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Edited by:

Piet Kommers

Adriana Backx Noronha Viana

Tomayess Issa

Pedro Isaías



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**7th INTERNATIONAL CONFERENCE
on
Educational Technologies 2020
(ICEduTech 2020)**

**PROCEEDINGS OF THE
7th INTERNATIONAL CONFERENCE
on
Educational Technologies 2020
(ICEduTech 2020)**

SÃO PAULO, BRAZIL

5 – 7 FEBRUARY, 2020

Organised by



international association for development of the information society

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FOREWORD

These proceedings contain the papers of the 7th International Conference on Educational Technologies 2020 (ICEduTech 2020), which has been organised by the International Association for Development of the Information Society and co-organised by the University of São Paulo (*Universidade de São Paulo*), Brazil, from 5 to 7 February 2020.

ICEduTech is the scientific conference addressing the real topics as seen by teachers, students, parents and school leaders. Scientists, professionals and institutional leaders are invited to be informed by experts, sharpen the understanding what education needs and how to achieve it.

Topics for the ICEduTech Conference:

- **Education in Context:** Education in the Network Society, Educational Games, Social Media in Education, Home Schooling, Students' Rights, Parents' Rights, Teachers' Rights, Student-Safe Searching, School Violence, Education and Tolerance for Peace and Education in Developing Countries.
- **Education as Professional Field:** Teacher Education, Teachers' Professional Development, Teachers' Workload, Teacher Support for Grading, Time Tabling, Grading, Learning Tools, and Online Learning Software, Teachers' learning in Communities of Practice, Web-based Communities for Teacher Support, Teachers' Career Planning, Legal and Financial Issues, Conflict Resolution and Mediation, Governance and Servant Leadership and Educational Policies.
- **Curricular Evolution:** Problem-based Learning, Critical Thinking Skills, Creativity Skills, Learning Citizenship, Global Education, Media Literacy / Pedagogy, Multicultural Education and Alternative Assessment Methods.
- **Learner Orientation:** Student-Oriented Learning, Peer- and Collaborative Learning, Learning Strategies: Learn how to Learn, Motivating Students, Recognizing Students' Learning Styles and Special Education.
- **Integrating Educational Technologies:** Social Media and Social Networking, The Semantic Web 3.0, Podcasting for Broadcasting Video Lectures, Podcasting feedback to students, Wiki and blogs in Higher Education, Mobile, Virtual and Vicarious Learning and Simulations and Modeling.
- **International Higher Education:** Marketing Higher Education as a Business Case, Pitfalls and Solutions in Joint and Double Degree Programs, Enculturation and International Teacher Accreditation, Web-based, Mobile, Virtual Presence and Social Media to Overcome Student Mobility, Blended Learning and Student Assessment at a Distance, Student Mobility and Distance Education, New-Emerging Standards and Benchmarks for Higher Education, Education, Research, Exchange and Capacity Building, 21st Century Academic and Industrial Brain Exchange, Academic Salaries, Faculty Contracts, Residence Permits and Legal Issues, International Student Exchange Funding Programs: Erasmus Mundus, the U.S. Council on International Educational Student Exchange, and the Euro-American "Atlantis" program, Networks for International Higher Education in the Pacific, Australia, Europe, Asian and European countries and Higher Education, Cultural Diversity, Tolerance and Political Conflict.

The International Conference on Educational Technologies 2020 (ICEduTech 2020) received 71 submissions from more than 17 countries. Each submission was reviewed in a double-blind review process by an average of four independent reviewers to ensure quality and maintain high standards. Out of the papers submitted, 15 got blind referee ratings that published them as full and short papers, which means that the acceptance rate was 21%. Some other submissions were published as reflection papers.

Best paper authors from the ICEduTech 2020 conference will be asked to extend their papers to be published in the IADIS International Journal on WWW/Internet (ISSN: 1645-7641) and the IADIS Journal on Computer Science and Information Systems (ISSN: 1646-3692).

Besides the papers' presentations, the conference also includes one keynote and a workshop presentation from an internationally distinguished researcher. We would therefore like to express our gratitude to Professor Pedro Isaias, Information Systems & Technology Management School, The University of New South Wales, Australia as our keynote speaker and also for delivering a workshop.

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 least, we hope that participants enjoyed São Paulo and their time with colleagues from all over the world.

