sensor by current mobile services and applications, giving rise to a new category of services commonly called in the literature Location-Based Services (LBS) (Schiller & Voisard, 2004).

1.1 Location-Based Services

Location-Based Services (LBS) were defined by Virrantaus *et al.* (2001) as "services accessible with mobile devices through the mobile network and utilizing the ability to make use of the location of the terminals". From a more user-centered view, Zipf (2002) defines LBS as "services for mobile users that take the current position of the user into account when performing their task". In 2004, Schiller & Voisard (2004) defined LBS as "services that integrate a mobile device's location or position with other information so as to provide added value to a user". From a more system-oriented view, such services were also defined in 2005, by the international OpenGeospatial Consortium, as services that: "deliver information about location to people who are using wireless, position-aware devices such as cell phones and PDAs. (OGC, 2005) According to Zipf *et al.* (2012), the LBS concept was early proposed in 2002 by Brimicombe as an "intersecting field of various technologies, namely Geographic Information Systems (GIS), Internet, and mobile networks/devices". So,

[1] In http://www.riehler.com/sensors-and-sensors/ by *Asad-Uj-Jaman*

basically, LBS are using the potential and the capabilities of modern mobile devices, positioning technologies and mobile Internet to deliver user value-added information or services based on the user's location. Although LBS seem something completely new and recent, this is not quite true. According to Zipf & Jost (2012), LBS had its origins in 1995 (at the same time as the Internet began expanding at a global level) from a mandate issued by the Federal Communications Commission (FCC) requiring that "… wireless carriers should be able to locate 911 callers within 50m of their location." (VanderMeer, 2002) Regarding Position/Location Data alone, its use started even sooner - in the 1970s. In the first decade, it was just used by the entity that created it, presently the owner of the Global Positioning System (GPS) - the U.S. Department of Defense (U.S. Government, 2013). Since 1980s, several were the industries that, at a worldwide level, have been accessing position data through the GPS.

1.2 The Common LBS Infrastructure

In general, LBS are not "standalone applications but rather services that require some sort of network connectivity" (Zipf & Jost, 2012). This is why any LBS is based on the following four key basic components, or individual elements (Ferraro & Aktihanoglu, 2011): Mobile Devices, Service and Application Providers, Communication Networks and Positioning Component or Service (Figure 1).

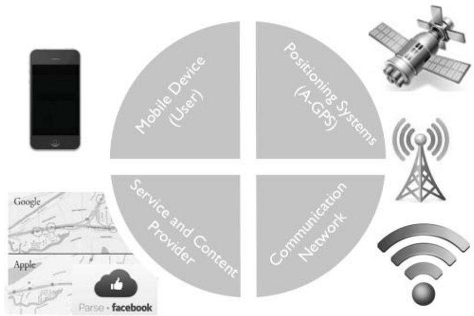


Figure 1. Four key basic components of any LBS

The ability to locate a mobile user or keep track of is one of the most important elements in all the LBS chain. Without this component, the mobile device cannot calculate the user location and, therefore, the LBS will be useless. According to Ferraro & Aktihanoglu (2011), "… it's become more common to be able to determine location via an API (Application Programming Interface) or software component to at least fix an approximate location". In fact, that has been the case with the major current mobile players - Apple with iOS and Google with Android. These mobile players have been providing freely access to their Software Development Kits (SDKs) to any mobile developer, that can now take advantage of the GPS or other location technology and, further more, in conjunction with realistic graphical maps. According to Cruz-Cunha & Moreira (2011), this reality leads to a fact that must be taken into consideration: "… these new mobile devices have become a platform with many possibilities to develop research and implement new kind of LBS".

1.3 Some Examples of Location-Based Services

Based on the existing commercial offer in the online Apple App-Store and among research projects in the area, the WIZI SMS LOCATION App and the CONNECTOR (Almeida *et al.*, 2012) Research Project were identified as the most relevant mobile applications, considering the similarities with the goals of the present prototype: the promotion of face-to-face communication between users located within a given geographical area. The analysis made can be seen in Table 1. These two LBS examples have contributed and provided the basis for the implementation of the prototype "I'm on campus and …", as will be seen further on.

Table 1. An excerpt of a checklist of the features/characteristics available on apps similar to "I'm on campus and . . . " (August 2013)

Features/Characteristics	WIZI SMS LOCATION	CONNECTOR
Require registration to work?	NO	YES
Send the current location by	SMS or email	-
Map provided by	Google	-
Context-sensitive help to the composition of the messages?	Just one field-level assistance.	NO
micro-broadcast Time Dependent (near-me notification)?	NO	-
Implemented scenarios:	1. Travel Status	1. Academic Events
	2. Leisure activities plan	2. Status
"Follow Me" background mode (User tracking)	YES	YES
On-App Chat:	NO	Instant Messaging (IM)

1.4 Mobile Developer Platforms Trends

As far as the development of native apps is concerned, according to data revealed by Mobile Vision (2014), both Android and iOS captured "over 94% of smartphone sales in Q4 2013". This data may explain why these two platforms continue to be the prioritized choices for the current mobile developers: "… 84% of mobile developers are now developing for Android or iOS (or both), the two clear winners in the developer mindshare race". This is because, at this point, for many developers the question is not which mobile platform to develop, but rather, which mobile platform to prioritize.

1.5 Face-to-face Promotion

To end this first section, related to this research study's context and motivation, one more concept must me addressed. Maybe it can be translated by the following question, suggested by Grossman (2011): "*Is face-to-face learning still important*"? Though, nowadays, there are several technological solutions to overcome the barriers of time and space, when one speaks of Education, several research studies show that face-to-face communication is still the preferred medium over all forms of computer-mediated communication (Daniel Johnson & Sutton, 2000; Hardesty, 2010). As Escotet (2013) contends, maybe because "Education as a general concept" should be neither confused with just "Instruction", nor considered only "teaching or instruction, but social and cultural learning". Therefore, as stated by Grossman (2011), nothing can be compared to face-to-face communication: "communicating face-to-face sends a message before you say a word.

Having outlined the main technologies which were used to prototype a new micro-broadcasting LBS to promote face-to-face learning, as well as having contextualized and presented the main motivations behind this research study, in the next section, the prototype implementation will be described, covering these three main topics: Goals and Target Audience, System's Model and Architecture, and Functional Aspects. Finally, in the last section, usability and preliminary user experience evaluation results are presented and discussed.

2. PROTOTYPE AND EVALUATION METHODS

The "I'm on campus and ..." mobile app prototype was developed in Objective-C for mobile iOS platforms and it uses Parse Cloud as the mobile Backend as a Services (mBaaS).

2.1 The Prototype

2.1.1 *Goals and Target Audience*

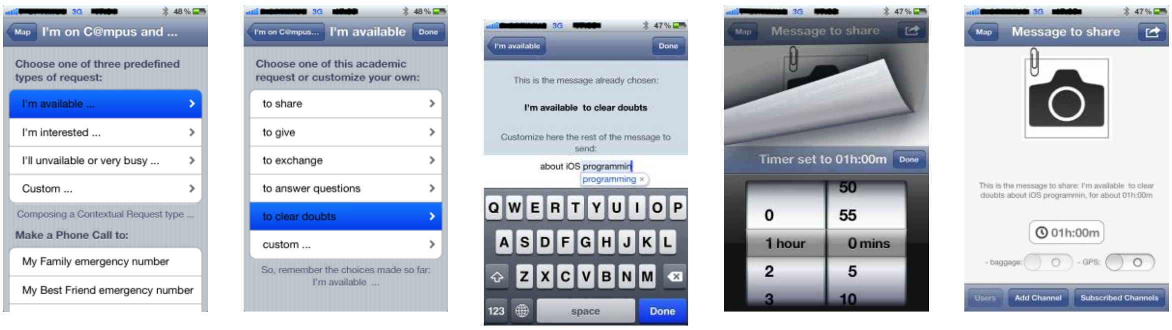
"I'm on Campus and …" implements a new kind of LBS that aims to provide some specific communication service support for people interacting in a limited geographic area, such as a Higher Education campus, to promote face-to-face communication. Consequently, the main target audience will be teachers and students belonging to particular academic campus.

2.1.2 *System's Model and Architecture*

Like any LBS, as it was stated before and illustrated in Figure 1, the "I'm on campus and ..." follows a client-server architecture comprising the "standalone application" (the iOS client mobile app) and "*some sort of network connectivity*" (Zipf & Jost, 2012) to be able to deliver the whole package of functionalities proposed: (1) *The Mobile Device* - any iOS mobile device (iPhone, iPod Touch or iPad) where the app must be downloaded and installed from the App-Store. (2) *The Communication Networks* - the existence of any network connectivity supported by the iOS device (3G/4G or Wi-Fi).(3) *The Positioning System* - the A-GPS is the location embedded engine/sensor present in the iPhone or iPad 3G/4G. (4) *The Service and Application Provider* - Parse was the mBaaS chosen. For the present research purposes, the Basic Free Plan is being used.

2.1.3 *Functional Aspects*

The communication services provided by "I'm on Campus and …" are context-based and both context- and time-dependent, and include the possibility to offer or request specific support from active subscribers located within a specific geographic range. One of the key features of this App is a context-sensitive help to the composition of the messages. Therefore, the App offers to the user field-by-field assistance. Currently, the options available include the following scenarios: (1) The possibility to express availability for some specific activity to be performed at a specific location during a specific time frame; for example, Figure 2 shows a professor notifying near-localized students of his/her availability to provide some academic support. (2) The possibility to notify other users of specific interest; for instance, this may be used for a student to let his/her classmates know that he/she is interested in getting in contact with colleagues keen to play chess in the next 3 hours and that they can meet at the cafeteria. (3) The possibility for a professor to notify his/her students or colleagues that he/she will be very busy during the next hour and would appreciate not to be disturbed within that time frame.



(a) I'm available … (b) to clear doubts … (c) … (d) for about 1 hour … (e) Complete message

Figure 2. Field-by-field context-sensitive aids to compose a "I'm available . . . "-type message: I'm available to clear doubts about iOS programming, for about 01h:00m

2.2 The Evaluation Methods

The prototype evaluation ("I'm on Campus and . . . ") is being carried out in two different stages. (1) In the first stage, related to the evaluation of Usability and User eXperience aspects, tests were carried out in a controlled environment, a lab and several offices, according to the availability of the participants. An option for a qualitative study was based on the idea that, as Nielsen Norman Group states "... you don't have to measure usability to improve it"; "it's enough to test with a handful of users and revise the design in the direction indicated by a qualitative analysis of their behavior" (Nielsen Normal Group, 2006).

(2) In the second stage, a User eXperience field trial is being conducted at the Viana do Castelo Polytechnic Institute (IPVC) Campus. The focus of this study is the usefulness of the service and the

consolidation of the preliminary User Experience results obtained in the first stage. The methodology approach is also being a qualitative study.

According to Nielsen Norman Group (2000), with a sample of 5 users we can achieve 85% of Usability Problems. This is why we invited two groups of 4 users each - one formed by 4 students and another composed by 4 teachers, to a total of 8 users for the first stage. The option by these two kinds of profile were based on the fact that they are the main target audience of the service provided by the App, with aims to promote the face-to-face interaction between these two major groups in a Higher Education campus. The instruments to collect the data in this evaluation phase were the following: (1) A survey questionnaire to be filled out by the participants during the Usability tests. (2) Three iOS Devices, two with the "Display Recorder" app to record on video the entire user interface interactions and, simultaneously, the audio from verbalized thoughts, doubts and comments, according to the 'Think Aloud Protocol'. (3) An observation Checklist to be filled out by the researcher during each session to assure a rigorous data registration. The evaluation tests were performed with each participant individually and always in the presence of the researcher.

3. USABILITY AND UX FIRST RESULTS

The data collected in the first section of the survey questionnaire has the main goal of revealing the most relevant usability problems. It was filled out by a sample of 8 users and where each user performed the following 5 practical scenarios: (1) User sign-up, user log-in and user localization; (2) I'm on campus and I am driving to Aveiro in about 30 minutes and have space for 2 passengers with baggage; (3) I'm on campus and I need a ride to Porto for 1 person with baggage, in about 2 hours. (4) I'm on campus and I'm available to clear doubts about iOS, for about 3 hours; (5) I'm on campus and I'm interested in forming a study group on iOS programming, for about 1 hour. The second section of the same survey questionnaire, filled out at the end of each usability session, has the main goal of catching the preliminaries evidences about the User eXperience.

From the first section, the data collected provides some evidence about (1) **Task efficacy** - all the tasks were successfully completed as requested; (2) **Interface validation** - although some usability issues were detected, in terms of "Easy to Use", we think they are not so critical that justify a new version of the app to move to field trial (real usage scenarios tests).

Table 2. Usability and User eXperience (UX) data collected from a sample of 8 users: value 1 corresponding to "I strongly disagree" and value 5 "I strongly agree"

A_i - Affirmation i with $i \in [1-15]$	1	2	3	4	5	$\bar{x}$	σ
A_1. It was simple to use the app.	0 - 0.0%	0 - 0.0%	1 - 12.5%	2 - 25.%	5 - 62.5%	4.5	0.76
A_2. I managed to achieve the desired goals with the app.	0 - 0.0%	0 - 0.0%	0 - 0.0%	1 - 12.5%	7 - 87.5%	4.9	0.35
A_3. I used the app effectively.	0 - 0.0%	0 - 0.0%	0 - 0.0%	2 - 25.0%	6 - 75.0%	4.8	0.46
A_4. I think that I need to know more about the app to use it in an efficient manner.	1 - 12.5%	1 - 12.5%	0 - 0.0%	4 - 50.0%	2 - 25.0%	3.6	1.41
A_5. It was easy to learn using the app.	0 - 0.0%	0 - 0.0%	0 - 0.0%	3 - 37.5%	5 - 62.5%	4.6	0.52
A_6. The app does not need more help messages.	1 - 12.5%	2 - 25.0%	0 - 0.0%	3 - 37.5%	2 - 25.0%	3.4	1.51
A_7. The app. provided me the proper feedback to my actions.	0 - 0.0%	1 - 12.5%	1 - 12.5%	1 - 12.5%	5 - 62.5%	4.3	1.16
A_8. I felt that when I make an error, the app allows me to easily and quickly recover from it.	0 - 0.0%	1 - 12.5%	2 - 25%	0 - 0.0%	5 - 62.5%	4.4	1.06
A_9. The app provided me all the information that I needed.	0 - 0.0%	1 - 12.5%	0 - 0.0%	3 - 37.5%	4 - 50.0%	4.3	1.04
A_{10}. The information in this present app is clear and organized.	0 - 0.0%	0 - 0.0%	2 - 25%	2 - 25%	4 - 50.0%	4.3	0.89
A_{11}. The app has basically the functionality that I expect from an App of this category.	0 - 0.0%	0 - 0.0%	0 - 0.0%	1 - 12.5%	7 - 87.5%	4.9	0.35
A_{12}. The app allowed me to explore functionalities by trial and error.	0 - 0.0%	0 - 0.0%	1 - 12.5%	1 - 12.5%	6 - 75.0%	4.6	0.74
A_{13}. Overall, I'm very satisfied with the app.	0 - 0.0%	0 - 0.0%	0 - 0.0%	2 - 25%	6 - 75.0%	4.8	0.46
A_{14}. I'll use this app in the future.	0 - 0.0%	0 - 0.0%	0 - 0.0%	3 - 37.5%	5 - 62.5%	4.6	0.52
A_{15}. I consider this app very useful and I'll recommend it to my friends.	0 - 0.0%	0 - 0.0%	0 - 0.0%	1 - 12.5%	7 - 87.5%	4.9	0.35

From the second section of the survey questionnaire, the data was summarized in Table 2 and provides evidence about (1) **Learning Time and Efficiency of Use** ("Easy of Use") - related to Learnability, Effectiveness and Efficiency quality metrics - the majority of users declared that the interface interaction was very simple to use, very easy to learn and very efficient; (2) **Memorability and User Errors** - related to Help and Feedback, Error Recovery and Information Over-load quality metrics - some users declared that they need some more help and feedback messages; (3) **Subjective satisfaction** - related to Satisfaction, Future Interest and Usefulness quality metrics - all users confirmed the usefulness of this new micro-broadcast LBS in Campus scenarios and also declared their future interest in using the app.

4. CONCLUSION

Despite the relevance of these evaluation activities, it is important to underline that these tests were made in a controlled environment - a laboratory. So, a field trial was required in order to provide further evidence about: (1) What are the most frequently used scenarios and under what circumstances the app is mostly used? (2) With which perception each user stayed in terms of qualities, gains and weaknesses of the app? (3) Finally, with which perception each user stayed in terms of control, privacy and safety when using the app? Although these tests are still underway in ESTG/IPVC campus, we are confident that with the accomplishment of these field trials we will understand more in-depth the real interest in having this kind of new mobile micro-broadcast, or near-me, Location-Based Services in a campus. More precisely, with real usage scenarios tests we are very convicted that we can achieve a better understanding of how much this new mobile service will develop and facilitate the interrelationship and interaction between users located within a given geographical area, and how useful it will be to have a service of this kind on a campus to promote face-to-face learning.

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INCORPORATING COLLABORATIVE, INTERACTIVE EXPERIENCES INTO A TECHNOLOGY-FACILITATED PROFESSIONAL LEARNING NETWORK FOR PRE-SERVICE SCIENCE TEACHERS

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ABSTRACT

This paper describes the utilisation of a technology-facilitated professional learning network (PLN) for pre-service teachers, centred on chemical demonstrations. The network provided direct experiences designed to extend their pedagogical content knowledge on demonstrations in Chemistry teaching. It provided scaffolded opportunities to collaborate as they 'negotiated their identity' as chemistry educators. Using technology to facilitate conversations around the use of chemical demonstrations was seen as advantageous as it provided an explorative workspace to discuss and refine pedagogical approaches. Importantly, it was anticipated that through these personal experiences the pre-service teachers would better understand ways to utilise technology within a PLN. The design of the PLN, and two examples of discussions designed to phenomenologically explore the teaching and learning associated with chemical demonstrations, ably facilitated by technology, are described here.