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São Paulo, Brazil
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KEYNOTE LECTURE

WILL IT BLEND? INSIGHTS INTO BLENDING UNIVERSITY COURSES

By Prof. Pedro Isaias
Information Systems & Technology Management School,
The University of New South Wales, Australia

Abstract

Blended learning approaches are thriving within the higher education sector mainly for their promise of providing students with the best of both worlds: face-to-face education and online learning. The deployment of blended learning initiatives is commonly associated with an enhanced student experience that results from a wider access to learning resources, improved interactivity and collaboration, increased engagement and motivation, and greater control over their own learning. As a growing number of higher education institutions revise their course offerings to provide their students with blended learning opportunities, it is fundamental to examine how these opportunities can be accomplished and to what effect. This keynote presentation addresses the benefits and challenges of blending a course, alternative platforms and technologies that can be used and also how to evaluate the whole process. Key aspects to consider include guaranteeing a user-friendly interface, promoting active learning activities both online and on campus, safeguarding a flexible access to the activities and warranting the clear communication of the expected outcomes and assessment requirements throughout the process.

WORKSHOP

DOING IT! ACTIVE LEARNING – DIFFERENT POSSIBILITIES TO EXPLORE IN CLASS

**By Prof. Pedro Isaias
Information Systems & Technology Management School,
The University of New South Wales, Australia**

Abstract

Currently, Active Learning is gaining an increased importance in curriculum design in order to engage further students and bring them back to class. This workshop will address the key aspects that need to be followed in order to implement active learning into your class. Several Active Learning Strategies will be presented. Participants will have the possibility to plan their Active Learning implementations for their classes.

Full Papers

LEARNING STYLES AND MOBILE LEARNING USAGE BEHAVIORS OF GRADUATE STUDENTS IN UNIVERSITY IN CURBING PLASTIC POLLUTION

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ABSTRACT

Plastic waste pollution has already affected everything on earth, especially with frighteningly high amounts of waste plastic being found recently in un-inhabited places. Responsibility of reducing plastic use and waste is more dependent on highly educated people than normal people as highly educated people are social reform leaders. This study is a guideline M-Learning or Mobile Learning which is teaching and learning through courseware offering content and activities via wireless network technology and wireless internet network technology Telecommunication Network so that learners can learn anywhere, anytime. In this study, the researcher studied only plastic wastage and smart phone usage with the objective to 1) study plastic waste and smartphone usage behaviors of graduate students and 2) study the relationship between plastic waste and smartphone usage behavior in the classroom and academic performance by collecting data using a purposive sampling of different learning styles; including observation, inquiries and interview forms for master and doctoral students at the Faculty of Education, Industry and Technology of King Mongkut's Institute of Technology at Ladkrabang, with 7 people. Data were analyzed using descriptive statistics and chi-square test. The results of the research revealed that 1) Most students use their smart phones in their classrooms to research information while doing their assigned activities causing increased plastic use and waste but without paying much attention to waste pollution because it was felt that the subject matter is not linked directly to pollution management. Students are aware of this problem but do not take it seriously. In addition, mobile phones are used to take pictures or listen to music, communicate in and outside the classroom, not deemed related to plastic pollution and 2) Smartphone behavior has a relationship with the academic performance of students with statistical significance at the level of 0.00.

KEYWORDS

Learning Styles, Mobile Learning, Behavior, Graduate Students, Plastic Pollution

1. INTRODUCTION

Controlling or reducing the continual build-up of plastic waste is something that everyone should do something to prevent, due to the increasing amount of waste in our world. Also, plastic waste exceeds plastic recycling. In addition, plastic breakdown is slow and wastes require much time to decompose affecting all levels of life on Earth. New Awareness Methods and behavior changes to reduce plastic use are highly recommended, especially for graduate students who are able to spread knowledge to many people and making a cleaner world, thus becoming future leaders of society.

There are many behaviors associated with using smart phones for teaching and learning. One can find information and communicate with each other at any time. However, using a smart phone in school has a great impact on teaching and learning activities. In one way, students tend to focus on one particular purpose, whether typing or using the phone via social media, rather than thinking of other factors related to their activity. However, there are still some students using smartphones to help search for content related to their study topic. Learning Style is the method that learners use in their educational process, which has many characteristics. In this study, the researchers classified the subjects according to Frames of Mind from the story. The Theory of Multiple Intelligences by Howard Gardner will lead to the provision of information about smartphone habits concerning plastic waste in school, the relationship between smartphone behavior and the academic performance of students. Waste pollution content relates the amount of plastic use of students and to the teaching and learning methods that could reduce plastic pollution.

2. RESEARCH OBJECTIVES

1. To study smartphone usage behavior in the classroom of graduate students concerning plastic pollution.
2. To study the relationship between increased plastic pollution and smartphone usage behavior in the classroom or related places of study.

3. LITERATURE REVIEW

3.1 Learning Styles

In teaching and learning management, teachers often find that students have a variety of characteristics with some liking art, mathematics, or those liking to study alone and others with friends. Moreover, some like to go study outside of the classroom by learning from an actual location. Teachers need to respond to all different students. If the instructor knows the learning styles of the students, he/she can enhance the learning strategies of the students as well as affect the future environment. In this study, the researcher studied from the following:

3.1.1 VAK Learning Styles (Fleming, N.D., 2014)

The Visual-Auditory-Kinesthetic learning styles model, usually abbreviated to VAK, provides a simple way to explain and understand each learning style, and the learning styles of others. Most importantly, it helps you to design learning methods and experiences that match people's preferences.

This model uses the three main sensory receivers: Visual, Auditory, and Kinesthetic (movement) to determine the dominant learning style. It is based on modalities or channels by which human expression can take place and is composed of a combination of perception and memory.

Each of us has a natural preference for the way in which we prefer to receive, process and impart information. For example

Some people like to “see” what you mean (Visual preference)

Some people like to “hear” your ideas (Auditory preference)

Some people like to “experience” what you are talking about (Kinesthetic)

The VAK model provides additional perspectives how we think and relate to the world, and where our natural strengths lie. It also provides a different perspective for understanding one’s learning style.

The original VAK concepts were first developed by psychologists and teaching specialists such as Fernald, Keller, Orton, Gillingham, Stallman and Montessori in the 1920's.

VAK learning styles model states people can be divided into three preferred styles, as follows:

Someone with a Visual learning style has a preference for seen or observed things, including pictures, diagrams, demonstrations, displays, handouts, films, flip-chart, etc. These people will be best able to perform a new task after reading the instructions or watching someone else do it first. These are the people who will work from lists and written directions and instructions.

Someone with an Auditory learning style has a preference for the transfer of information through listening: spoken words, sounds and noises and are best able to perform a new task after listening to instructions. These people can hear spoken instructions over the telephone, and remember all that they hear!

Someone with a Kinesthetic learning style has a preference for physical experience - touching, feeling, holding, doing, practical hands-on experiences. These people will be best able to perform a new task by going ahead and trying it out, learning as they go. These are the people who like to experiment, hands-on, and never look at the instructions first!

According to the VAK model, most people possess a dominant or preferred learning style, however some people have a mixed and evenly balanced blend of all styles. No-one has exclusively one single style or preference. It is also important to remember that this tool is just one tool to help us understand a person.

When you know and you understand your style, you will do your best work.

3.1.2 Gardner’s Theory of Multiple Intelligences

These are 8 different learning styles which based on psychologist Howard Gardner’s theory of multiple intelligences (<http://howardgardner.com/multiple-intelligences/>).

Gardner's (1983, 1999) conception of intelligence as pluralistic grew out of his observation that individuals who demonstrated substantial talent in diverse domains could be accounted for in conceptualizing intelligence. Accordingly, Gardner did not focus on the creation and interpretation of psychometric instruments and he drew upon research from evolutionary studies of prodigies and savants.

Through synthesis of relevant research across these fields, Gardner established several criteria for identification of a unique intelligence (see Table 1).

Table 1. Criteria for Identification of an Intelligence

Criteria for Identification of an Intelligence	
•	It should be seen in some prodigies, autistic savants, stroke victims or other exceptional individuals who have high or low levels of a particular capacity.
•	It should have a distinct neural representation—that is, distinguishable from that of other major human faculties.
•	It should have a distinct developmental trajectory. That is, different intelligences should develop at different rates and along paths which are distinctive.
•	It should have basis in evolutionary biology, an intelligence ought to have a previous instantiation in primate or other species and putative survival value.
•	It should be susceptible to capture in symbol systems, of that used in education.
•	It should be supported by evidence from psychometric tests of intelligence.
•	It should be distinguishable from other intelligences by various tasks.
•	It should demonstrate a core, information-processing system, identifiable mental processes that handle information related to each intelligence.