KEYWORDS

Professional learning network, Science, pre-service education.

1. INTRODUCTION

Today's pre-service teachers are active users of a wide range of social technologies. Whilst their perceptions on how to utilize technology for learning varies, for the most part they share an obligation to use technology effectively (Linehan & McCarthy, 2000, Redman & Rodrigues, 2008). Within the Science Education program at the Melbourne Graduate School of Education, The University of Melbourne, the pre-service teachers are provided with strategically placed science education learning opportunities by explicitly embedding collaborative, engaging and integrated eLearning experiences within teaching practice. Research evidence (Redman, 2013) indicates that situating these new technologies within cognitively challenging, collaborative and engaging contexts leads to development of positive identities for pre-service teachers as learners and teachers with new technologies.

This paper presents one aspect of ongoing research to document and identify the thinking and pedagogical practices of pre-service teachers as they utilize technologies as learning and reflective tools. The researchers pay close attention to the pre-service teacher's perceptions of technology for effective Science learning, as well as their visions for technology use for their Science teaching practice. This research is being supported by an eLearning Learning and Teaching Initiative (LTI) grant (The University of Melbourne). As pre-service teacher educators, this research also informs our own practice, and helps align Science teaching in the subjects with students' current usage of technology (as well as helping us support their future needs).

This research reports on the utilization of a technology-facilitated professional learning network (PLN) with Chemistry pre-service teachers. Explicitly, the PLN provides direct experiences that extended their pedagogical content knowledge on chemistry demonstrations in Chemistry teaching practice. Implicitly, opportunities exist to collaborate as they 'negotiate their identity' as chemistry educators, and to develop an identifiable and shared language for teaching and learning. Focussing on discursive practice, incorporating 'do' and 'say' of the educator and the learners, is supported by the pedagogical standpoint that meaning is co-constructed in discussion with others. A key premise is that meaning is further improved by making learning and the language associated visible to the learner (Hattie, 2003). Supporting choice, curiosity, discovery and collaboration are seen as vital to the 21st century learner (Hayes, 2006), as is placing language at the centre of empowered teaching and learning (Bourdieu, 1994).

In Chemistry Education, which is largely the study and application of abstract concepts of atomic matter and sub-atomic interaction, educators and learners have always been challenged to teach and learn on multiple levels simultaneously. Students are required to think on a macroscopic level, that is the visible, the descriptive and functional, as well as the sub-microscopic level, that includes the invisible, but what explains why chemical substances behave as they do, and also the symbolic level, incorporating the visual, algebraic depictions of chemical understanding (Johnstone, 1982, 1993). Building an appreciation of pedagogical approaches that can be utilised to facilitate knowledge construction on these multiple levels (Gilbert et. al., 2002) has become an important aspect of Chemistry pre-service teacher education.

One such pedagogical approach to address the multiple levels is the chemical demonstration. The teacher demonstration, either with or without student involvement is a key teaching practice for Science pre-service teacher to learn to master. This involves questioning techniques, understanding methods of meaning making and facilitating the assimilation of concepts of Science through concrete observations.

Using technology to facilitate a conversation around the use of chemical demonstrations was seen as advantageous as it provided an effective way to support the explorative workspace to discuss, improve and 'fine tune' pedagogical approaches not only for individual demonstrations (timing, use of questioning, observations to highlight, opportunities for student involvement etc.), but also for the use of demonstrations as a whole. Importantly, it was hoped the pre-service teachers would begin to appreciate the benefit of these discussions, including a broad range of collaborative feedback and reflection experiences, occurring within a PLN, ably facilitated through technology. These approaches, along with a few examples of their use, are described below.

It is notable that we tried to create a collaborative environment for learning that had invited the technology to show effective uses. Salomon, Perkins and Globerson (1991) stated that "it is not technology alone affecting minds, but the whole 'cloud of correlated variables', technology, activity, goal setting, teacher's role, culture…exerting the combined attempt" (p. 8).

2. METHODOLOGY

2.1 Participants

The participants were a cohort of Chemistry method pre-service teachers enrolled in their first semester of the Master of Teaching (Secondary) course at the University of Melbourne. During their first week, the pre-service teachers were provided with a link to an on-line survey, of which 50 of 56 enrolled students responded. The survey focused on a number of areas including; their use and relationship to new technologies; perceived benefits of using technology in the classroom; goals and vision for teaching and learning; perceptions of how ICT can be used to support their own professional learning. The survey also asked some chemistry-specific questions including about their own chemistry education background, their perceptions of effectiveness of chemistry demonstrations, and their current confidence in Science pedagogy.

The survey responses are being coded and analysed using Positioning Theory (Harré, 1997) and referenced against Bloom's taxonomy (Anderson & Krathwohl, 2001) to determine their existing perceptions and approaches for using technology. Comparing these to a similar survey completed at the end of the semester provides some insight as to how their perceptions of effectiveness of technology changed, for using technology for their professional learning, and their emerging confidence in teaching chemistry.

2.2 Design of the Professional Learning Network

Each week, two-three pre-service teachers present a chemistry demonstration to the rest of the pre-service teachers, around a central theme for the week (acid-base, gases, teaching junior levels etc.). As part of this presentation, they describe what they see as the challenges of teaching and learning associated with the theme for the week, and how their demonstration could be used and conducted as an educative experience.

A series of collaborative feedback and reflective experiences then follow. Depending on the week, two-four fellow pre-service teachers are pre-allocated to participate in an online discussion around the particular demonstration presented that week. These online discussions were framed by the use of one of four different diagnostic tools that gather perceptions of effectiveness, and the perspectives of the teacher and learner. These are described in more detail in the next section.

All discussions took place in google drive documents, in a shared google drive folder between the pre-service teachers and the educators. The pre-service teachers were given a session on how to utilize and collaborate within the google drive documents together as a group at the start of the semester, but other than that the pre-service teachers were left to decide on how best to participate and complete the collaborative exercises together.

At the start of the next week, the entire cohort gather around two-three tables to have an informal 'summing up' discussion. This includes the presenter of the demonstration, those who were allocated to participate in the online discussion, and other interested members of the cohort. Whilst largely an informal 'chat', this was seen as vital to the researchers, as it brought to the fore the meta-cognitive nature of these discussions, and provided further opportunity for voice and to question, providing a more enriching personalized learning experience.

Finally, the demonstration presenter is also tasked with writing a brief reflection and posting this in another shared exploratory workspace. *Edmodo* was used for this purpose, given that it provided a highly personalized experience, and allowed for the cohort to post and share resources with each other in a free, secure social learning platform. The posts written by the demonstration presenters summarized some of the feedback and comments from the online discussion and the follow-up discussion. These were written as a self-reflection on their ability to conduct the demonstration as an educative experience.

3. RESULTS AND DISCUSSION

Four different approaches were trialed as collaborative experiences facilitated by technology. Each were chosen for their ability to gather and document perspectives of the participants, from a phenomenological view, i.e. what the teacher and the students were 'seeing' and 'doing' during the delivery of the chemistry demonstration. Each required little or no modification to be utilized in an online exploratory workspace.

The four approaches were a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis; the SCAMPER (Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, Reverse) technique; a Collaborative Interactive Discussion (CID), and; a Personal Meaning-Making Map (PMMM). The first two were known to the pre-service teachers. For the later two, class-time in an early session was allocated to allow the teachers to undertake one of each, to promote how these could be used to make thinking visible, document and discuss their perspectives, and how this could be done in an online social environment.

Figure 1 below shows a CID about a chemistry demonstration, lead iodide precipitation with different reagents in excess (Commons & Hoogendoorn, 1990), which took place in an online environment. Briefly, the pre-service teachers are all shown the same 'focus statement', and are then given different 'focus questions'. Each participant fills in the response in the first row, with a 1-2 word response in the left column, and a longer response in the right. They then move on to responding to another participant's initial response to a different focus question and so on (Ryan and Jones, 2014).

An analysis of their utilization suggested that the participants were able to deeply explore the discursive practice of each chemical demonstration. Facilitated by technology, this gave individuals time to consider their response and the comments of others, and provided an equal voice to all participants. One negative was that as the duration of the discussion was considerably longer than if it had occurred during a class workshop, participants often had to wait for their turn to respond, which perhaps limited the buildup of narratives in the shared workspace.

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24		
25	**Focus statement**	
26–28	A good 'mole' demonstration makes an amount of substance visual to the learner. A great 'mole' demonstration goes further and shows the amount of substance to not be defined by its mass and/or its volume.	
29		
30	**Focus question**	
31	What could be done to enhance the key observation in this demonstration. What do we want to learner to focus on, and make use of building new knowledge?	
32		It was very hard to actually see the total height of the solid/liquid mixture, as well as the position of the interface. Preparing the samples more carefully and earlier, to give a longer sedimentation time, could make things clearer. Using a thinner stirrer to mix the solutions together would help.
33	Slow though	Maybe by inserting the second solution slowly into the bottom of the measuring cylinders might help "neaten" up the experiment so we can easily visualise the heights of the precipiates.
34	not clear interface	Much bigger samples, in bigger vessels will allow clearer view of the solids-liquid interface and the main key of this demonstration will be much clearer
35	Yes, but...	Perhaps another compound that precipitates so students could compare and do a few formulas at once may also enhance their experience and learning
36		
37		
38		
39		

Figure 1. Excerpt from an online collaborative interactive discussion (CID) around a chemical demonstration.

Figure 2 below shows a personal meaning-making map (PMMM) of one participant written after observing the Carbon pillar demonstration (Commons & Hoogendoorn, 1990), and the follow-up discussion had with another participant (which would appear underneath the map in the google drive document). Inside the online document, the pre-service teacher was easily able to gather their perspectives using the figure drawing function, as shown here, or take a photo of a hand-drawn picture and upload the picture with any device. Having generated the discursive ideas to discuss, a second participant (another pre-service teacher in the cohort) then came into the online workspace to ask clarifying questions, providing an opportunity for the map maker to elaborate on their ideas and further identify and document their meaning making processes (Falk & Dierking, 2002).

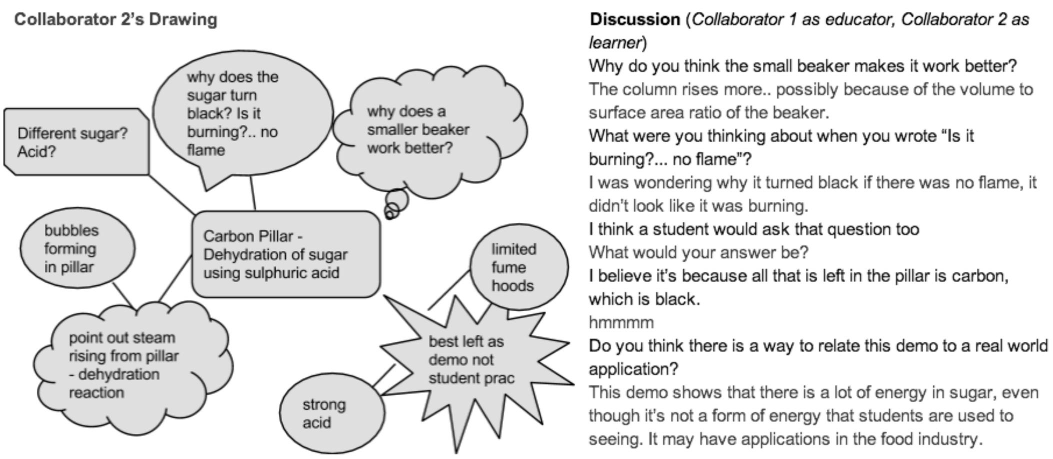

Figure 2. Excerpt from an online PMMM drawing and discussion (modified from original)

Each of the four approaches trialed, including the SWOT analysis and SCAMPER technique, did not appear to lose any authenticity or capacity for free choice by moving the discussion into an online exploratory workspace. As described above, the 'drawn out' nature of the discussion was seen as the main negative, but perhaps this also highlighted to the participants how learning with others in an online social environment can be a constant, ongoing journey of reflection and discovery.

A follow-up survey of participants occurs at the end of semester, and is used to analyze and track how their perceptions of the use of ICT for professional learning have changed, and their 'goals' and 'visions' statements for their use of ICT in teaching practice will again be coded and analyzed to determine if the 21st century skills we as higher education educators have tried to demonstrate have started to translate into their own teaching practice.

4. CONCLUSION

This study examined how a combination of pedagogical approaches were utilized to help redefine teacher identities. Through these experiences we anticipate these teachers are more likely to be willing to incorporate technology in their classrooms. A number of approaches were utilized to facilitate novel collaborative and reflective online discussions around language and discursive practice associated with a series of chemistry demonstrations. Technology ably facilitated this approach, and its affordances allowed for more voice and authentic responses from its participants. A survey of initial perceptions of the use of ICT for professional learning showed a broad range of opinions and abilities, and so it is expected the upcoming follow-up survey will show a cohort of pre-service teachers who are building an appreciation of how technology can be used to analyze and improve their professional learning and teaching practice.

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THE EFFICIENCY OF E-LEARNING ACTIVITIES IN TRAINING MENTOR TEACHERS

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ABSTRACT

In the present article we aim to present the general framework related to the laws and practice of mentorship in Romania, as well as the results of a related investigation of the POSDRU project concerning the training of professional insertion mentors, "From start to success – national program for the professional insertion mentorship of teachers". The paper aims to measure the degree of efficiency of the project's e-learning platform. In this sense we are using an evaluation model for e-learning activities called Kirkpatrick's progressive evaluation model on 4 levels: Reaction, Learning, Behaviour, Results. To obtain a maximum congruence with these 4 progressive levels we use the following research methods: document analysis and survey-based research. The sample was comprised of 342 teachers from the lower secondary system, participants in the project in order to obtain an extra mentor qualification. The data processing was done in the IBM SPSS software package, the obtained results indicating a maximum level of efficiency of the project's e-learning platform both in assuring a high level of learning as well as implementing information on a behavioural level and the impact on the organizational context through the effects it can produce.

KEYWORDS

E-learning platform, Kirkpatrick's model, mentorship, teacher training

1. INTRODUCTION

In the present article we aim to present the general framework related to the laws and practice of mentorship in Romania, as well as the results of a related investigation of the POSDRU project concerning the training of professional insertion mentors, "From start to success – national program for the professional insertion mentorship of teachers". In the national law of Education no. 1/2011, in article 236 (1), letter c, apprenticeship is seen as part of the initial training: every apprentice teacher undergoes a 1 year long practical stage in a school, under the coordination of a mentor teacher. During the apprenticeship period we can observe an ever growing exit from the system of the young apprentice teachers (over 500 annually), which reconvert to other fields of activity, not only for financial reasons, but also for the lack of support programs aimed at overcoming difficulties in adapting to the professional environment. Every year 1000 graduates receive tenure. The weak methodical training is reflected in the results at the tenure contest: from 7241 enrolled in 2007, 1764 (33%) were accepted; from 8890 enrolled in 2008, 2264(47,3%) were accepted. Although the legal framework for supporting an apprentice teacher is new in Romania, it's important to mention that in the Romanian Education system theoretical and practical experiences exist, concerning the mentorship activity, several national and international projects of this type being organized in the last few years: the MOSS (Mentor Observation and Support Scheme) aimed to create national standards for the mentorship activity through elaborating a structure to support mentors (of all specialties) through the involvement of all mentorship partners; Romanian trainers have delivered such training activities, consultancy and experience exchange with countries such as Hungary, Ukraine, countries from the former Soviet Union, Latvia, Bulgaria (http://asmero.ro/index.php?module=cms&page=79); the START project - The purpose of the project is to create and implement a training model that leads to the systemic professional development of apprentice teachers in the first 2 years of their teaching career (http://www.euroed.ro/index.php/home).

The project "From start to success – national program for the professional insertion mentorship of teachers" held between February – December 2013 aimed to improve the professional insertion of apprentice teachers from the lower secondary school educational system through the development of a national, formal and coherent system of apprenticeship. The professional insertion concept outlines the integration process of a young apprentice or new employee in the professional environment for which he received specific training (L. Ezechil, 2013, page 1). The improvement of professional insertion of teachers involves that this process is so well done that it provides teachers who are performers to the education system starting from their career beginnings and on the other hand it retains them into the system. The teacher is not yet fully qualified, so he is called a candidate or trainee, even if he runs certain teaching activities. This form of training that belongs to the initial training period is present in numerous European countries: Germany, France, Luxembourg, Portugal, Austria, Scotland, Holland, England, Cyprus, and Slovenia. There is, in education systems from other countries, a transition period of 2-3 years, in which the young teacher, the apprentice, does not have the status of a definitive teacher, but obtains it if he fulfils certain criteria concerning the quality of his teaching activity, promoting certain forms of examinations. This is the case in Greece, Spain, and Italy. Only half of the countries in Europe offer new teachers a certain method of support in their first year of teaching. In the school systems there are various guidelines for transferring initial training of teachers to their actual professional activity. For example, the duration of programs varies from 7 months to 2 years. In the majority of countries, mentor teachers, most of the time in cooperation with the school's director or other more experienced teachers, have the responsibility to help teachers start up. Experienced teachers, invested with the role of tutors (mentors, trainers, counsellors, coordinators) have the task to offer support to candidates from 3 points of view: 1. training for their teaching activity; 2. knowledge and adapting to the school environment; 3. monitoring and evaluation of professional activities of the candidates. Therefore, we can see the effort of education systems in several countries to facilitate the transition of future teachers towards their full professional activity (L. Şerbănescu, 2011, page. 76-77).

The project "From start to success – national program for the professional insertion mentorship of teachers" aimed to harness the experience of senior teachers therefore growing the attractiveness of the teaching profession and to create new education professions (professional insertion mentor, mentor trainer), the creation of a body of nationally certified mentors and the actual assistance of apprentice teachers from different specializations. One of the specific objectives of our project is to assure the accessibility, the efficiency, the transparency and the later sustainability of the project through the creation of the online platform. In order to reach this objective several activities were held: the design and implementation of the online platform with e-learning content and educational resources for training activities; the development of the software support for the online platform; the editing of the usage guide for the online platform; the submission of mentor training materials to the online platform; producing a project virtual library accessible to all teachers involved in the project; the editing and publishing of content in the e-learning sections; maintenance of the project's web site. The training program pursued the development of several competences, including an ITC blended-learning training module aimed at using the online platform. The monitoring activities in the project comprised the assistance of apprentice teachers by the mentors in the project through online communication via the ITC platform. Constant communication happened on the online platform, the online monitoring including the progress evaluation of the apprenticeship program, allowing corrections as applicable.

2. THE DESIGN OF RESEARCH

The paper's purpose is to measure the degree of efficiency of the project's e-learning platform. Working hypothesis: "We expect that the e-learning platform of the - From start to success, national program for the professional insertion mentorship of teachers - project will represent a virtual learning environment useful for mentors, destined to develop their competences in order to facilitate the professional insertion of apprentice teachers". To verify the working hypothesis we are using the Kirkpatrick model, a model that measures the efficiency of e-learning through a progressive evaluation of 4 levels: reaction, learning, behaviour and results. According to Kirkpatrick's model, the first level – the reaction – measures what the course attendants believe about the e-learning platform in general; the second level – learning – measures what the attendants actually learnt. The third level – the behaviour – measures the degree of information

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implementation, their transfer into behaviour. The fourth level, the results, measures the impact on the organizational framework through the effects it produces. To obtain a maximum level of congruence with these 4 levels we are using the following research methods: document analysis and survey-based research. The sample is comprised of 342 lower secondary school teachers who have more than 18 years experience and who participated in the project to be certified as mentors. The data processing was done in the IBM SPSS software package, using descriptive statistics by calculating frequencies.

3. DATA PROCESSING AND INTERPRETATION

3.1 Document Analysis

Through the document analysis of projects we can observe the online activities delivered by experts and mentors of which we can name: creating homework, feedback for homework, quality assurance online procedures, online follow-up procedures, online ongoing evaluation activities, the support & monitoring of mentor's online chat activities with apprentices (www.mentorat.cpi.ro, pe-mentorat.cpi.ro). To emphasize results we will make a short description of the activities. Course manuals in electronic format were created as well as extra resources useful for mentors (the mentor's kit, the apprentice's portfolio, quality assurance procedures, etc). The implementation of the professional insertion program comprised the theoretical framework preparation and the instruments (online and face-to-face surveys) through which a feedback regarding the qualitative level of the program was obtained. All the organizational details have been posted on the project's platform thus facilitating a good dialogue between the management team, experts, mentors and apprentices.

3.2 The Survey Based Research

The items of the surveys were created to verify the way in which the 4 progressive levels (specific to Kirkpatrick's model) were attained. Level 1, the Reaction – measures what the course attendants believe about the online platform in general. We verify the attainment degree of this level through the result analysis of the following item: "To what degree do you appreciate the project's online platform components?".

Table 1. The degree of appreciation regarding the following levels of the e-learning platform

	Very large		**Large**		**Moderate**		**Small**	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Site graphics	141	41.2	132	38.6	62	18.1	7	2.1
Site usability	205	59.9	117	34.2	19	5.6	1	0.3
Site sections	211	61.7	107	31.3	22	6.4	2	0.6
The quantity of information	205	59.9	116	33.2	20	5.9	1	0.3
The quality of information	194	56.7	132	38.6	15	4.4	1	0.3
The timeliness of information	192	52.1	123	36.0	24	7.0	3	0.9
The Forum	205	59.9	114	33.3	21	6.1	2	0.6
The Chat	201	58.8	122	35.7	17	5.0	2	0.6

The obtained data show (Table 1) a favourable reaction of attendants regarding the various components and aspects of the platform. Thus, we observe that they appreciate the platform especially because of its usability, 59,9% of attendants appreciate that they navigated very easily on the platform's pages and 61,7% appreciate to a large degree the website's sections. Of these we can observe very favourable reactions for the forum (59,9%) and the chat (58,8%). Level 2, Learning – measures what the attendants actually learnt. We verify the degree of attainment of this level through the result analysis of the following item: "To what extent the intellectual interaction of attendants with the learning material and with the online tasks was encouraged?". The various activities designed into the project and held on the platform prove their efficiency judging by the resulting values that indicate the appreciation of attendants regarding the fact that all activities encouraged their intellectual interaction with the learning materials and the online tasks, to a large and very large degree (Table 2).

Table 2. The degree of intellectual interaction of apprentices with learning materials and online tasks

		Frequency	Percent	Valid Percent
Valid	Very large	213	62.3	62.3
	Very small	1	0.3	0.3
	Large	110	32.2	32.2
	Moderate	18	5.3	5.3
	Total	342	100.0	100.0

Concerning the online evaluation tasks of topic 5, Informational techniques in the mentorship activity and the measure they were learning and development tasks of ITC abilities, from Module 2, homework was evaluated from topics such as: a. making a Google Drive Form and submitting its link on the platform; b. making a Wiki glossary of useful links for the mentorship activity; c. making a SWOT analysis for an e-learning platform.

Level 3 - Behaviour, measures the degree of information implementation and its transfer into behaviour. We verify the degree of attainment of this level through the result analysis of the following item: "Did you use in your mentorship activity the materials on the platform?".

Table 3. Usage of the platform's materials in the mentorship activity

		Frequency	Percent	Valid Percent
Valid	Very large	213	62.3	62.3
	Very small	1	.3	.3
	Large	110	32.2	32.2
	Moderate	18	5.3	5.3
	Total	342	100.0	100.0

After the training program the certified mentors started their activity of mentoring apprentices. The platform also offered mentors a virtual library that had resources useful in the mentoring activities: the mentor's guide, the mentor's kit, the apprentice's portfolio, the legal framework, etc. These resources, as well as the information obtained during the training period through the forum and the chat regarding the experts' answers to the various problems that were foreseen in working with the apprentice, represent for the mentor a guiding mechanism when needed. The values (Table 3) indicate the fact that the mentors through implementation have capitalized the experience and information acquired during the training period, the platform offering such training resource with a large degree (62,3%) of applicability in the daily school environment. Level 4 – Results, measures the impact on the organizational framework through the effects it produces. We are interested to see whether in the mentors' opinion, the program contributes to the creation of a national system of assisting and supporting junior teachers in the lower secondary school system, online teaching activities on the ITC platform contributing to this coherent teaching system. The impact on the organizational level is a large one, the mentors considering to a degree of 99,4% (Table 4) that the program contributes to the creation of national system of assistance and support of junior teachers in the lower secondary school system, online teaching activities on the ITC platform contributing to this teaching system.

Table 4. Online teaching activities on the ITC platform create a coherent teaching system

		Frequency	Percent	Valid Percent
Valid	Yes	340	99.4	99.4
	No	2	0.6	0.6
	Total	342	100.0	100.0

Concerning the platform's limits, identified at the level of possible difficulties met by mentors in using the platform we find a few worth mentioning: the difficulty of working simultaneously on several open pages in the platform; more suggestive keywords should be used on the platform.

4. CONCLUSIONS

Working hypothesis: "We expect that the e-learning platform of the - From start to success, national program for the professional insertion mentorship of teachers - project will represent a virtual learning environment useful for mentors, destined to develop their competences in order to facilitate the professional insertion of apprentice teachers" is confirmed. The reactions of the attendants to the online platform are favourable ones, 59,9% from the mentors appreciate they navigated very easily on the platform's pages and 61,7% appreciating to a very large degree the sections found on the website. Also worth mentioning are the requests of mentors posted on the online platform regarding the maintenance of the platform as long as possible, even after the end of the project, so that all mentors can have access to the discussion forum and the existing resources. The impact on an organizational level is a very large one through the effects it can produce on the Romanian educational system, the mentors considering in a proportion of 99,4% that the teaching activities on the ITC platform form a coherent teaching system and the program contributes to the creation of a national system of assistance and support of apprentices in the lower secondary school system.

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DEVELOPMENT OF AN IOS APP USING SITUATED LEARNING, COMMUNITIES OF PRACTICE, AND AUGMENTED REALITY FOR AUTISM SPECTRUM DISORDER

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ABSTRACT

This paper presents the development process and framework used to construct a transportation app that uses situated learning, augmented reality, and communities of practice. Autism spectrum disorder (ASD) is a neurodevelopmental disorder that can cause social impairments as well as the limit the potential for the individual to achieve independence (American Psychiatric Association [APA], 2013). The use of technology to support learning in individuals with ASD has been well documented, however gaps exist in the pedagogical approaches that are being used. Future research opportunities into the pedagogical implications of this app are highlighted.

KEYWORDS

Situated learning, communities of practice, augmented reality, authentic learning, autism spectrum disorder, intrinsic learning

1. INTRODUCTION

The use of technology is well documented for the enhancement of learning, with countless pieces of software, apps, devices, and tools available to help educate individuals. Recently there has been an increase in the number of tools developed for individuals with special needs as more and more iPads, iPods, and similar devices are making their way into the classroom. Many of these apps were developed for individuals with autism spectrum disorder as tools to increase communication or comprehension abilities, however the majority of these tools are developed for use within the K-12 system. Unfortunately, there appears to be a lack of tools developed for adults with autism spectrum disorder (ASD), creating a gap in resource availability. Additionally, tools that have been developed often use behaviourism as their primary approach to learning, which can lead to a stimulus response pattern, as opposed to the creation of new understandings (von Glasersfeld, 1989a).

This paper focuses on the development of an iOS transportation app that makes use of situated learning, augmented reality, and communities of practice. The app was developed and designed for high-functioning young adults and adults with autism spectrum disorder. The development of this app stems from a gap in available tools that facilitate authentic learning in individuals with autism spectrum disorder. The iOS application is currently being tested before use in a research setting; therefore this paper focuses on the development process of said application. The research question propelling this study is whether an app that makes use of situated learning, augmented reality, and communities of practice will increase intrinsic learning in high-functioning individuals with autism spectrum disorder.

2. CONTEXTUAL INFORMATION

2.1 Autism Spectrum Disorder

Autism spectrum disorder is a neurodevelopmental disorder that is typically manifested in childhood, and is sustained throughout the individual's life (American Psychiatric Association [APA], 2013). Individuals with autism spectrum disorder have persistent social impairments, including social-emotional reciprocity, non-verbal communication, developing and maintaining relationships (APA, 2013). These individuals may also have restricted and repetitive patterns of behavior, including motor stereotypes, strict following of routines, and resistance to change (APA, 2013). Autism is a spectrum disorder; some individuals may have extreme social impairments while others may have mild social impairments (APA, 2013). Individuals can also range from having no/mild to severe intellectual impairments (APA, 2013). Because of the range of intellect within the population, the design of this app and related study focuses on individuals who are high-functioning, those who have the ability to take transit on a semi-dependent or independent basis as well as those who are have technical competencies to use an iOS device. Individuals with ASD often have low adaptive skills, making planning and organizing very difficult (APA, 2013). This, paired with a low tolerance for change, as well as a high prevalence for anxiety and depression in the young adult and adult populations, makes it difficult for adults with ASD to achieve independence (APA, 2013).

One such area in which individuals may experience difficulties is using public transportation. Individuals with ASD who rely on transit, such as buses, streetcars, subways, and trains, may find navigating transit schedules particularly stressful or challenging. These individuals may employ the transit system to attend appointments, community functions, school, or work. As a consequence, they may have to rely on Community Support Workers, caregivers, guardians, or parents, which, in turn, impedes their sense of independence. This app has been developed to provide information to these individuals in a situated learning environment.

2.2 Situated Learning

Situated learning is used to form the framework for the design of the app; situated learning approaches learning as the construction of knowledge by the learner, rather than the transfer of information from one individual to another (Wehlage, Newmann, & Secada, 1996; von Glasersfeld, 1989b). Additionally, this knowledge is acquired actively by the learner and is gathered through their experiences within their authentic environment (von Glasersfeld, 1989b). When learners have an active role in their education, when they are responsible for what they learn, they are able to maintain a sense of ownership and control of their education (von Glasersfeld, 1989a). To achieve an authentic environment where learning can occur, it must be situated within a highly contextualized setting (Brown, Collins, & Duguid, 1989). The nature of these environments fosters learning as individuals are practicing in authentic situations with their own peculiar cultural practices (Brown, et al., 1989). By engaging in this highly contextualized and authentic environment, learners are able to transfer knowledge to new situations and settings (Brown, et al., 1989).

This pedagogical approach was a foundational component of the framework that supports the design of the app. The app is intended to be used by the individual out in the field as opposed to a laboratory or classroom setting. This, according to Brown, et al. (1989), is to ensure that the individual is immersed within the same contextualized setting that they will be experiencing, thus promoting transfer of learning (Lave, 1991). Learning within the same environment within which the app was intended to be used will be beneficial to individuals with ASD, increasing their potential to navigate transit systems independently.

2.3 Augmented Reality

In addition to providing an environment that is situated, the app needs to provide supports to the user in terms of navigation, location, and transit information. To do so, the app was built using augmented reality as a means of providing those supports. Augmented reality (AR) is defined as an environment that combines real and virtual information, is interactive in real time, and is registered in 3D (Azuma, 1997; Feiner, MacIntyre, & Seligmann, 1993). The use of AR supplements reality with information or tools that would not be available in the physical environment (Azuma, 1997). Additionally, compared with virtual reality where users are immersed in a virtual world, AR allows the user to be present in the physical world (Azuma, 1997). Common examples of AR tools are Head Mounted Displays, such as Google Glass, Head Up Displays, which can be seen in military aircrafts and some automobiles, AR Apps and Games, which superimpose characters, graphics, text, or audio, into the physical world. Educational applications of AR can range from manipulating 3D geometrical objects (Kauffmann & Schmalstieg, 2003) to providing virtual models of objects (Azuma, 1997).

In this case, AR is used to supplement the environment by providing visual tools as well as auditory information to the user. This app makes use of this by providing turn-by-turn navigation to the user, GPS information, as well as auditory warnings for upcoming transit stops. Through the development process, the app went through a number of changes that reduced the amount of augmented reality that could be used within the app. This is discussed with more details in section three. The most recent model of the app contains auditory augmentation, providing the user with real-time transit information, as well as visual augmentation, in the form of visual cues.

2.4 Community of Practice

As previously discussed, individuals with ASD may have social and communication impairments, which can interfere with their ability to build and maintain relationships, as well as learn from peers (APA, 2013). As adults these individuals may also have poor psychosocial functions, including independent living and gainful employment (APA, 2013). This substantiates the need for peer interaction support, as well as in the community at large, as individuals with ASD often rely on caregivers and guardians for participation in these social interactions. This app is designed to facilitate legitimate peripheral participation, as discussed by Lave and Wenger (1991). During this process, an individual becomes a part of the community of practice by participating in ongoing activities, making use of scaffolds, and will eventually be able to help others, transforming from a ‘newcomer’ to an ‘old-timer’ (Lave, 1991; Lave & Wegner, 1991).

The app provides transitioning supports to the individual, as would an ‘old-timer’ within the community of practice. Lave and Wegner (1991) describe a community of practice as a domain where individuals share knowledge through active participation in the cultural practice. Due to the social impairments that individuals with ASD face, this app is designed to support these individuals to actively participate within the greater community.

3. APP DEVELOPMENT

The Transit App was built in conjunction with the Faculty of Education and the Faculty of Business and IT at the University of Ontario Institute of Technology. The app design was developed by a graduate student as a part of an ongoing thesis research project and was programed by three undergraduate students. Currently, the app is still in development, as it still needs to be tested before using it for the research project. The app has gone through many revisions over the development process, however the main purpose of the app is to provide supports to an individual with ASD as they navigate the Toronto Transit Commission (TTC), which is comprised of subways, light rail transit lines, streetcars, and buses. The basic structure of the app is to provide the user with transit schedule information, turn-by-turn navigation, as well as audio and visual indicators that inform the user that they are approaching the desired stop. To use the app, users will either type in their starting destination or use the current location as determined by their GPS signal. Following this they will enter the desired location, or search through previously selected destinations in the app’s history. The app will then show a map of their desired path and when users select the ‘Go’ button, see Figure 1, the app will provide directions for the user. As seen in Figure 1, the directions provided indicate the time, location, route for the selected trip. These directions will update as the user arrives at each point, as well as make changes as necessary. These features were included to provide navigation support to increase the user’s autonomy, transfer of knowledge, and participation within their community.

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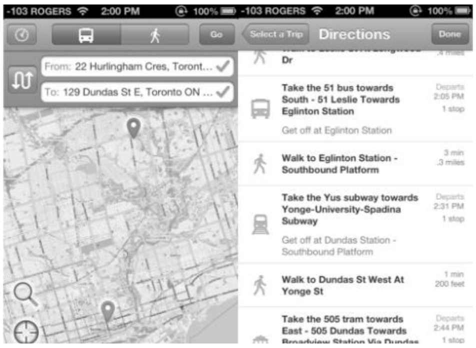

Figure 1. Screenshots of Transit App

Through the design process, a number of changes to the app had been made. Originally, it was desired that the app could provide opportunities for users to make amendments to the route, for example the user could tag a specific bus stop as always running late, or that the route typically has a nice driver. This was thought to enhance the community of practice by increasing participation of the user. However, this was not added due to server constraints. Additionally, original designs of the app had a timer that would indicate when the transit vehicle was set to arrive, however this would not be accurate due to a lack of GPS location of the specific vehicle. Although turn-by-turn navigation is still present in the current model of the app, it was originally planned to use the camera feature of the device to overlay these directions onto the physical world as depicted on the device's screen. This feature was not included due to developer limitations. There had been a number of issues during the design process, including the availability of the programmers due to their status of full-time students. Server problems and computer malfunctions also caused a number of delays.