(Gardner 1983; Kornhaber, Fierros, & Veneema, 2004)

Drawing on these criteria, Gardner initially identified seven intelligences. However, in the mid-1990's, Gardner concluded that an eighth intelligence, naturalistic intelligence, met the criteria for identification as an intelligence as well (see Table 2). Naturalistic intelligence allows individuals to identify and distinguish among products of the natural world such as animals, plants, types of rocks, and weather patterns (Gardner, 1999). In a world where this particular skill is less important than it was in earlier times, naturalistic capacities are brought to bear in making consequential distinctions with respect to a consumer society.

Table 2. Gardner's Eight Intelligences

Intelligences	Description
Linguistic	An ability to analyze information and create products involving oral and written language such as speeches, books, and memos.
Logical-Mathematical	An ability to develop equations and proofs, make calculations, and solve abstract problems.
Spatial	An ability to recognize and manipulate large-scale and fine-grained spatial images.
Musical	An ability to produce, remember, and make meaning of different patterns of sound. Naturalist - An ability to identify and distinguish among different types of things found in nature.
Bodily-Kinesthetic	An ability to use one's own body to create products or solve problems.
Interpersonal	An ability to recognize and understand other people's moods, desires, motivations, and intentions.
Intrapersonal	An ability to recognize and understand his or her own moods, desires, motivations, and intentions.

The above descriptions of the eight intelligences that comprise MI theory relied upon the domains or disciplines in which one typically finds individuals who demonstrate high intelligence. For example, no test has been devised to assess directly whether an individual possesses a profile of intelligences high in spatial intelligence; however, one might reasonably infer that an individual who demonstrates excellent performance in the domain of architecture or sculpture or geometry possesses high spatial intelligence. Likewise, excellence in the domains of ballet or orthopedic surgery suggests the possession of high bodily-kinesthetic intelligence. It is possible that in the future more direct methods of measuring intelligences may be devised.

3.2 Mobile Learning

An important component of Mobile Learning is communication that can facilitate activities of 3 factors which are hardware and network technology, software, the basis of learning and the Digital Learning Environment. Mobile learning has features that require mobile communication devices to track and give students freedom to access information, teaching and a private space for knowledge. The focus is on the use of communication in learning through the network and using knowledge that relies on cloud technology.

This study involved only Mobile Learning which uses a smartphone, a mobile phone that has capabilities that are beyond normal mobile phones and is able to connect the core capabilities of mobile phones and the phone's own application. Smartphones can also allow users to install additional programs to enhance their vocabulary and smartphones become part of the student's life which can be observed in both open use and subtle use in the classroom. In the past, research shows that students often used their smartphones, both as a learning tool, and for personal matters, such as internet use, gaming, and social media usage.

The features of learning via smart phone are as follows: 1. Teachers can organize learning and teaching activities that allow learners to search for information on subjects through the internet on their own personal devices. Teachers can use their own smartphones as a learning and teaching medium, as an opening song, video clip or pictures related to teaching and learning 2. Students are able to use their smartphones to search for content related to the lesson, able to download applications for the educational need to find more knowledge and can prepare documents for teaching and learning media according to teachers and lessons related to understand the purpose of their study.

However, before mobile computers, or smartphones, people could only do research at home, in the library or at a public internet shop, where the ability to drink or eat was restricted due to location and therefore plastic pollution from users was negligible. When smartphones were on the rise, the amount of plastic waste from cups, bottles, bags and wrappers for food increased, making a new source of waste problem.

3.3 Plastic Pollution

Plastic pollution has caused negative impact on our oceans and wildlife health. Several years ago, an island of plastic wastes was discovered in the Pacific Ocean between Japan and America in the Pacific Ocean. Moreover, plastic residual wastes have been found in glaciers, ocean trenches and the bodies of many animals, including the death of some animals due to the ingestion of large plastic items deemed to be food by the animals. This makes the improvement of waste management systems across the world critical to addressing plastic pollution. Overall, approximately 80 percent of ocean plastics come from land-based sources, and 20 percent from marine.

3.3.1 How Plastic Effects Climate Change?

Plastic pollution is now so ubiquitous on the planet that cities, counties, and even states have banned single-use plastic bags. New York is expected to soon ban the tippable, mostly useless sacks.

Yet beyond the blight and recycling woes wrought by society's plastic bag addiction, plastics have an effect that bears heavy weight for the future. Overall, global plastic consumption has quadrupled in the last 40 years, and if the consumption of these fossil fuel-made plastics continues apace, the industry will carry a massive carbon emissions load by 2050.

Specifically, if modern civilization ever manages to cap the planet's total warming at around 2.7 degrees Fahrenheit above 19th century levels — which would limit the worst consequences of a globally disrupted climate — the plastics industry would account for a whopping 15 percent of the total amount of carbon society can expel into the atmosphere. In a world where cars, planes, ships, electrical generation, cement-making, and belching cows all contribute sizable carbon emissions, 15 percent from plastics is an oversized, if not ridiculous, contributor.

Scientists wanted to see how, and if, society might avoid such a future reality. In a study published Monday in the journal *Nature Climate Change*, they found that limiting carbon emissions from the plastic industry to 2015 levels requires a colossal societal undertaking involving four strategies: cutting growth in demand for plastics by half, making plastic out of plants rather than oil and gas, generating electricity with renewable energy, and increasing recycling.

4. METHODOLOGY

4.1 Population and Sample

The population is graduate students, Faculty of Education, Industry and Technology at King Mongkut's Institute of Technology at Ladkrabang, Bangkok who are still studying in 2019, and the sample comes from the researcher who chose a purposive sampling of 7 people with different learning styles and using the questionnaire as a tool.

4.2 Research Tools

The tools used in this research were observation, interview forms and questionnaires which were created from a review of relevant concepts and research. The interview form is for purpose 1, to study the behavior of using a smartphone. The questionnaire was created to find answers about the relationship between the behavior of using smartphones and the academic performance of students. The researcher has inserted the content of plastic pollution concerns into both research tools.

4.3 Data Collection

Analyzing behavioral data on smartphone usage using descriptive statistics as for the analysis of the relationship between smartphone usage behavior in the classroom and learning outcomes, the Chi-Square test was used.

5. FINDINGS

5.1 Smart Phone Use Behavior in the Classroom

The research found that most students use their smartphones to research information from assignments in the classroom as well as outside in public places where rules for consumptive goods did not apply. At the same time, it can be used to listen to music or to communicate with people outside of the classroom. In the conversation, not long after observing, it was found that students who worked by studying documents or books while working were finished faster than those who researched from the internet via smartphones. In addition, it was found that students use smartphones to record activities or to record pictures or some documents that the teacher presented in the classroom. The researcher observed that students could plagiarize work by sending information via smartphone and secretly playing games or even secretly playing LINE, a free communication system developed in Japan, Facebook or Instagram as well, causing them to have some negative behavior after the end of the lecture teaching activities. In addition, there is no directly-related waste pollution content from smartphone study work, in the teaching and learning activities. During the course, however, students bring some hot and cold drinks into the classroom or order from a delivery service because there are many works to send in school hours. Students have to work against time and therefore have to call to order food in the classroom, or stop at a convenience store and buy things to eat or drink at school in classes or outside classrooms before entering. No one brought food from home. The plastic waste from this activity comes from drinks and food, with the students taking the garbage out in the same bag and throwing it in the bin which has no waste sorting or separation done. The researchers observed that there is an increasingly big amount of this kind of waste from plastic that before did not accumulate because people ate at shops or restaurants. The number of food shops serving hot meals has declined while the stalls that sell portable plastic containers of items has rapidly increased. Therefore, the amount of plastic pollution has greatly increased in campuses and public areas.

5.2 Relationship between Smartphone Usage Behavior in Class and Academic Performance of Students

The research found that students use their smartphones to study or research additional content. There is also a correlation between academic performance with statistical significance at the level of 0.00 in which students use

their smartphones in the classroom for regular study. Students without smartphones have a grade point average (53 percent) and (42 percent) higher than students who use a smartphone often or sometimes. It was found that there was a great amount of time that the smartphone was secretly used in the classroom for purposes not related to education. Correlated with academic performance with the statistical significance at the level of 0.00 by the students who have a secret period Smartphones less than half of the class have a higher level of learning (55%) than students with a period of using half or more of their smartphones.