4. CONCLUSION

The aim of this paper is to highlight the design and development of an augmented reality app that uses situated learning and communities of practice to promote authentic learning in young adults and adults with autism spectrum disorder. This app promotes learning as knowledge construction through a social constructivist perspective (von Glasersfeld, 1989a). The design and pedagogy of this app provide practical applications that extend to other developmental and intellectual disorders, which provide future areas of research. The research applications of this app will be tested through an ethnographic study with the participation of young adults and adults with autism spectrum disorder as they navigate between locations using TTC and navigation directions provided by the app.

Currently, the app is still in the developmental stages with testing still occurring. The process of designing and developing an app has proven to be a longer experience for all students involved than initially thought with many changes and revisions occurring based on technological complications. However, this process has provided countless learning opportunities for these students, providing a large area for growth and development.

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USING CASE-BASED REASONING TO IMPROVE THE QUALITY OF FEEDBACK PROVIDED BY AUTOMATED GRADING SYSTEMS

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ABSTRACT

Information technology is now ubiquitous in higher education institutions worldwide. More than 85% of American universities use e-learning systems to supplement traditional classroom activities while some have started offering Massive Online Open Courses (MOOCs), which are completely online. An obvious benefit of these online tools is their ability to automatically grade exercises submitted by students and provide immediate feedback. Most of these systems, however, provide binary ("Correct/Incorrect") feedback to students. While such feedback is useful, some students may need additional guidance in order to successfully overcome obstacles to understanding. We propose using a Case-Based Reasoning (CBR) approach to improve the quality of feedback Computer Science students receive on their programming exercises. CBR is a machine learning technique that attempts to solve problems based on previous experiences (cases). The basic idea is that every time the instructor provides feedback to a student on a particular exercise, the information is stored in a database system as a past case. When student experience similar problems in the future, knowledge contained in past cases is used to guide the students to a solution. While the system will provide detailed feedback automatically, this feedback will have been previously crafted by human instructors, leveraging their pedagogical expertise. We describe a system of this kind, which is currently under development, and we report results from a preliminary experiment.

KEYWORDS

Case-based reasoning, e-learning, e-assessment, immediate feedback.

1. INTRODUCTION

Higher education institutions around the world are rapidly adopting information technology to help students. According to Chen et al. (2010), more than 85% of universities in America make use of Learning Management Systems (LMSs), such as Moodle and Sakai. Such systems allow students access to course materials, discussion forums, and other resources. LMSs facilitate the online submission of assignments or quizzes, in addition to managing enrollments and grades. Researchers have found that using LMSs to supplement the traditional classroom environment has been beneficial to students (Chen et al, 2010).

Some institutions have recently started providing Massive Online Open Courses (MOOCs), where the entire learning experience is online. Organizations like EdX and Coursera offer online courses from leading universities. All instruction is done using pre-recorded video lectures, and communication with instructors is facilitated through online forums. Quizzes and assignments are submitted online and are graded either by fellow students (peer grading) or automatically (e-assessment), with feedback often provided instantly.

Immediate feedback has been shown to facilitate deeper learning (Epstein et al, 2002) and is generally regarded as an advantage. Most automated grading systems, however, only provide binary feedback, in the form of "Correct/Incorrect". In the case of an incorrect solution, these automated graders are not able to provide guidance to the student. Some intelligent tutoring systems attempt to provide richer feedback, but this approach is not trusted by many educators (Van Lehn, 2011).

In this paper, we propose a methodology for improving the quality of feedback provided by automated grading systems. The proposed framework is built upon the principles of Case-Based Reasoning (CBR). While the idea of using CBR for e-learning applications is applicable to a wide range of academic disciplines, we focus on improving the quality of feedback given to undergraduate Computer Science students on solutions to programming exercises.

The rest of the paper is organized as follows: Section 2 introduces the reader to the Case-Based Reasoning methodology and provides examples of systems where CBR has been successfully applied. Section 3 provides the details on our proposed e-learning system. Section 4 presents the results of preliminary experiments, and Section 5 contains a discussion and concluding remarks.

2. BACKGROUND AND RELATED WORK

Case-based reasoning is a machine learning technique that uses knowledge from past experiences (or cases) in order to find solutions to current problems. Since case-based reasoning is a lazy technique, it builds up its knowledge base by simply storing past cases into a database. A case is defined as a description of a problem along with a solution to the problem. For example, the technical support department of an Internet service provider may employ a CBR system. A typical case in their database would have a description of the symptoms, say “Modem LED blinking rapidly”, and a solution, for example, “Try restarting the modem”.

A new problem being encountered is called a “query”, presenting a description of the problem symptoms. The CBR system uses its knowledge base to try to find a solution to the query. There are typically four steps in the process.

1. Retrieve: In this step, the CBR system finds all cases whose problem descriptions are similar to the query. The most critical component here is the metric used to measure the similarity between the query and the past cases.
2. Reuse: Using the solution(s) retrieved in the previous step, construct a solution to the query.
3. Revise: Evaluate the quality of the solution provided in the last step.
4. Retain: Based on the outcome of the revise step, decide whether to store the query and the solution as a case in the database, or not.

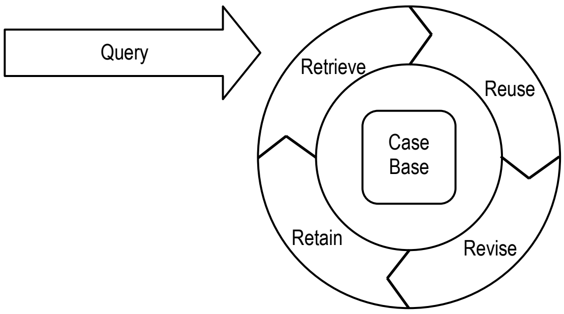

Figure 1. The case-based reasoning methodology, adapted from López (2013)

Figure 1 illustrates the steps of the CBR process. For more details on the methodology, see López (2013). CBR systems have been successfully applied in customer support centers, as shown in Allen (1994), while Jo et al. (1997) used a CBR approach to predict bankruptcy in Korea. Begum et al. (2010) surveyed a number of CBR systems used in the health sciences and found that these systems are being used for a wide variety of tasks, such as diagnosis, treatment planning, and training of medical personnel.

CBR has also been applied to the educational sector, although it has not received as much attention as it has in other domains. Jonassen and Hernandez-Serrano (2002) proposed a CBR system to support problem solving using stories, and Ballera et al. (2013) proposed a CBR system to personalize the e-learning experience of students by sequencing the topics being presented. Wiratunga et al. (2011) presented RubricAce, a CBR system designed to assist instructors who use rubrics for grading students’ work. RubricAce suggests feedback comments to instructors once they have assigned grades according to a rubric. Instructors then decide how to use the suggested feedback to provide summative evaluations to students. One of our goals is to provide high quality immediate formative feedback, to the degree that such is possible. To our knowledge there have been no previous attempts to use CBR in order to improve the quality of immediate feedback provided to students by e-learning systems. In the next section we describe a framework for achieving this.

3. PROPOSED SYSTEM

We now present the details of our proposed methodology for improving the quality of feedback generated by automated grading systems. We assume that a system for providing "Correct/Incorrect" feedback already exists. In the Computer Science domain, it is easy to implement a system that will distinguish correct from incorrect programming assignment submissions. Upon creating a programming exercise, the instructor provides test cases that are used to verify the correctness of student-submitted solutions. This is the "Grading System" module in Figure 2. When a student submits his/her first solution to a given exercise, the code is sent to the grading system and if it is determined to be correct, the student is given positive feedback. If, however, the solution is incorrect, the CBR component of the system comes into play.

First, the system searches the case base for past cases that are similarly incorrect to the current submission. Two programs are similar with respect to incorrectness when they both contain the same bugs, or suffer from the same problems. A possible metric for establishing incorrectness similarity is to treat two submissions as similar if they both fail on a common set of test cases. This metric was used in the preliminary experiment described in Section 4. Other possible metrics, such as static code analysis, are be briefly discussed in section 5 and will be further explored in future studies.

The past cases that are retrieved will contain pedagogically appropriate guidance on how to resolve the problems that are being experienced. Pedagogical appropriateness is determined by instructors who generate the feedback. They may generate different kinds of feedback for different students, experiencing the same problem. The system can use student-specific as well as submission-specific features to determine when a given kind of feedback is to be generated.

Before the feedback is presented to the student, the system determines whether human intervention is necessary, which would be when the system is unable to retrieve similar cases, or when the student has repeatedly failed to rectify a particular problem, indicating that the feedback received has not been helpful. If it is determined that intervention is needed, a human instructor will manually examine the feedback and update it as necessary before it is given to the student. If intervention is deemed unnecessary, the system-generated feedback is passed directly to the student, who uses it to update and resubmit his/her solution.

The resubmitted solution is graded again. If it is correct, it shows that the feedback that was generated by the system was, indeed, helpful to the student, and the entire submission history of this interaction with the student is used to update the case base. If the resubmitted solution is still incorrect, it is pushed through the CBR process repeatedly, including potential human intervention by members of the teaching team, until the student succeeds at the exercise.

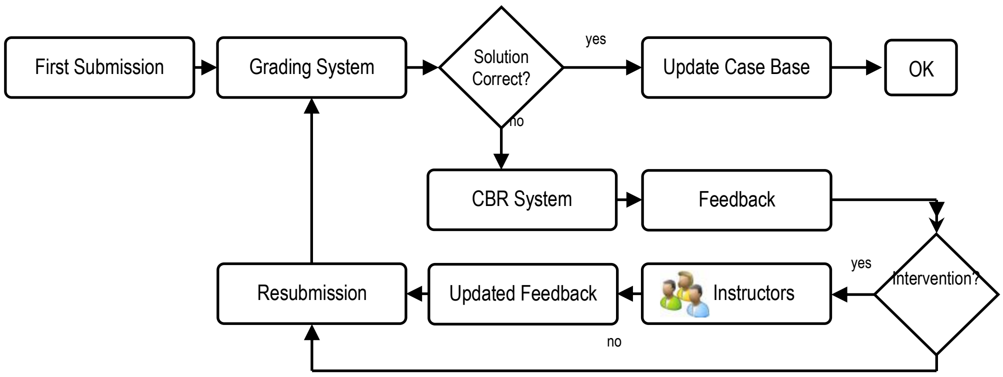

Figure 2. A flowchart of the proposed system

4. PRELIMINARY RESULTS

At our institution we use an online grading system to automatically evaluate programming assignments completed by undergraduate students on a weekly basis. The correctness of each student submission is determined by compiling and running their code against predefined test cases. We have collected submission data from several undergraduate computer science courses over the past 2 years.

As a proof-of-concept we have implemented a simple CBR system in order to gauge the potential impact of the methodology. We use a simple incorrectness similarity measure, where two programs are declared similarly incorrect if they fail on a common subset of the test cases.

For the purposes of this experiment, we clustered submissions based on the incorrectness similarity measure above in order to determine whether instructor-generated feedback for one member of a cluster will be applicable to the rest of the members. Cases in which the previously generated feedback is not applicable are called “interventions”. We randomly sampled 3 out of the 82 exercises assigned in an undergraduate computer science course with 60 enrolled students. The exercises are labeled 1-3 in Table 1. Exercise 1 asked students to read in an integer *n* and sum up all integers from 1 to *n*. Exercise 2 involved reading from a text file and counting the occurrences of a given word. Exercise 3 was a simple OOP exercise where students had to create a “circle” class that has radius and area. Table 1 summarizes the results of the experiment.

Table 1. Results of clustering experiment

Exercise	Num. of incorrect submissions	Clusters by system	Clusters by instructor	Interventions needed
1	123	28	9	3
2	180	13	9	1
3	149	14	11	0

Despite the simple incorrectness-similarity metric used in this experiment, Table 1 shows that significant labor savings can be had. For example, the third exercise would have required 149 separate interactions between an instructor and a student, but the system reduced the number of required human-generated guidance passages to 14, resulting in a savings of over 90% with regard to instructor time. In addition, the system allowed all students who submitted incorrect solutions to be assisted in a timely manner, with most students receiving appropriate feedback instantaneously, all while requiring the instructor to do roughly 10% of the work that he/she would have had to do without the system.

5. DISCUSSION AND CONCLUSIONS

Our proposed e-learning system makes use of a case-based reasoning mechanism to improve the quality of feedback by looking at previously encountered incorrect submissions and the steps that were taken to resolve them. Once an instructor has determined the pedagogically appropriate feedback to remediate a particular misunderstanding, and that information is stored in the case base, students who share that misunderstanding will receive useful guidance immediately. In this way, our proposed system combines the rapidity of feedback delivery present in modern e-learning systems with the integration of human teaching expertise, which is used to design rich and detailed feedback.

A metric that captures similarity with respect to incorrectness is an essential component of our CBR system. This metric allows the system to find previously submitted incorrect solutions that have similar flaws. Identifying a good similarity metric for this process is not easy. While one might imagine assessing similarity by performing some form of direct comparison of source code, we have found such approaches to contain hidden problems. First, surface features of source code, such as the names of identifiers, are typically irrelevant to the nature of the errors in a program. Minimally, some analysis of the logical structure of the source code samples must be done. There are existing tools for performing comparisons of the logical structure of two source code samples, but we have yet to find a way to leverage these tools for identifying common errors. For example, the popular MOSS system for detecting plagiarism in computer programming assignments does an excellent job of identifying pairs of programs that pass a threshold of similarity, suggesting a common origin for the two programs (Schleimer, S. et al, 2003). Upon careful examination of this system, we discovered that the kinds of comparisons needed to detect plagiarism are nothing like those needed to detect common errors. Consider two programs that take very different approaches to solving a problem (e.g., an iterative approach versus a recursive approach), but make a common error in some small section of code, such as failing to initialize a critical variable. In this case, MOSS would rate the two programs as highly dissimilar, despite the fact that they share a common error. Conversely, consider two programs that are virtually identical, except for the fact that one makes a particular error in one line of code while the other does not. In this case, MOSS would flag the two programs as highly similar, despite the fact that they do not share an error. If the logical structure of source code is to be used as part of the similarity measure for the proposed CBR system, it will need to be carefully crafted to focus on similarities in terms of common errors. One possible approach would involve allowing human instructors to annotate source code submissions, identifying the sections that are most relevant for the detected error.

In addition to exploring approaches to similarity focusing on such a static analysis of code, we intend to continue to investigate similarity metrics based on the common failure of programs on carefully crafted arrays of test cases. Possibilities include methods for automatically checking that individual test cases are discriminative of particular errors, comparing the output generated by test cases in more detail, and applying additional machine learning methods to learn to discriminate between error types based on a variety of both static and dynamic features. Since some errors may mask the presence of others, we are also designing methods for maintaining a hierarchy of potential errors, keeping the similarity metric from being deceived by such masking.

Computers are ubiquitous in higher education institutions, and they are increasingly being used to improve the quality of the education being offered. E-learning systems have the ability to offer students immediate feedback, but it is often of the form of “Correct/Incorrect”. While such binary feedback is helpful, students may need additional guidance. We propose a case-based reasoning approach in order to try to improve the quality of feedback generated by automatic grading systems. We conducted a proof-of-concept experiment to determine the usefulness of CBR in a Computer Science e-learning system. Despite using a very simple incorrectness-similarity metric, our results are promising. Research is currently underway to improve the incorrectness similarity metric and to test the complete system in live classroom environments.

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INTERNATIONAL MULTIDISCIPLINARY LEARNING: AN ACCOUNT OF A COLLABORATIVE EFFORT AMONG THREE HIGHER EDUCATION INSTITUTIONS

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ABSTRACT

Requiring students to complete their course assignments in partnership and in collaboration with students from other institutions is not commonplace teaching pedagogy. Even less so when they transcend disciplines and international borders. This Paper presents a brief account of an ongoing collaborative effort between Ryerson University, Coventry University and Loughborough University to inculcate cross border communication and teamwork skills to their Built Environment undergraduate students by way of having them work collaboratively on joint project assignments. It describes its scope and organisation and summarises some circumstantial and anecdotal observations of participating students' inclination and disposition to working inter-institutionally. In an industry where cross disciplinary interactions and exchanges are the norm and where contracting parties to the project can frequently be across international divides, it is imperative that its professionals be trained in cross border teamwork skills.

KEYWORDS

Collaborative Learning, Built Environment, Construction Management.

1. INTRODUCTION

This student and faculty collaboration was prompted by two reports from The Royal Academy of Engineering, United Kingdom. The first is titled "Educating Engineers for the 21st Century" (RAE, June 2007). The report took the stance that today's business environment demands that engineers must have "the ability to work in globally dispersed teams across different time zones and cultures." We surmise that the profession of engineers in this RAE report embraces all Built Environment (BE) professionals and in particular construction project managers and coordinators, whose background and training are commonly in related disciplines such as architecture and construction project management.

Today's Built Environment professionals and stakeholders need to be acutely aware of an increasingly globalised world where few economic borders remain. An economic "one-world" has bearings on procurement of goods and services in the BE industry as it can take away work that traditionally was viewed unmovable or "un-outsourceable" as well as creating new opportunities where there otherwise would be none. A good example is the growing use of offshore detailing firms for all manners of shop drawings and drafting services. These highly price-competitive detailing firms are largely located in Asia where a near half-day time difference oftentimes adds to their already competitive edge.

If they seek to lead the industry tomorrow, today's BE professionals must look beyond construction site boundaries. They must concede that they no longer have to sit in adjacent cubicles to get the work done, but more importantly they must learn not to. Advancements in information and communication technology over the last two decades have largely eliminated that need to. Tele-conferencing application tools such as Skype and GoToMeeting are nearly as physical as one can get to – minus the physical handshake. All manners of documents, drawings and renderings can be transmitted across the globe in mere seconds. Then there's also the largest single form of communication in existence today – emails. Plus the modern telephone where a trans-Atlantic call can be made very inexpensively and oftentimes for next to nothing using one of the bewildering numbers of Apps available. Use of some of these comes with concerns and trepidations but it is not the intent of this paper to discuss them.

In its second report “Engineering Graduates for Industry” (RAE, February 2010), the academy apprised that academia must supply graduates with skills that ensure their “employability” meaning graduates with personal and interpersonal skills, communication skills, self-management skills, and skills in the application of information technology. Being fully equipped with mainstream technical knowledge and skills is no longer sufficient for today’s industry demand. None of these employability skills are more needed than in the BE industry. Few undergraduate curriculums in architecture and engineering schools have room for all of these skills. Most were learnt on the job, some painfully.

What these all point to is a necessity for the BE professional to surpass an ability to engineer and to manage the complexities and uncertainties that are characteristically inherent in construction projects. To the best of our knowledge, there is currently a dearth of endeavour in BE professionals’ training programs where these two RAE’s advices are taken heed. Work in this regard started in 2011 with 37 Architectural Science students from Ryerson University in Canada and 32 Civil Engineering students from Coventry University, United Kingdom. Loughborough University, United Kingdom joined the collaboration in 2013, involving to date a total of 182 students from the three institutions. The intent of this paper is to share our experiences with educators our approach to address the two issues raised in the two RAE reports and outline what we circumstantially and anecdotally observed in the classrooms. It should assist other BE educators who may wish to implement similar collaborative projects in their own institutions.

2. PROJECT SCOPE AND ORGANISATION

This faculty and student collaboration stemmed from Coventry University winning a research grant from Hewlett Packard in 2010 to develop new and novel approaches to science, technology, engineering and mathematics (STEM) education. In its first year, 4th Year Architectural Science (Project Management Option) students from Ryerson University worked co-operatively and collaboratively with Coventry University’s 3rd Year Civil Engineering and Civil and Structural Engineering students on a year-long Design-and-Build project. Each project team consisted about equal numbers of students from each institution. The project brief was developed jointly by faculty instructors and took into considerations the institutions’ course requirements. At the end of the joint project assignment, each student was required to go online and assess the effort and contribution made by other team members using the Web-PA system. This confidential assessment returned a factor which was then used to adjust their earned final grades.

In its second year, the project was changed to an A&A (Addition and Alteration) work to an existing academic building where unfettered access was available only during prescribed periods. It was felt that an A&A work as such would be more thought-provoking and challenging such as in designing, planning, scheduling and executing the work. Besides, it would require them to do some serious thinking around the context of the building project, including local building regulations and health and safety considerations for users of the building whilst it is being upgraded. The same project was used a second time in 2013 when Loughborough University brought to the collaboration its first group of 24 Final Year Construction Management students followed by a second group of 28 MSc Construction Management students in early 2014.

Project team composition thus closely fulfils the criterion for “globally dispersed teams across different time zones and cultures” except that the cultures of Canada and the United Kingdom are not generally recognised as significantly different. The teams, comprising architecture, civil engineering and construction management students are furthermore multi-disciplinary and to a good extent typifies project teams in the real world. Work was to be responsibly and equitably divided among the team members and was expected to be carried out in a coordinated industry manner.

At the beginning of each academic semester, a faculty member from Coventry University would fly into Toronto to brief and take questions from Ryerson University students just so that students from both institutions received the same information and directions. This took place without fail since 2011 when the collaboration began, up till and including last year when Loughborough University joined. Further and additional briefings were conducted using Skype and latterly using GoToMeeting.

At team level, leadership was rotated every four to five weeks among the team members. The Team Leader is assisted by a Team Manager, whose main responsibility is to schedule and keep records of meetings, thus enabling the team leader to focus on coordinating team members' progress and performance on their assigned sections of the work. At the succeeding leadership change, the manager assumes the role of team leader. At all times, we ensure that the team leader and the manager were not from the same institution.

Each team identified itself as a company and prepared an initial proposal in response to a project brief developed jointly by faculty members. A well-thought proposal must include a design proposal to meet the client's requirements, a set of specifications, a schedule and a preliminary cost estimate. Faculty members, in addition to advising and directing the teams, also doubled as clients. The assignment ends with a presentation to client and would typically include a reasonably detailed sets of architectural and structural drawings, a more definitive set of specifications, a revised cost estimate, a construction schedule and a method statement taking into consideration health and safety considerations, and for Academic Year 2012/13 a sustainability report on the proposal.

Until 2013 when a grant for the project became available from the Higher Education Academy (HEA), United Kingdom, students communicate largely using Skype and emails. All manner of drawings and documents were deposited in Dropbox for further work. During the first year, the work was supported by a Hewlett Packard grant and students were encouraged to use HP Virtual Room communication software. The grant also made available use of HP laptops to Coventry University students. In 2013, GoToMeetings became the primary means of communication and work among students from the three institutions. This desktop sharing service allows the students to work together for their architectural and structural designs with 3 dimensional Building Information Model (BIM) in real time with synchronous audio and video. The funding from HEA has permitted a higher level BIM collaboration to be implemented in this initiative. BIM has recently become the key requirement of building design and construction around the world.

3. CIRCUMSTANTIAL AND ANECDOTAL OBSERVATIONS

Working with geographically distant team members presented the students with some challenges and did require some changes and adjustments to the way they would normally do their work. The observations made here are largely based on casual conversations with the students and discussions among the students themselves over the years. At the time of writing this paper, work is ongoing to gain an understanding of some of the underlying reasons and motivations. We have, earlier, published those that we have conclusions (Soetanto et al, 2012; Soetanto et al, 2014; Soetanto et al, 2014). This paper does not intend to discuss them.

3.1 Time Difference

Time wise, the United Kingdom is ahead of Canada by 5 hours which effectively means that when the Canadian students start their class hours (invariably after lunch time), their United Kingdom team members would likely have been tired out from a full day at school. A 5-hour time difference is significant in that it effectively leaves only a common 3 work hours from a typical 8-hour work day. Canada moves to Daylight Saving Time typically 2 weeks earlier than the UK and a resulting time difference of 4 hours sometimes caused confusions with scheduled meeting times. But for the most part, the students managed well such as agreeing on days and times for meetings and for working together. Weekends seemed to be a popular choice of days when most have no classes to attend.

3.2 Multidisciplinary Aspect

In contrast, it was the multi-disciplinary aspect of the collaboration that seemed to be more difficult for the students to deal with. Whilst we observed numerous constructive discussions among the architecture and civil engineering students as to what works and what doesn't, we also observed that at times they find it hard to come to terms that each discipline has particular strengths (and weaknesses). For example, the architecture students have on a number of times lamented on their counterparts' lack of design aesthetics and drafting skills. Another issue which sometimes cropped up relates to common knowledge that all the students would be expected to know by then but have yet to be taught or in the process of being taught – such as use of drafting and scheduling software.

3.3 Team Members Preference

There is little doubt that if they had a choice most of the students would prefer to team up with friends and with those they knew in the class. In this collaboration, students first formed “sub-teams” of their choosing from the class - typically of two to three students. Faculty members then randomly ascribed one sub-team from each institution to form a project team of seven to eight members. Thus, they do get to work with a few team members they know but with more they do not - a situation most Built Environment professionals will find themselves in the real world. It is not clear to us why this would be so and we conjecture that familiarity, perceived reliability or otherwise, competence or simply just plain chemistry may play a part. When asked late into the project, most valued their experiences of working in an international multi-disciplinary team.

3.4 Team Interactions

On the whole when the students learned that they would be required to work with students from other institutions, about half of them displayed some unease - such as what their team members from the other institutions might be like in terms of technical competence, diligence, work ethics and responsibility. These trepidations either diminished or get exacerbated into the project. Over the three years, about one in five or six groups did not get passed their disagreements and differences - consistently about work below expectations or not on time, ineptness on the part of some individuals, unreliability, not attending meetings and, in a few instances, non-participation or apathy. But for the majority, team performance and cooperation were as best as be expected and the quantity and quality of work produced were very good.

Referring to the other groups of Coventry students who were not participating in this international collaboration, one testimony suggested that working with distant partners online was in fact sometimes better than working offline. Some students have also mentioned that they work harder as they are representing their university and don’t want to be seen in a ‘bad light’ compared to other institutions. With other supporting evidence, it could be concluded that successful collaboration is very much dependent on the professional work ethics and trust. The impact of mediating technology is not critical if the team has strong work ethic and trust (Soetanto et al. 2014).

3.5 Us and Them

Whenever work was not progressing as planned, the “us and them” differentiation or discrimination would come into play with little hesitation that the culpability rests squarely on “them”. Notwithstanding being reminded time and again that there is no “us” and “them” in a team, this mindset persisted. Over the years, we have not had one single complaint where a student placed the fault or shortcoming on the team member from his or her own class. This distinction between us and them embraced issues such as design and drafting skills, ability to write and structure a report, or simply “we are doing more work than them and it’s not fair”. What was also noticeable over the years was that students tend to rate their contributions higher than those of their virtual team members in terms of quality and quantity.

3.6 Recognition and Fair Play

Notwithstanding the “us” versus “them” mindset that permeated, students were also quick to give recognition and acknowledgement to their virtual team members and this was commonly reflected in the end of project *Web-PA* peer evaluation that was also used to adjust their earned grades. Over the years, we have also heard frequent complimentary and admirable comments from students about some of their virtual team members. Likewise, they are also quick to castigate those whom they felt had not lived up to their expectations. They would also not hesitate to use the confidential peer evaluation process to rate them negatively. Deemed “free loaders” appeared to be the worst categorisation.

4. ONGOING WORK

Work is continuing with the collection and analysis of student experiences and the issues encountered - both students interaction-related and technology-related. The findings will be used to develop a guidance of effective practices for international student collaboration in a real-time online platform. Experiences, cases and lessons learnt will feature in the guidance.

An online *BIM-Hub* is currently under development to assess approaches, practices and technologies to support this international student collaboration, concurrent with its use as a platform for student virtual collaboration. When fully completed, it will encourage a community of learning among HE academics and their students through open discussion forums in relation to issues such as experiences and practices. The *BIM-Hub* will also provide limited access to interested external parties, support a range of social media popular among students and will be supported beyond the life of this project.

5. CONCLUSIONS

Increasing international collaboration in the Built Environment industry obliges its professionals to have "the ability to work in globally dispersed teams across different time zones and cultures". This skill set embraces skills to interact and to work with counterparts from distant lands employing appropriate communication technologies, which no doubt enhance their employability in the industry.

In addition to their (design and technical) program requirements, this collaborative effort among our three HEIs provided our students an opportunity to learn and practice team work skills in an online environment across geographical and time zones divide. The multi-disciplinary team environment challenges them to a range of issues that are not uncommon in the real world. And they also get to acquaint themselves with the industry practices of another country. We are of the view that as BE educators we have an obligation to inculcate these skill sets in tomorrow's Built Environment professionals.

ACKNOWLEDGEMENT

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INTERACTIVE LEARNING TO STIMULATE THE BRAIN'S VISUAL CENTER AND TO ENHANCE MEMORY RETENTION

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ABSTRACT

This short paper describes an ongoing NSF-funded project on enhancing science and engineering education using the latest technology. More specifically, the project aims at developing an interactive learning system with Microsoft Kinect™ and Unity3D game engine. This system promotes active, rather than passive, learning by employing embodied cognition with interactive visual/spatial information, in which human movements could impact a lasting effect on both the short-term episodic and long-term memories of students. Two groups of Biomedical Engineering students at The University of Akron participated in a study of the four educational modules (Cell, DNA, Immune System, and Gene Therapy) and were tested after the conclusion of each educational session. The preliminary results show a trend toward better performance with the system compared to traditional instruction in second-year college students. However, more studies with a larger group and with a younger population, such as K-12, need to be evaluated since these students have a less developed visuo-spatial sketchpad relative to the sophomores in college.

KEYWORDS

Interactive Learning, Visuo-Spatial Sketchpad, Natural User Interface, Embodied Cognition.

1. INTRODUCTION

When teaching educational contents that are inherently graphical in nature, research has shown that learning is more efficient when stimulating the visual component of the brain (the visuo-spatial sketchpad) as compared to the language-based approaches [1]. In the working memory model proposed by Baddeley and Hitch [2], the central executive controls the flow of information from and to the phonological loop (verbal buffer), the visuo-spatial sketchpad (visual buffer), and the episodic buffer (where context is added to short-term-memory codes for storage in long-term memory). We know that both verbal and visual codes are stored in short-term memory because we can use these two types of codes to interfere with working memory performance [2]. Because of the "video game effect," there is accumulating evidence that individuals can use visual codes to help supplement verbal-code information in short-term or working memory.

Furthermore, there is evidence that humans use "embodied cognition" to improve performance [3-5].

That is, we encode the state of the body and use it as a "somatic marker" (or contextual cue) when storing working-memory information in long-term memory [3-6]. Using these assumptions, it is predicted that visual codes and motoric feedback from movements should improve the educational outcomes in learning science and engineering information.

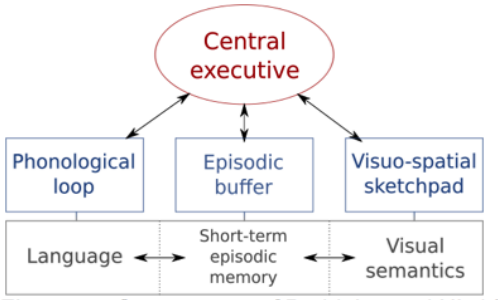

Figure 1. Components of Baddeley and Hitch's updated concept of working memory.

The goal of this project is to refocus science and engineering education by introducing a new technology that is integrated with interactive, educational content that engages, inspires, and stimulates the visual center of the brain. To accomplish these goals, a new curricula has be designed and implemented that engages students and interactively introduce visual information using the Microsoft Kinect™ device [7]. This device will be coupled to a computer system and will allow students, as an example, to actively explore a cell's anatomy and its functions using an interactive spatial interface instead of simply showing pictures with verbal descriptions. This approach also promotes active, rather than passive, learning by employing embodied cognition, where human movements could impact a lasting effect on both the short-term episodic and long-term memories of students [3-6]. In our approach, both the visual/spatial information and the motoric interactions can be stored with a memory trace of the learning event (e.g., structures and functions of an eukaryotic cell and its organelles).

We hypothesize that introducing graphical information that is designed specifically to simulate the visuo-spatical sketchpad with gestures will positively impact the students' learning and have a lasting effect on cognition and episodic memory [8-9]. Since our educational content is also designed similar to a game interface, we will also enhance the emotional states of the students which is associated with potentially better episodic memory performance for remembering events [9] as demonstrated by applications of Damasio's somatic marker hypothesis [3-5]. Thus, encoding the visual information (in visuo-spatial sketchpad), along with integrated gestures, should result in more accurate retrieval of the contextual information than will lead to more efficient learning.

2. SYSTEM DESIGN

Human gesture recognition is an important part of advancement in human-computer interaction [10]. Recent development in natural user interface (NUI) is exemplified by gesture-based interactions. Natural user interfaces are user-centric and allow people to interact with the computer in ways that are easier to learn. By eliminating the mediator of a keyboard or mouse between the user and the computer, gesture-based interactions enable the user to directly interact with the visual content on the computer. Furthermore, if the users are represented as an avatar, they will gain the sense of embodiment and be immersed into the programmed contents.

Kinect™ device is the latest natural user interface that provides real-time gesture recognition [11]. In addition to a RGB color camera, it has a depth camera, which consists of an infrared projector and an infrared sensor [12-14]. Microsoft® has developed an algorithm that utilizes these cameras to recognize human poses [15]. Furthermore, the depth information enables the system to capture gesture motions in three dimensions; therefore, Kinect™ recognizes left-right, up-down, and front-back motions [15].

In this project, we use Kinect™ to capture the motion of students and track their gestures to allow them visually interact with the education contents. We developed a set of educational contents for Biomedical Engineering and created virtual 3D objects for four learning modules: Cell, DNA, Immune System and Gene Therapy. Those virtual objects are then imported into a game engine (Unity3D [16]) for animation and display. User movements captured by Kinect™ are sent to the game engine through the application-programming interface (API) provided by (OpenNI [17] and Zigfu [18]). The students will be able to rotate

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the virtual objects, for example, the entire cell or its organelles. The students will also be able to zoom onto nano-sized molecules such as DNA, ribosomes, and cellular receptors. They will be able to study not only their structures but also their functions through interactive animation. They will have the control to translocate from outside of the cell into various organelles within the cells. This "first person" perspective will use embodied cognition and should import the relevant contextual information more efficiently into the student's long-term memory. These and other features will be linked to the student's gestures that are captured by the Kinect^{TM} system. Since these gestures are intuitive, the leaning curve to use the proposed educational modules and the hardware will be minor.

Figure 2 depicts the architecture of our Kinect^{TM} based system and figure 3 demonstrates the system in action.

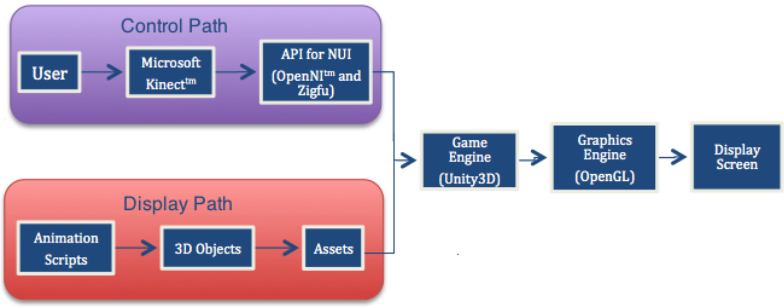

Figure 2. The architecture of the Kinect^{TM} based learning system.

Figure 3. The system in action.