Table 3. Percentage of student grades Classified by smartphone usage behavior in the classroom
Smartphone usage behavior in the classroom

Smartphone usage behavior in the classroom.	School record			\bar{x}^2	p-value
	Low	Moderate	High		
Using a smartphone to search for additional content or to confirm an answer					
Always	9	49	42	15.71	0.00
Sometimes	22	42	36		
Never	37	40	23		
Duration of sneaking of a smartphone in the classroom					
More than half of the lesson	38	53	9	68.27	0.00
Half of the lesson	16	55	29		
Less than half of the lesson period	9	36	55		

6. DISSCUSSION

6.1 Smartphone Behavior in Students' Classroom

The research found that students use their smartphones in the classroom to help them research and gain confidence in unsure areas. Consistent with the findings of Seifert, T. & Har-Paz, C., 2018 learning that “The result of this study show that the implementation of a mobile learning teaching unit with a small groups of students during a short period of time does not affect the self-regulation learning abilities of the students. However, it does reveal an increase in external and internal motivation, motivation together with a shift in the application of learning strategies, which find expression in the significant increase in the students’ scores after the intervention.”

And in accordance with Pastore, R.S. & Martin, F. (2013). “Mobile devices are increasingly being used in classrooms and corporations as a means to deliver instructional content. Currently, there is limited research on how to best design and develop mobile based instruction. As a result, the purpose of this research study was to examine students' perceptions of designing and developing mobile-based instruction by a) interviewing instructional design graduate students in a computer based instruction course who were given the opportunity to construct mobile-based instruction and b) surveying instructional design graduate students to uncover their perceptions of mobile instruction design, usability, and delivery. Results of the survey and qualitative data analysis indicated that usability was a key issue on the mobile device. Users enjoyed quick access, good organization, user control, single column layouts, and large links/buttons. These findings contribute to the literature base on the design and development of mobile based instruction.”

In addition, students also use their smart phones every time they study and do research. Consistent with the research of Iqbal, S. (2017). who discovered “Mobile phones are increasingly becoming part of the daily life of today and 2019s youth. This widespread usage of mobile technology has attracted the attention of researchers and academicians to explore the ways and means of using it in formal and informal education”

However, teachers are worried that although students are using smart phones to help them learn better, it was found in the interviews and observation that students secretly send answers to each other via social media or even playing music or watching movies as well as playing games at school time being inappropriate and causing the student to not concentrate on the subject being studied In accordance with the research results of Seifedine Kadry et al 2019 who found that “Teachers are always frustrated with students and their use of cell phones during classroom. Texting, tweeting, and snap chatting during in class are an incredible distraction, resulting in a difficult teaching environment. In this paper, we pro-pose an innovative approach to encourage

students to use effectively their smartphone in classroom. The main idea behind this is to develop an easy and friendly application related to the course that may be accompanied by the used textbook. The proposed application can be adapted easily to any textbook, where no coding is required.”

6.2 Relationship between Smartphone Use Behavior in the Classroom and Student Performance

The research found that students use their smartphones in the classroom with the objective of helping them study, such as searching for answers or confirming answers, mainly for the benefit of study which has a relationship with academic performance with statistical significance by those who use smartphones in the classroom, with objects for regular study, in a moderate and high level, more than students who use their smartphones sometimes or never, in which, such behavior helps students to understand the content of the study more. The results of this research were consistent with the research of Jacobsen and Forsre (2011), who found that, “Little is known about the influence of electronic media use on the academic and social lives of university students. Using time-diary and survey data, we explore the use of various types of electronic media among first year students. Time-diary results suggest that the majority of students use electronic media to multitask. Robust regression results indicate a negative relationship between the use of various types of electronic media and first semester grades. In addition, we find a positive association between social-networking-site use, cellular-phone communication, and face-to-face social interaction.”

It was also found that time secretly using a smartphone for communication or entertainment, regardless of academic subjects, has a statistically significant relationship between grades of students who have a secret period smartphones, less than half of the time each school has a high grade, more than students who had a secret period of half or more than half of the time studied because the use of smartphones in the classroom with other goals, such as communication or playing games, caused students to lose concentration in their studies, which affected their grade level. The quality of work done and more time spent working makes students think they can do many things at the same time as for the environmental awareness, especially waste pollution, there is no mention at all at any level.

Regarding the learning style of the learners from this study, most of the students are Spatial Learner (Visual) learners. That is, the learners have preferences in accordance with the learning style according to their aptitude from watching. (Visual Learner) in which students have good skills from reading Interpretation from images or recognition from visible images, i.e. the visual or spatial learner is often referred to as a right-brained learner. This person is typically good at deciphering visual data in the form of maps and graphs. While they excel at subjects such as geometry, they struggle with arithmetic and numbers in general. Incorrectly labeled as "late bloomers" for their struggles with reading and writing, these learners simply see the world in a different manner: They are imaginative, think outside of the box and quickly process what they see rather than what they hear. Ways to Enhance Retention are as follows 1. Use of charts, graphs, maps, diagrams, time lines and infographics. 2. Implement digital tools and technology to assist learning. 3. Replace words with colors and images. 4. Create outlines with different levels instead of blocks of text and 5. Highlight important points in text.