3. EXPERIMENT DESIGN

An experimental goal of the project is to compare the learning outcomes for seniors and sophomores undergraduate students using traditional verses technology-enhanced (Kinect^{TM}) teaching methods in biomedical engineering courses. The rationale for this preliminary experimental design is to compare populations of students with fully developed visuo-spatial sketchpad (seniors) to a group in which this component of their brains is still under development (sophomores). Thus, seniors are more efficient in learning by visual means. The learning and understanding of educational materials related to each module will be tested. The learning and understanding of educational materials related to each module will be tested. The experimental design is given in Table 1. Students will be exposed to both the traditional techniques (through modules 2 and 3) and enhanced teaching using the Kinect^{TM} system (through modules 1 and 4). The contents for Modules 1 - 3 are focused upon biological science. In contrast, module 4 is focused upon biomedical engineering. This experimental design will allow for intragroup and intergroup comparisons. In this way, all students will be exposed to our Kinect^{TM} system. After each session, students were tested. The results for the traditional and technology-enhanced teaching methods were averaged and compared using paired t-test.

Table 1. Experiment groups tested using traditional verses enhance teaching methods.

	Seniors	Sophomores
Module 1 – Cell	Kinect^{TM}	Kinect^{TM}
Module 2 – DNA	Traditional	Traditional
Module 3 – Immune System	Traditional	Traditional
Module 4 – Gene Therapy	Kinect^{TM}	Kinect^{TM}

4. PRELIMINARY RESULTS AND FUTURE WORK

Two groups of Biomedical Engineering students at the University of Akron participated in study of the four educational modules (Cell, DNA, Immune System, and Gene Therapy) and tested after the conclusion of each educational session. We expect that seniors using the Kinect^{TM} system will not perform better with technology-enhanced teaching method, and the preliminary results show that no differences for seniors using both the Kinect^{TM} and traditional approaches (Figure 3, $p = 0.92$). For sophomores using the Kinect^{TM} system, their performance in learning is better with the technology-enhanced method, but the results were not statically different ($p = 0.49$) from the traditional method. However, a correlation exists between the Kinect^{TM} and the traditional method for this group ($p = 0.034$). With $n = 6$ and 5, respectively, for each group, we demonstrated the potential utility of the Kinect^{TM} system's ability to enhance teaching graphical information. However, more studies with a larger group and with a younger population, such as K-12, need to be evaluated since these students have a less developed visuo-spatial sketchpad relative to the sophomores in college.

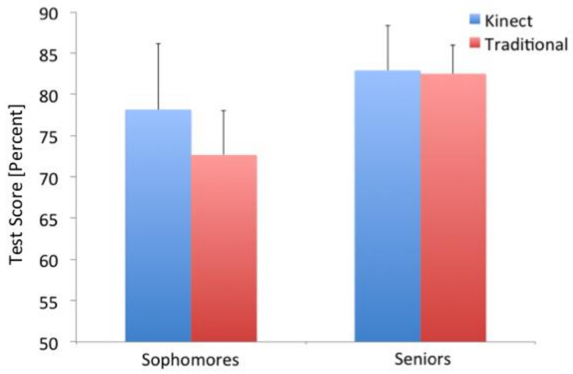

Figure 4. Results of the Kinect^{TM} and the traditional teaching methods for seniors and sophomores.

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Reflection Papers

HOW DIGITAL TECHNOLOGIES, BLENDED LEARNING AND MOOCS WILL IMPACT THE FUTURE OF HIGHER EDUCATION

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ABSTRACT

Digital technologies are revolutionizing all parts of society, including higher education. Universities are rapidly adapting to the prevalence of staff and student mobile devices, digital tools and services on campus, and are developing strategies to harness these technologies to enhance student learning. In this paper, I explore the use of digital technologies to support blended learning in universities, and discuss how massive open online courses (MOOCs) can be improved through better understanding of successful use of technology, communication and collaboration in such scenarios.

KEYWORDS

Blended learning, higher education, learning, digital technology, online courses, students.

1. INTRODUCTION

The academic community has largely accepted PowerPoint and Virtual Learning Environments essential tools of the trade, but we face new opportunities and challenges. For example, our students are bringing mobile devices into the classroom and using them to access information and communicate, and we have lecture capture systems recording our classes. Massive Open Online Courses (MOOCs) are available to our students to supplement their learning and personalised learning environments and use of learning analytics are set to transform education. There are expectations from our students of a blended education and expectations from governments and policy makers of increased integration of technology in our approach to education. All of these issues provoke vociferous discussion in academic settings, as we all grapple with the rapidly changing landscape of learning in a digital age.

In this paper, I will explore the nature of these changes, the implications for teachers and students and the challenges and benefits of a holistic approach to digital learning for a modern university. I will also look forward to the future of education in our connected society.

2. THE ERA OF THE DIGITAL STRATEGY

The nature of student education is changing. Information is easily accessible via the Internet on PCs, laptops and mobile devices, and the challenge for teachers has shifted from one of information transfer to a role supporting students to curate, filter and critique information, and use it to solve real-life problems. This shift has been rapid and unprecedented. The notion of the lecturer as the custodian of knowledge is hard to overturn, particularly when the alternative means re-thinking curriculum design, teaching delivery, student activities, assessment and feedback. But we must adapt the ways that students are taught and learn in Higher Education as this will impact on their skills, competencies and ability to contribute effectively in a digital workplace and society. The world is now digital and higher education must reflect this, and indeed should be at the vanguard of the revolution leading the way for other sectors to follow.

Many universities are recognizing (at a senior level) the need to revolutionize higher education in this changing landscape, with many introducing 'e-learning', 'blended learning' and more recently 'digital' strategies to support the changes in curriculum design, academic practice, infrastructure and training and support necessary to deliver higher education in a digital age (Garrison & Kanuka 2004). Take for example the author's institution, which has a 'Digital strategy for student education' and a 'Blended learning strategy'; the former sets the overall agenda for the digital ecosystem at the University, prioritizing investment in seamless, user-focused content, tools and services to support education and student services. The blended learning strategy sets the pedagogical framework for appropriate use of online resources, technologies and tools to support face-to-face interaction between students and teachers. In combination, these strategies position the University as an open, content-rich, digitally connected environment where face-to-face interaction is supported by online multimedia content, digital tools and services. In this environment, teaching spaces are digitally equipped, and the VLE is just one of a range of online tools for providing students with learning resources and opportunities for interaction and collaboration. External digital learning channels are well populated with openly available content, and the University is offering the full range of face-to-face, blended and fully online courses.

3. BLENDED LEARNING APPROACHES

Staff in universities are using an increasing number of digital approaches to support student learning, drawing on a growing pedagogical literature evidencing the effectiveness of technology to enhance learning outcomes, student engagement and enjoyment (Sharpe et al. 2006). The following approaches are growing in use within universities by both staff and students: event capture, mobile learning, mobile voting, eBooks, social media, e-assessment and use of open educational resources. Each has its own literature base expounding the benefits and challenges of adoption for teachers and students, and all are supported by a plethora of technical solutions. As we continue to understand the potential of the connected web to support and enhance learning, students and teachers will expand their use of participatory, collaborative and networked learning approaches.

The availability of these blended learning approaches has reignited the debate about the most appropriate sequence of events when supporting students to acquire new knowledge, skills or competencies. Advances in technology and online repositories have made the concept of the 'flipped classroom' a realistic and viable option for the majority of educators (Sams & Bergmann 2013). In essence, the flipped classroom overturns the traditional sequence of events and requires students to engage in conceptual understanding of key facts and information using online resources and tools prior to interacting with educators and learning mentors. Imagine a course where the traditional 'lectures' have been digitized using an event capture system, edited into chunks or bite sized learning units and provided to students online with some introductory materials, instructions and opportunities for online interaction and discussion between learners. The original lecture time is replaced with tutorial or seminar style sessions where students undertake problem solving, discussion, Q&A or other collaborative activities using mobile devices, to reinforce understanding, challenge misconceptions and deepen knowledge; a very active learning approach.

A holistic, seamless and well-integrated blended learning approach using pedagogically appropriate tools can enhance student learning and the quality of the student experience. Combining the flipped classroom approach with integrated use of mobile devices containing multimedia interactive eBooks and apps to support learning, along with access to online learning resources and tools for student collaboration and interactivity would satisfy many educators and students. However, this solution brings with it a number of challenges, including digital fluency, technical skills and factors affecting the adoption of technology, including perceived ease of use and usefulness (Venkatesh et al. 2003).

4. HOW MOOCS CAN LEARN FROM BLENDED LEARNING

Since 2008, Massive Open Online Courses (MOOCs) have dominated the higher education headlines, with promises of educational revolution and global learning, and worries about the end of physical universities, an abundance of cheating and plagiarism, and superficial education. None of these prophecies have yet materialized, but MOOCs offered on the major xMOOC platforms (e.g. Coursera, Edx, Futurelearn) have gained a seat at the table of higher education, as one of a number of routes available to learners, alongside blended learning, face-to-face and traditional distance courses. However, there is room for considerable improvement in the pedagogy of massive open online courses as they evolve and morph (Siemens 2013), drawing on the experience gained in distance education and blended learning.

MOOCs that engage, stimulate and provoke learners to meet their learning goals require consideration and understanding of the following elements: (1) course design, navigation and accessibility (learning design); (2) participants' learning goals, pre-requisite knowledge and digital literacy skills (learner skills) (3) opportunities for interactivity, communication and collaboration between learners and with subject experts within the course (social learning); and (4) the methods of assessment and feedback (learner outcomes). These are critical elements of well-designed traditional face-to-face, blended and online courses, but there is one key difference: MOOCs attract an audience which is often not predefined, from 16 year old school students, current undergraduate and postgraduate students, through to professionals and leisure learners. MOOC participants are all at different levels trying to reach a clear learning goal from the same materials within a defined learner journey.

It has become clear that the majority of MOOCs attract well-qualified, professionals seeking to learn something new. However, most courses have very low retention figures with high drop-out rates early in the course (Koller et al. 2013), which probably results from a combination of the following factors: (i) curious learners with no intention to complete, (ii) learners who only needed or wanted one aspect of the material to meet their learning goal, (iii) learners with good intentions but lack of time or commitment to study online, (iv) disengaging learners who were taught in a face-to-face environment who struggle to transition to an online environment and (v) learners who do not respond well to the teaching style (be that didactic or participatory). Clearly, future online courses will need to address these issues to encourage a greater proportion of participants to stick with the course through to the end, in order to achieve the course's learning outcomes. It is worth noting that most face-to-face, blended and wholly online courses normally offer learners support to make the most effective use of the resources e.g. course map, learning journey etc. and provide study skills advice about how to study effectively online e.g. how to communicate, how to learn from multimedia resources, how to provide peer feedback etc. (Morris et al. 2014). The majority of MOOCs do not offer this support to learners, and it may be a contributing factor in the large dropout rates observed.

The constructivist or 'c' MOOC encourages learner centered, non-linear learning experiences where problems, ideas and solutions are developed through sharing the best of the web, creating materials and communicating through a variety of channels, including social media networks (Brennan 2013). However, the cMOOC is seen as inaccessible or daunting to some learners, particularly those lacking expertise in the subject or lacking confidence and skills in a digital environment. The answer, the xMOOC, where the focus is on tutor-generated content, a linear learning experience and more structured opportunities for communication, appeals more to the masses, but may not offer the best deep learning experience, due to lack of active and participatory learning.

It is rapidly becoming apparent that the distinctions of c- and xMOOC are unhelpful, and the challenge to MOOC developers is to offer the best of both scenarios, so that the subject expert and the learners contribute problems, ideas and solutions equally, using the best of the web and through creation of digital materials, and offering opportunities for rich conversation in structured, accessible and appropriate ways for learners with differing needs. Conversation drives learning, through clarifying understanding, problem-solving, building mental representations and fostering deep learning (Laurillard 2002), and this must be better represented in online courses. The challenge for MOOCs, and indeed any online learning opportunity, is to provide learners with regular, authentic, accessible, and structured opportunities to engage in conversation with other learners about the course materials supported by subject experts.

5. FUTURE OF ONLINE LEARNING

Laurillard has recently argued that learning technologies are "hopelessly underexplored" (Laurillard 2014), due to the fact that most online learning experiences don't take account of the theories that underpin effective education. Therefore, we should now begin to explore the potential of learning technologies to offer a participatory, active, networked and personalized online learning experience that delivers real improvements in learning for learners at all levels, and with differing learning needs.

MOOCs could offer high quality learning experiences for all types of learners, but at present they are too linear and one dimensional to fit the needs of all participants. So, let's consider a MOOC that adapts to the individual. In order for this to happen, the platform will need to understand the learner in advance of the course. This information could come from a pre-course survey, in which the participant reports on the experiences, prior modes of learning, social learning preferences etc., or the system could interpret their behaviors from analysis of their social networks, if the participant provides account details for Facebook, Twitter, Google etc. upon registration. Algorithmic and social network analysis could be used to predict if the participant is likely to prefer a teacher-focused or learner-focused experience, adjusting their participatory exercises accordingly. Once the course has begun, learner analytics should dynamically adjust the learning experience, based on the participants' behavior (e.g. choice of media format, page navigation, dwell times, social activity), constantly checking with the participant that the changes are suitable. In this way, participants will receive a personalized and dynamic online learning experience suited to their preferences, which would be likely to enhance their engagement, enjoyment and ultimately the quality of their learning.

Of course, this model doesn't address the challenge of effective participatory and collaborative learning at scale, with thousands of learners and only a few tutors. Many have argued that this is a fundamental flaw of MOOCs, but given that many courses have well qualified professionals enrolled and participating, it may be possible to use their collective knowledge to mentor and support other learners, in a similar way that discussion forums use validated expert contributors to answer questions.

6. CONCLUSION

In this paper, I have explored the current use of digital technologies in blended learning approaches, and outlined their benefits and challenges. I have also attempted to suggest how massive open online courses could be improved, by drawing out proven benefits of blended learning which could be applied to such courses, and I have described how online courses might evolve in the future to capitalize on learner analytics and personalization. Of course, massive open online courses are only one route for learners to enrich their learning online, and they must evolve to cater for individuals with differing goals, background and skills if they are to have a long-term future for the masses.

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FACTORS INFLUENCING THE ACCEPTANCE OF E-LEARNING ADOPTION IN LIBYA'S HIGHER EDUCATION INSTITUTIONS

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ABSTRACT

The growing influence of technologies on all aspects of life, including the education sector, requires developing countries to follow the example of the developed countries and adopt technology in their education systems.
Libya has been able to boost its economic and educational position over the years, and this brings it to the concern of applying modern methods of learning into its Higher Education (HE) system. E-Learning has been advocated by several university professors and researchers as one of pertinent method in the education system in the current society context of busy schedules and dual responsibilities of adult learners. However, due to many cultural, governmental and technological reasons, the state of e-Learning in Libya's HE has not been to an adequate level.
This paper aims to shows the outcomes of several studies, which discover the effect of national and international ethos and methods to education on the usefulness of manipulating, applying and utilizing e-Learning schemes and machinery in Libya's Higher Education institutions. The writers have advanced an inquiry form, which was finished by ripe Libyan students registered for PhD educations in the United Kingdom, who are also permanent professors at the Universities of Tripoli, Garyounis, El-Zawia and Aljabal-Algharbi. The measurable and qualitative inquiry of the replies show numerous complications connected to the utilization of e-Learning and, Information and Communication Technology (ICT) in Libyan universities.

KEYWORDS

E-Learning, Information Communication Technology (ICT) Infrastructure and Higher Education (HE).

1. INTRODUCTION

E-Learning denotes to the utilization of electric media and information and communication technologies (ICT) in learning. E-Learning is widely comprehensive of all forms of instructive skill in learning and coaching. E-Learning is comprehensive of, and is widely identical with montage learning, technology enhanced learning (TEL), computer based instruction (CBI), computer based training (CBT), computer aided instruction or computer assisted instruction (CAI), internet based training (IBT), web based training (WBT), online learning, computer-generated education, virtual learning environments (VLE) (which are also named learning stages), m-learning, and digital educational association. These substitute names lay emphasis on a specific feature, constituent or distribution technique.

E-Learning comprises of several kinds of mass media that convey text, aural, metaphors, animatronics, and flowing video, and comprises of technology uses and procedures such as audio or video tape, satellite television, CD-ROM, and computer grounded learning, as well as native intranet or extranet and web based education. Information and communication schemes, whether free vertical or grounded on either native nets or the Internet in schmoozed learning, underlie many e-Learning procedures.

E-Learning can befall in or out of classroom. It can be self-paced, asynchronous education or may be teacher commanded, synchronous education. E-Learning is suitable to remoteness education and plastic learning, but it can also be utilized in combination with face-to-face education, in which situation the term merged education is commonly utilized.

Libya has a decent evaluation for learning in the setting of the Arab world, bestowing to the United Nation's Human Progress Index. Libya remains at the topmost of the list of all African countries in provisions of education, not only geologically, but also tactically. Libya has enduringly been keen to safeguard entrance to suitable education for all associates of its society, men and women. The administration system devices plans to develop and progress the ICT substructure of Libya, and it pursues to progress and refurbish the complete educational procedure, together with the enlargement of prospectuses and informing its logical content; the implementation of ICT within teaching, together with higher education, is an vital factor in its general development tactics. Al-badree (2006) converses the educational, technical, and attitudinal contests connected to this. The outline of e-Learning packages in the edifying system of a particular country must take into reflection the communal and cultural features of that humanization. The communal and cultural upbringing of the educationalists and beginners plays an important role in deciding the achievement of e-Learning teaching. This importance varies from one culture to another, according to the ethics of the society, and its civilizations and customs.

E-Learning needs more than mere technology to be fruitful. There is the necessity for educational specialists who are well skilled in ICT, proficient of utilizing e-Learning systems and emerging learning constituents that discourse the needs of beginners. Nearby based experts are also mandatory to sustain apparatus as well as e-Learning schemes and tackles.

2. E-LEARNING IN LIBYA

Libya plays a chief role within the African landmass, on both an occupational and an educational level, by stimulating and supporting main creativities and plans, comprising of those in the adjacent states of Sudan, Chad, Niger and Mali. Nevertheless, the contests of a pitiable and unripe substructure, joined with a deficiency of experienced, skilled teachers, ICT endowment and ICT for teachers, shows a great trial to the present transformation process. The 1st methodical study of the application of e-Learning schemes in Libya was directed by Al-badree in 2006 and this study signposted that the application procedure is still in its determinative years. The effort to inspect e-Learning is yet at a situation study phase, because the disposition of info and infrastructures skills is not extensive. Nevertheless, teachers have been appearing in drill courses on e-Learning operation since 2002, and e-Learning was successively combined into the HE exam process in 2005. The Libyan Section of Education has lay emphasis on that ICT generates new methods of education & drill and has the ability to augment the organization of, and progress the level of, teaching in Libya. The worldwide spread of ICT has permitted individuals to utilize skill in all scopes of life, be it at work, at home, in institutes or in the field of amusement. This has controlled to an augmented number of beginners and coaches in Libyan universities, institutions and colleges bringing distance learning sequences.

This paper will show the features that pupils reflect to be blockades to initial, on-going, and concluding online educational sequences, utilizing a quantifiable investigation of the replies to an investigation survey intended and applied by Kenan (2009). The analysis offered the views of sixty three accused, which consist of 12 (19.05%) females and 51 (80.95%) males. The survey recognized the contests skilled by teachers, pupils and practical staff in HE organizations in Libya. The queries were articulated after an extensive initial study had been done, linked to barriers to the application and utilization of e-Learning and ICT in learning. The goal of the survey was to check if the accused views definite previous insights concerning the blockades to utilize e-Learning and ICT in learning. Also the accused were required to direct their individual opinions about any other contests they confronted when dealing with e-Learning and ICT.

The education freight in Libyan universities is characteristically large; for instance, the normal number of coaching hours for educational staff is 24 hours per week, and Libyan universities have not up till now recognized a scientific investigation tradition. Consequently, even professors find it difficult to find the time for active research and educational development. The after graduate packages started in 1973 in several staffs of Libyan universities comprised of education (Tripoli University) and prose. In 2004, the entire number of after graduate pupils who had required a Master’s degree from Libyan institutes in diverse disciplines was about 3150, and only 40 students had acquired a PhD certificate from the 3 main institutes. Although 7 or 8 institutes now have the incomes and educational position to award PhDs, many pupils, specifically in engineering, science, management and finance, found it essential to voyage abroad to carry out after graduate learning, and there were some 3500 who did this in the academic year 2004/2005 (Said, 2005).

2.1 The Challenges to E-Learning in Libya

Artemi (2009) categorized the contests connected to the application and utilization of e-Learning and ICT in Libyan organizations into 3 classes: deficiency of ICT substructure; deficiency of skilled workforces, and confrontation to alteration. Kenan (2009) performed further studies regarding these contests. She clustered the barricades into 3 categories grounded on the deductions from her study, and on her private skill as an educationist: Organization barriers; Technical barriers and Social barriers.

2.1.1 Technological

The maximum proportion of professed blockades is knowledge, at 34%; this blockade has an effect on instructive procedures and is connected to: IT recital abilities; design abilities; boundaries connected to bandwidth, and the safety supplies of IT systems. The mainstream of Libyan beginners does not have access to a personal computer or the Internet. Libya is still way behind other countries in terms of access to private computers. In 2004 it was assessed that in Libya, personal computer density was low, at 3.4 per 100 people; nation-wide 17% of Libya schools had a processor, but only 12% had one for coaching and education (MBNQA 2004). While in other states, such as United States and United Kingdom, the fraction of computers accessible in subordinate institutes was 73% and 78% correspondingly (Consultation Unit 2007). Nevertheless, there are also many less advanced states where computer learning is very great. In accumulation, the capability to contact the Internet and the amount of Internet users varies extensively from country to country.

2.1.2 Mismanagement

The proportion given for misconduct as a blockade is 29%; there are numerous issues which oppose the operation and utilization of e-Learning and ICT in Libya, such as augmented amount of work for educational staff; advance time; conveyance time; lack of strategic arrangement and visualization; deficiency of drill in technical progresses, and lack of provision for educational features of the progresses.

2.1.3 Cultural

The proportion of accused who professed culture as an obstacle was 21%; cultural obstacles occur where a definite ethos or collection is incapable to admit or accept a new procedure in a significant area of their lives, due to features such as spiritual principles, social taxes or habits. This boldness has been strengthened by actions because, with the arrival of new technologies, jobs that could previously be done with a minimum of education have quickly disappeared. A main notion of e-Learning is the litheness of timing for pupils, but some religions enforce a stern daily schedule, and it is also extensively known that many institutions of higher education have timetables, which are stationary and not at all lithe. In order to reflect social issues or social encounters that could act as blockades to e-Learning, one has to find the causes why people or persons may favour not to study in an electrical atmosphere. Some of the causes are matters such as: the terror of signifying a deficiency of ability or capability; terror of skill; terror of separation from other pupils; deficiency of responsiveness of the necessity to progress or the chances obtainable; accusing others for insufficient presentation somewhat than captivating accountability for one’s own activities; deficiency of private self-assurance, and a overall belief that persons cannot alteration. Consequently, fear stances a solemn blockade to e-Learning, because it is merely through coverage and skill that one can expertise or be relaxed with e-Learning.

The ethos which still rules most investigation presented by Libyan institution of higher education is usually the notion of a ‘research drill’, such as expositions presented by scholars to acquire documentations, or by educational staff to whole the educational necessities for job advancement, so the aims of such investigation have not arisen from the actual requirements of civilization. The Libyan Business Administrative Survey or Global Keenness Report (LBES/GCR) positions Libya 97th out of 111 states in institution of higher education or business investigation cooperation. Nonetheless, some educational staff conducts additional happenings, such as inscription and publication of text books for instance, to upsurge their salary.

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2.2 The Benefits of Using E-Learning and ICT in Libyan Institutions

Libyan institution of higher education could profit from the notion of lively education, and progress it in the shape of e-Learning, where scholars are not only hearers in the period, but also intermingle with the instructor and converse collected the information presented by the matter. Both lively education and e-Learning inspire students to use numerous bases of information, and encourage them to incorporate and occupation info proficiently, so that scholars are permitted to generate queries and converse new notions inside functioning teams, where info is joint in order to attaining a mutual aim.

3. CONCLUSION

E-Learning can prove creative in meeting the challenges of higher education. In Libya, e-Learning has enormous prospects. The vast and constant improvement of the information and telecommunication technologies in Libya indicates that society is ready to accept and embrace e-Learning fully. However, special care should be taken to analyse the opportunities and factors that can influence e-Learning adoption and implementation.

This paper reflected on the higher education context in Libya and the applications of ICT and e-Learning in Libyan higher education to date; it also discussed the challenges for and prospects of integrating ICT in higher learning institutions in Libya. It was found that the challenges or the barriers to e-Learning in Libya could be classified generally into 3 categories: Organization barriers; Technical barriers; Social barriers. The integration of e-Learning in the education system is likely to gather speed thanks to recent decisions and commitment of the Libyan government. Access to ICT facilities is likely to be improved in the very near future in all Libyan institutions thanks to major infrastructure projects that are currently in progress. However, there is a need for provision of suitable training at different levels, the development of expertise in e-Learning use, and research to gather data and inform future developments; these are important factors that require plentiful attention and great effort from the Libyan government to ensure the development of adequate awareness, attitude, and motivation towards e-Learning as well as suitable responses

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MOTIVATION AS A METHOD OF CONTROLLING THE SOCIAL SUBJECT SELF-LEARNING

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ABSTRACT

The paper substantiates inertial nature of the motivation system impact on the individual. Such exposure is a major shift from the level of motivational signs of external perception on the level of the individual internal motivation system. This approach justifies the ability to control the quality of the individual education as in the process of learning, and at its further self-learning.

KEYWORDS

Social subject, social system, inertial social system model, education, self-study, learning activities motivation, individualized academic trajectory.

1. INTRODUCTION

A conversation about human motivation is far from new.

Existing differences in the vision of causes a particular human response to a specific situation are increasingly worse as the accumulation of facts "inexplicable" illogical in terms of existing theories of individual behavior. In the educational process understanding of the mechanisms to motivate student learning activities, the development of his skills has almost paramount. Inability to understand the reasons for a particular activity or, on the contrary, student inactivity makes, in principle, impossible to control the educational process, not to mention the ability to manage its self-learning.

Problems of motivation of educational activities are devoted to E.P. Ilyin [1], Grebenyik O.S., Grebenyik T.B. [2]. It is an interesting experience in building motivational systems presented by Edward L. Deci, Robert J. Vallerand, LUG G. Pelletier, Richard M. Ryan [3], Florian H. Müller and Marko Palekčić [4].

2. THE PROBLEMS OF INDIVIDUAL MOTIVATION

Today, there are several points of view on the nature motive, E. P. Ilyin identifies the following [1]: motive as a need, motive as a target (subject to meet the need), motive as a motivation, motive as an intention, motive as resistant properties (personal dispositions), motive as a condition, motive as wording, motive as satisfaction.

Let us talk somewhat more detail on some of them.

One of the most common points of view on the essence of the motive is statement, according to which the first cause, impelling man to perform certain actions, is need. Motive is a conscious motivation, recognized need. Needs are a source of human activity, and motive expresses the direction of its activity [2]. From this perspective, rather convincingly explained the different behavioral patterns, which people are using, getting into various life situations. American scientist A. Maslow identified the following levels of human needs, placing them on the basis of the relative dominance: physiological needs, safety needs, the need for belonging and love, the need for self-esteem and self-actualization need. Distributing thereby subordination needs and hence motives. On the basis of the dominance principle proposed - each subsequent need arises just as the previous is met.

Attempts to explain the irrationality of human behavior led to statements about the motive nature as a psychological state of the person. That is to manage human, ie initiation of certain "required" actions - motivational system formed involves the creation and consolidation of a certain psychological state in which a person can only do so and not otherwise.

Systematized in the works of E. P. Ilyin point of view, describing the essence of the motive, each in its own way, exclude a number of "inexplicable" human behavior facts, leading them to unmotivated actions, thus these theories are distinct, not transmitting full perspective. However, if we assume that the issue at hand is one, then the above theories are only special cases of motive essence manifestations.

The author proposes a generalized vision of the motivation nature, built around the concept of the development of social inertia subject [5, 6].

3. THE CONCEPT OF THE SOCIAL SUBJECT INERTIAL DEVELOPMENT

Under the social subject development we will understand the process of different knowledge accumulation, skills formation and consolidation of certain skills [6, 7, 8]. Or otherwise the development is Knowledge accumulation process. Thus, under the Knowledge we will understand a set of specific behavioral individual stereotypes describing his response to the news, activity, psychological and other environmental influences.

Accumulation Knowledge process involves the collection of information, its accumulation and understanding that ultimately rearranges or subject to a different quality level of consciousness (brings a new basis), or lead to internal conflict, which resulted in the denial, becomes the subject of experience gained before (return to original basis). At the same time to estimate the amount of accumulated knowledge, we introduce an evaluation criterion - static evaluation, ie something that specific sibject possesses "here and now". Besides the static characteristic, the process of subject development is described per dynamic response, defined as the degree of subject perception of the new information. Accordingly, the high (increasing) - describes the growing interest of the individual to a particular field of knowledge, the average (constant) - is the possession of existing knowledge and the lowest (sloping) - extinction of interest to the field of knowledge, ie, the experience begins to be used either (a qualitatively new level exit to the new basis), or denied (return to the previous basis). The basis will be understood by a set of knowledge and skills is essential for the existence of an individual within a given social community (or individual sectors). Changes in terms of entity social functioning initiates a change in its baseline, and, conversely, a change of basis of the individual outputs it to other social society.

Thus, the process of acquiring knowledge (development of the subject) can be represented as a movement (changing static characteristics) on a trajectory from one basis to another. This movement triggered near both internal (goal setting, internal psychological states, the desire for self-expression and self-satisfaction) and external (changes in technology, changes in the social environment, changes in the material status, etc.) factors [6].

According to the proposed by the author concept of inertial development of the social subject movement from one basis to another, it can be represented by a linear plot of the static evaluation (Accumulated knowledge) from time to time (learning, life, …). Then the transition from one basis to another is macro-aim. Macro-aim changing is management resources costly. Much less costly is to make minor adjustments - macro-aim formation in the trajectory of the individual, which eventually change the macro-aim structure. Visually, you can submit two, built in the form of graphics, time dependencies. One of them is the desired path of movement, the other - real characterizing features of this particular individual. Then, setting the macro-aim would mean the formation of one or another delta (difference) between the already familiar knowledge and the fact that an individual need to learn (to study). Macro-aim setting is a way to control the trajectory of the individual and the formation of a stable system of his internal motivation. In other words, for an individual to be identified (observable) goals (Macro-aim) and known ways of achieving them. And here we are faced with the psychological aspect as interest. n some cases, and even in their majority, the most that neither is a promising training programs do not work - only one answer why: they're uninteresting

4. PERSONALITY PSYCHOLOGY - THE ART OF MANAGEMENT

Interest is the emotional state associated with the implementation of cognitive activity and this activity is characterized by incentive.

An emotion is a response to the distinction between external and internal factors of the individual expectation. Basis, from the point of view of psychology, can be defined as a psychologically comfortable condition. Like any physical body or system that seeks to occupy the position which will be characterized by the lowest energy consumption, anyone seek to find the most comfortable position, whether it is the basis. Any movement that displays an individual of this state requires certain costs. Consequently, the individual will be interested in changing their status in only two cases, first, to see if he will gain (consciously or unconsciously) the profitability of the other state - another basis, or, second, if there is a clear disadvantage of the state in which it is [5, 6].

Both of these cases are individual path control options, which give an idea about a possible management tool.

Let us return to the concept of interest. In game theory, the greatest interest in the game is evident when the player knows the rules of the game and how to influence (control) the game characters: principles of their interaction and options of equipment are known (equipment, technical improvements and other services game space management options that affect the course of the game), but there is a doubt as a result. Rather, the result depends on many small factors that player can evaluate and it is, in principle, a feasible task, but, nevertheless, possible inaccuracies of this assessment sharply reduce the predictability of the result of the game.

At the initial stage, the player is faced with uncertainty, it requires some time to learn the rules adopted in the game and how to control the impact on the game. At this stage, many of the games cease to be interesting - the game is unpredictable, there is no opportunity to evaluate the causes of the failure and, therefore, no chance of winning. Too large delta is set- psychologically uncomfortable for a player to distinguish between the subjective understanding of the game rules and gaming laws really set. Or on the contrary, the game is predictable, the player wins (loses) in any case - the game just becomes uninteresting. In this case, the obvious of result negates the need for its refinement and the whole game turns into a process of mechanical manipulation of gaming options.

The game is of interest when all the evidence in game action is present, and game result is still not obvious. "- Work with a" black box. " (Black Box - a device with an unknown principle of work having "input" and "output", changing the state of "entry", is necessary to achieve a given reaction to the "exit".) ... ". For example, the "rules of chess are known in advance. Rules of computer strategy game man "scoops out" of his playing experience. He will be losing as long as his ideas about the properties of shapes do not coincide with those established by the game creators." [10].

Thus, the basic of social subject development trajectory control principle is becoming clear or in a particular case management trainee learning trajectory - the formation of a stable system of individual internal motivation. Moreover, it becomes obvious, that the fact that playing another similar game, involuntarily the player will demonstrate the play behavior stereotypes learnt before Thus explained the ability to control not only the individual in the process of moving from one basis to another (in training), but also the foundations of its motion task in the future (self-learning control) - the principle of inertia.

Similar statements can be found in the works of V. K. Tarasov [9]. Individual state it is his picture of the world, which identifies goals, objectives and the ways to achieve them are known. The effectiveness of training (a special case of an individual path management) will depend on how much change is possible this particular world view.

The first is the connection to the Picture of the world - "catch on the fly."

"To raise a bucket of water, it is necessary to lean over and take it first".

Individual movement along a path of development is characterized by the previously constructed internal motivation system and any impact on its trajectory will call on his part unconscious (or completely conscious) psychological, social or other opposition. Resistance will be stronger with greater corrective action. If an individual is initially presented with a structure of adjusted goals, in case of significant discrepancies these goals with his expectations, it is likely triggering internal psychological defense, which will result in the rejection of all subsequent psychological motivation to achieve the goals presented, even if the profitability of the new approach will be obvious for him. There is an understanding of the goal (there is a reason for Action), but there is no movement - psychological state haven't formed yet.

Therefore, if for any reason the macro-aim is unacceptable to the individual, we should reduce the difference between the external (required) and an internal system of objectives - to generate number of micro-aims, the achievement of which does not cause a strong enough individual psychological rejection. "When we stand on the third step of the common staircase step we can easily step to the fourth step ... to step to the sixth is harder, and perhaps it is not possible - to step to the seventh and above" [9].

5. MAIN RESULTS

The following results were obtained:

- provided an overview of the main views on the theory of human motivation;
- justified inertial nature of the motivation system, which is a major shift from the level of motivational signs of external perception on the internal level of individual motivation system;
- justified the possibility of the learning process quality management through the formation of a trainee external motivational system;
- justified a basis to the subsequent self-learning management graduate, as a manifestation of the learning process inertia.

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Posters

DESIGNING ENVIRONMENT FOR TEACHING INTERNET OF THINGS

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ABSTRACT

One of the new topics taught at technical universities is Internet of Things. In this paper, a workshop for organizing a lab in academic environment for the subject Internet of Things is described. The architecture of the platform, scenario and a description of components used for creating the environment for learning Internet of things are also given in the paper. Students use their knowledge related to creating Android mobile applications and SMS services, as well as given sensors, microcontrollers and microcomputers to create an application for smart home automation.

KEYWORDS

Internet of Things, lab exercise, workshop, microcontroller, microcomputer, sensor

1. INTRODUCTION

Internet of Things (IoT) is a part of the future Internet which consists of billion sensor-based and actuator-based smart devices, with data-processing abilities (Perera et al., 2014). According to the Gartner report, over 26 billion of devices will have been connected to the Internet by the end of 2020 (Gartner, 2013).