6.3 Relationship between Smartphone Use Behavior in the Classroom and Plastic Pollution

Prior to the use of smartphones, people working in colleges, attending classes and visiting campuses for meeting with friends or relatives, restaurants and small food shops were the main places that were used. People would go to school a bit early and eat with friends before attending classes or after class would stop and eat before going home. With the popularity of smartphones after the prices of units became affordable for all, more people went to 7-11 or Family Mart on their way to school or home as it saved time eating in shops. The food stalls were eventually replaced with convenience stores and small shops that sell only bottled drinks or pre-packed food. However, the convenience of the packed food and bottled drink method created much more plastic bottle and bag pollution in campus areas. Garbage cans that before seldom filled up are now often overflowing with bottles or cans or bags causing filth, smells and ugliness, not to mention more frequent trash collection and less space to keep this kind of pollution until the public garbage collection service comes. Students who buy at stores and bring them to class, do not think about the effect of plastic pollution because it is only one bottle, can or bag each time, and insignificant. Due to everyone doing this, the world is filling up with plastic pollution. An awareness of the pollution problem must be taught to these people so these future leaders are able to help reduce the problem, not add to it.

7. RECOMMENDATIONS

1. In order for the teaching to be effective, learners and teachers must agree to use the smartphone in the classroom for academic topics only.
2. The smartphone should be used in the classroom for a specified period of time and the learning activities or teaching techniques should be adjusted to suit the needs of the students as much as possible.
3. The cause and content of waste pollution or environmental awareness should be incorporated into the course for the learners to understand their effect on the problem and love the environment by not wasting plastics when they are using other items, or by stopping the use of non-essential plastic goods.

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THE DIGITAL COMPETENCE IN THE INITIAL TRAINING. ESCAPE ROOMS: GAMIFIED ACTIVITIES FOR THE TRAINING OF EDUCATION PROFESSIONALS

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ABSTRACT

This work presents an educational innovation performed during the academic year 2018/2019, consisting in some escape room activities with the students of the Social Education and the Infant Education degrees from the University of Jaén. This kind of activity have maintained, for many years, certain popularity within the educational field, specially in compulsory stages of training; however, its usage in university classrooms has increased dramatically. Thus, they have been considered as an useful way to acquire competences in the university sphere, specially in Educational Science degrees. Aside from breaking the pattern of traditional methodologies, they also allow the implementation of new ways of teaching and learning using Information and Communication Technologies (ICT), and the development of metacognitive abilities. The general objective of this work is to present the didactic proposal developed, as well as the perception of the students after completing the activity.

KEYWORDS

Educational Technology, Higher Education, Teaching Qualification, Educational Innovation

1. INTRODUCTION

In the Spanish university the digital competence is one of the basic competences of citizens of the 21st century, being considered as a transversal competence after the creation of the European Higher Education Area. On the other hand, the educational innovation in our higher teaching system needs to become a basic element of our daily tasks if we want to adapt the institutions to the employment and economic context of today's society, in line with the Digital Agenda for Europe of the European Commission (2014). If we make some history, from the appearance of the first web in the nineties, the world of technology has moved forward at a great speed, a breakneck speed that we are not fully aware of. For example, it was only ten years ago that WhatsApp started to incorporate within people's lives; in the decade of the 2000s the evolution of mobile technology was overwhelming, until reaching the predecessor devices of the ones that we have today; causing the migration of the 2G and 3G to 4G en 2011; eight years after, the 5G is starting to appear in our lives. Facts like this have led to the implementation of more and more devices equipped with a greater complexity and portability, becoming an extension of the body itself. This way, the number of applications and/or softwares has notoriously increased, providing a bigger stimulation, a greater visual capacity and dynamism, that seduces every user.

One of the fields where this reality can be clearly seen is leisure and free-time, where more and more platforms are being developed for video games and their developing, with a growing orientation towards films, through the creation of stories that seek the empathy among players and their connection with virtual reality.

This way, through the development of media, images, animations, videos, etc., virtual reality generates a double dimension, resulting in a wide development.