Internet of Things deals with smart homes, as well as other smart environments, such as smart offices, smart cities, smart government, smart cites and others (Chan et al., 2008). Smart home enables automation of different areas of home, i.e. smart heating, smart air-conditioning, smart window (Jiang et al., 2004).

In this paper, we propose an environment for teaching Internet of Things at university. A workshop for creating applications for smart home automation is realized and a system for smart home automation is deployed where students use predefined smart home environments as a framework for creating their own applications for automation in order to learn principles of IoT. They are given a scenario and a diagram with connections between system components, as well as web services which manage components of the smart home. During the workshop, students implement a mobile and SMS application for smart home automation.

2. ENVIRONMENT FOR TEACHING INTERNET OF THINGS

An experimental workshop for learning IoT was performed during the laboratory classes of the elective subject “Internet of Things” attended by students of the final (fourth) year of the undergraduate studies within the e-Business Department, Faculty of Organizational Sciences, University of Belgrade. Eight students attended this workshop. The assignment was to create an IoT application for smart home automation.

2.1 A Scenario for Smart Home Automation

The main aim of the workshop is to familiarize students with Internet of Things technologies and smart home automation. The scenario which is given to students is related to automation of one part of a smart home. The scenario includes tracking of sensor status, logic for responding to environmental changes and managing particular components of the smart home. Students should manage the air-conditioning system in a smart home. If a temperature level is higher than defined threshold, an air-conditioning device should be turned on.

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The air-conditioning should be turned off if the temperature is below the threshold. For the simulation of air-conditioning, a light emitting diode (LED) is used (which is on when the "air-conditioning device" is on).

2.2 Hardware and Software Infrastructure

Students are given devices which they control using a given web service. In the Figure 1, a diagram with connections between a temperature sensor, LED, Arduino microcontroller and Raspberry Pi microcomputer is shown.

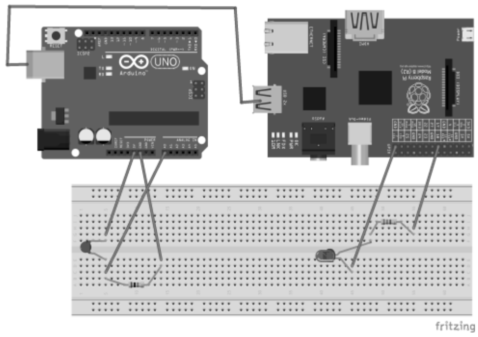

Figure 1. A diagram of component integration for smart home automation.

A temperature sensor is connected to Arduino which is connected to Raspberry Pi. A LED which simulates air-conditioning is also connected to Raspberry Pi. A web service is running at a web server on Raspberry Pi which has a network connection and IP address.

The web service is REST-based and it enables turning the LED on or off and reading the data from the temperature sensor. The web service is connected to scripts written in C++ and Python running on Arduino and Raspberry Pi, respectively.

SMS Cloud platform deployed within the University which is capable of sending and receiving SMS messages is used for creating a SMS application for home automation. The SMS platform contains a REST API with two functions – for sending and receiving SMSs. First, students need to log into the web application for obtaining their own API key. Also, they can obtain their own SMS prefix, which is necessary for receiving SMSs. All messages are obtained via the REST API.

2.3 Deploying Applications for Smart Home Automation

Students deploy Android mobile application and SMS application for home automation according to the given scenario.

Using the Android application, users can view the current temperature and turn the air-conditioning on or off. The final application contains buttons for enabling and disabling the air-conditioning and AUTO button which enables or disables the air-conditioning, according to the current temperature level and defined threshold. Also, the application can read current temperature from the web service and display the value in both Celsius and Fahrenheit degrees. The application logic of AUTO button is deployed on the client side of the application.

The SMS application is based on the SMS Cloud Platform. The SMS application manages the home automation by sending SMS messages with particular contents. The application is connected to the web service for home automation. For enabling and disabling air-conditioning, a sender should send a message with text "prefix on" and "prefix off", respectively. For getting the information about the current temperature, the sender should send a message with text "prefix cel" or "prefix far" for obtaining the current temperature in Celsius or Fahrenheit degrees, respectively. For enabling or disabling the air-conditioning, according to the temperature threshold, a sender should send a message with text "prefix auto". The keyword "prefix" should be changed with student's personal prefix.

3. CONCLUSION

This paper describes environment for teaching Internet of Things. It is based on Cloud PaaS (Platform as a Service) and hardware layer abstraction which enables using hardware components without knowledge of advanced hardware principles. Students generally were satisfied with this workshop. Only one of eight participants thought that the workshop had not been interesting. The main problem regarding the workshop was the lack in practical knowledge. The majority of participants (7 of 8) thought that this workshop had been difficult.

This environment is a good platform for learning about developing software for Internet of Things projects and it provides seamless features for extending applications in the future. After attending the workshop, students are able to create their own applications for automation various aspects of smart environments. Compared to traditional learning, students are more motivated in adopting IoT concepts by using modern technologies in workshops.

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FOSTERING CRITICAL THINKING SKILLS IN STUDENTS WITH LEARNING DISABILITIES THROUGH ONLINE PROBLEM-BASED LEARNING

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ABSTRACT

As a pedagogical approach, problem-based learning (PBL) has shown success for average and gifted students (Hmelo-Siver, 2004) and there are numerous incentives for its implementation in online learning environments (Savid-Baden, 2007; Chernobilsky, Nagarajan, & Hmelo-Silver, 2005). However, little research has been conducted regarding the impact of problem-based learning on higher order thinking skills of students with learning disabilities studying in online learning environments. This study examines the effects of an online problem-based learning course on critical thinking skills of university students with learning disabilities. Students participating in the study will be taking their first course in an online Bachelor of Arts degree at the University of Ontario Institute of Technology. Drawing on triangulation, this study includes a content analysis of reflective journals, a video analysis of a problem-based learning objective (PBLO) and semi-structured interviews with repertory grids, to observe the presence or absence of critical thinking skills among students with learning disabilities in an online PBL course.

KEYWORDS

Problem based learning, online learning, learning disabilities, critical thinking, problem-solving

1. INTRODUCTION AND IMPORTANCE OF STUDY

The 21st century is often referred to as the information based economy and is linked to technological growth, accessibility of information, and a need for higher order thinking skills such as problem-solving (Tan, 2007; Kalelioglu & Gulbahar, 2013). Dewey (1910) believed long ago that it is impossible to obtain knowledge without experience and that rote memorization approaches should be replaced with the development of problem-solving skills. Problem-based learning (PBL) has been promoted by numerous researchers (Gallagher, Sher, Stepien, & Workman, 1995; Gijbels, Dochy, Van den Bossche, & Siegers, 2005; Hmelo-Silver, 2004; Stepien & Gallagher, 1993) as a promising set of strategies that can nurture higher order thinking skills like problem solving and critical thinking among average and gifted university students (Barrows & Tamblyn, 1980). Recent studies have shown positive connections regarding the implementation of instructional strategies like PBL in online learning environments on critical thinking skills (Kalelioglu & Gulbahar, 2013) as a way to merge problem-solving skills and technological competencies (Savin-Baden, 2007). Unfortunately, there has been little research evaluating the influence of PBL as a pedagogical approach, attempting to foster critical thinking skills in students with learning disabilities in online learning environments.

2. CONTEXTUAL INFORMATION

Learning disabilities include a diverse cluster of neurological disorders that can alter the performance of the brain in a manner that affects how an individual stores, organizes, understands or uses verbal and non-verbal information (LDAC, 2002). The dysfunction in an individual's brain resulting from the neurological disorder causes impairments in one or more processes related to thinking, remembering, perceiving or learning (NCLD, 1999). However, in a technologically advanced, global and rapidly changing society of the 21st century, there is an increased demand for individuals with higher order cognitive skills like problem-solving and critical thinking (Behar-Horenstein & Niu, 2011). Critical thinking is defined by Glaser (1942) as an outlook and analytical application toward problem solving. Current researchers have further suggested that critical thinking is necessary for problem solving, which requires purposeful reflection (Brookfield, 1987; Sternberg, 1986; Ennis, 1993; Facione, 1990; Paul, 1997), self-regulation, interpretation, analysis, evaluation and inference (Facione, 1990).

Online problem-based learning has demonstrated effectiveness in enhancing technological, problem solving and critical thinking skills (Savin-Baden, 2007). Jonassen, Davidson, Collins, Campbell and Hagg (1995) found that the PBL model demands complicated problem solving where learners define the problem, identify resources, set priorities, and investigate alternative solutions. These are the same skills and abilities necessary for all individuals to employ during real-life problem solving and decision-making activities. If all individuals require cognitive skills to be highly adaptable the fast-changing environments of the 21st century as Tan (2007) states, then it is extremely important to ensure students with learning disabilities are also achieving these skills. If the goal of education according to Bruner (1960) is to foster the development of problem solving skills and encourage the process of inquiry and discussion, then PBL online may be a possible approach to take.

3. METHODOLOGY

3.1 Research Design and Data Collection Techniques

This study will examine a set of ethnographic case studies and carry out a triangulation design. "The Triangulation Design is a one-phase design in which researchers implement the quantitative and qualitative methods during the same timeframe and with equal weight. This design is used when a researcher wants to directly compare and contrast quantitative statistical results with qualitative findings or to validate or expand quantitative results with qualitative data" (Creswell and Clark, 2007, p. 62).

Qualitative and quantitative data will be collected through semi-structured interviews incorporating the use of repertory grids, content analysis of online discussion boards and video analysis. Observations will be recorded and analyzed using a variety of hardware and software in the EILab such as cameras, Adobe Connect, Noldus Face Reader and Observer XT.

3.2 Participants

The participants of this study will include five students from the online Bachelor of Adult Education and Digital Technologies (AEDT) program at the University of Ontario Institute of Technology. The group will be partaking in their first online PBL course in the program AEDT1120U Foundations of Digital Teaching and Learning Technologies. The five students range in age between twenty and thirty-five and all participants have a diagnosed learning disability

3.3 Research Questions

1. Can problem-based learning online foster critical thinking skills in students with learning disabilities?
2. Can problem-based learning online foster engagement in students with learning disabilities?
3. Does an online PBL environment support principals of Universal Design for Learning (UDL)?

4. CONCLUSIONS

The purpose of this paper is to discuss the preliminary research design of a study that will aim to analyze the presence or absence of higher order thinking skills demonstrated by students with learning disabilities in an online learning environment. Other areas of interest will focus on the level of engagement present in an online PBL learning environment and a gap analysis of Universal Design for Learning principals.

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A SYSTEM FOR THE AUTOMATIC ASSEMBLY OF TEST QUESTIONS USING A NO-SQL DATABASE

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ABSTRACT

We describe a system that automatically assembles test questions from a set of examples. Our system can create test questions appropriate for each user's level at low cost. In particular, when a user review their lesson, our system provides new test questions which are assembled based on their previous test results and past mistakes, rather than a completely random selection. By providing test question of the appropriate level, we hope to enhance the user's learning. We use MongoDB which is a no-SQL database system because the contents (test questions) are not structured. Most of test contents used in class are not structured, i.e. each question has a different structure and different selection type. Therefore, we used MongoDB system in order to structure the test questions more freely.

KEYWORDS

e-learning, personalization, automatically assembling, non-structure.

1. INTRODUCTION

In a class such as the language course of a university, the level of individual students will vary, even if classes are divided based on student ability. Moreover, even if students begin a course at the same level, differences in level will emerge as the course proceeds as students progress at different rates. However, until now, it has been common to present the same test questions to every student in the class. Even if, ideally, questions should be matched with each student's level, this has been impractical. Some part of this problem can be addressed with the growth of latest e-learning technology (Xia et al, 2014; Kundisch et al, 2013).

First, by using an e-learning system, each student's test result can be evaluated in real time by using the network. Second, the results for each student can be compared immediately. Third, by comparison of a student's test result with those of other students, the level of the student relative to the class can be assessed. In this way, if a study result is known in real time, it is possible to provide the test questions matched with each student at the next step.

Our system separates the example answers from the question. All example answers are managed in a database, with the relation information relevant to the questions. The sentences used for test questions are reconstructed using many example answers managed in the database. The database also has information about the results of each student for each question and example answers.

2. OUR SYSTEM FOR AUTOMATICALLY ASSEMBLING TEST QUESTIONS

The goal of our system is the provision of the test questions matched to the level of each student. After the first test about their lesson, we collect the information about their test result. This information is used to restructure the test questions when the student restudies about their past test or lesson. The construction of a system that allows students to improve their learning by solving specially selected new test questions is the concept of our system.

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The common test questions have various forms. Some questions are multiple choice and some questions require a written answer. The various types of questions make it difficult when data is stored in a relational database system. Moreover, since the most test questions were created by a program like a Microsoft Word, they cannot be stored in a database as-is. Data in MongoDB has a flexible schema. Collections do not enforce document structure (Kanade et al. 2014; Banker, 2011). This flexibility allows our system to control the document-oriented data.

3. SYSTEM ARCHITECTURE

For many, but not all, test questions, example answers can be separated from the question. We call each example answer or question "fragment data". We consider those questions from which example answers can be separated and focus on how to store the question and example answers from which new questions related to the original question can be formed. An initial set of questions was compiled by foreign language teachers. These questions were categorized by our system according to whether example answers can be separated or not.

A teacher who wants to use a test question can use the question as it is or a new question can be generated using the stored example answers. Our system supports the reassembly of the example answers with their related question automatically if the question has many example answers that can reassemble.

When our system provides the reassembled test question, our system refers to the percentage of correct answers for each test question and example answers and provides the test questions appropriate for the level of each student based on feedback of the student's previous results.

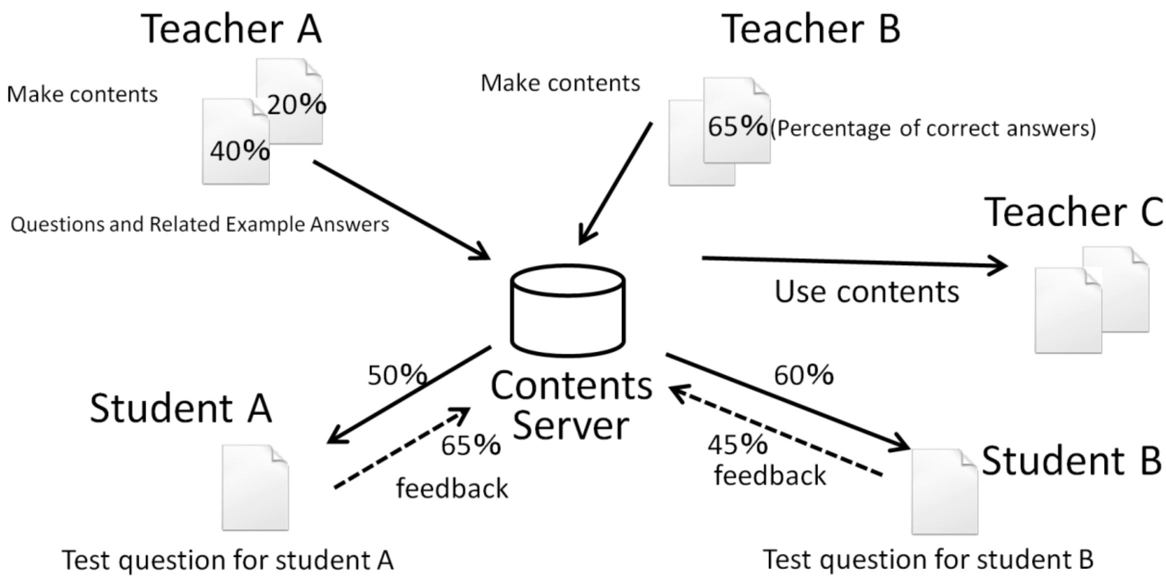

Figure 1. Architecture of System

Figure 2 shows a very simple sample data structure. The provided test question (The data matched to the level of student in Figure 2.) is constructed from the stored example answers (Example answers in Figure 2.). Each example answer has the percentage of correct answers (46%~78%). This percentage is used to generate questions of an appropriate level for each student, based on the student's previous test results. Of course, this percentage is changed by re-collection of test results.

Moreover, one test question is stored as one JSON style document, with various data added to each document.

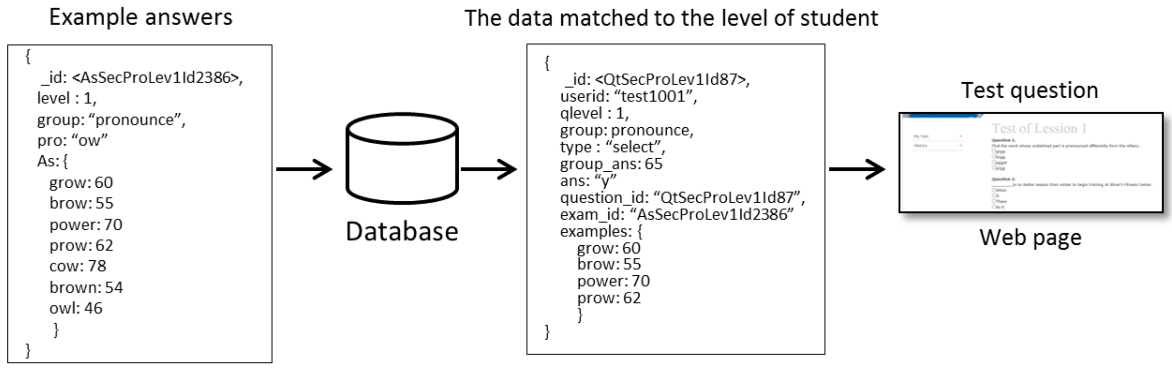

Figure 2. Example of Data Structure

4. CONCLUSION

We proposed a system for automatically assembling test questions. This system can assemble the example answers in the test questions automatically and at low cost. The processing of flexible data became possible by using MongoDB.

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