First of all, it highlights the possibility to exploit VR with a greater presence. On the other hand, the fusion between the real world and virtual reality generates the augmented reality, with ubiquitous and timeless characteristics and a teaching-learning constructivist and connectivist approach, oriented to the acquisition of competences of the 21st century (Wang, Callaghan, Bernhardt, White, & Peña-Ríos, 2018). This way, innovation in the education reaches a wider development in that teaching-learning process.

All of these resources represent the support for the development of methodologies in the classroom that contribute to the interaction with students and among them. In this sense, escape rooms contribute to create training spaces that facilitate learning, being essential for the metacognitive development. Thus, educational escape rooms acquire functionality and significance for learning, as they work on the contents of the different subjects and courses through the game.

For all these reasons, it is worth to highlight the scientific production regarding the studies in this sphere, specially in the last two years, in disciplines related with health, exact sciences and social sciences.

2. THEORETICAL FRAMEWORK

2.1 Escape Room: A Brief Concept

The origin of escape rooms, although they existed already in the virtual world, comes from the REG (Real Escape Games), created by the scriptwriter and film director Takao Kato of the company SCRAP (2007) in Japan; a Japanese company that developed an adventure-based game to solve different tasks, mainly puzzles, where different groups of five or six people participated. Later, they were performed organizing big massive events in wider spaces. From 2012 and 2013 onwards, escape rooms developed globally, starting in Asia, then in Europe and arriving to countries like Australia, the United States and Canada (Nicholson, 2015, 2018).

Authors like Nicholson (2015) y Simkins (2015) state that escape rooms have had five precedents:

- The growing and evolution of role-playing games.
- Treasure hunts and riddles.
- The development of interactive haunted houses and theaters.
- The film industry and adventure games.
- The progress followed by the entertainment industry, more and more worried about the interests and requests of users, adapting their themes to them.

This way, an escape room is a game of real action ruled by the cooperative work of the team, whose purpose is to escape a room full of riddles, clues and puzzles that participants must solve properly. Every escape room game is set in a specific theme. Normally, the main objective is to escape the room in a specified time, which normally is 60 minutes (Nicholson, 2015)

2.2 Escape Rooms in Education

The human being learns in a more efficient way when presented with activities based on games and own experimentation. In this regard, as escape rooms are activities based in a game, we believe it is appropriate to highlight the term gamification, as an attractive learning technique for students that transfers the mechanics of the game to the educational field, in order to achieve better results, whether to interiorize knowledge, improve abilities or to reward certain actions. This way, the interest and curiosity of students is increased, whose main objective is to attain the didactic objectives in, a priori, non-educational environments (Deterding, Dixon, Khaled, & Nacke, 2011; Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011; Rice, 2012).

Csikszentmihalyi (2012) presents seven elements that may be integrated within the teaching-learning process of escape rooms that were developed in his flow theory, which are:

- a) To define and specify a goal explicitly: when the teacher decides to carry out an escape room in the classroom, students know the final goal of the activity, to escape the room before the time is up.
- b) Realism in the achievement of the goal: the final objective depends on the students, their energy and effort in the performance of the challenges to obtain it.
- c) The challenge determines the activity: that is why the attention of the students must be constant and continuous to achieve the final challenge.
- d) The development of the escape room should not lead to stress or anxiety: although the performance of the activity requires effort and concentration, it is also based on a gamified environment with a high level of motivation.
- e) The game generates a continuous feedback: a coordinator will be in charge of narrating the story and provide support and help to students when in doubt, blocking, etc., indicating how to continue with the game.
- f) To make the students feel in control of the game: as the tasks involve some lack of knowledge about what the students will find or will have to do.
- g) There is an alteration in the time perception: being a gamified environment where it is necessary to maintain concentration, students lose track of time, causing them to feel that they have invested less time than they actually have.

For these reasons, gamification contributes to transform Higher Education in order to adapt it to the reality where we live, using the potential of games, their dynamics and mechanics to benefit and enrich the learning scenarios, as they become factors and motivating elements, both for teachers and students in the development and acquisition of the competences of the different degrees. It is necessary to take into account that the challenge and the possibility of winning points generates and causes a satisfaction feeling in students, because in order to get them, there must have been a series of achievements in a progressive way, and, therefore, they are aware of the progress they have followed to achieve the final goal (EducaLab, 2015; Ochoa, 2014).

3. EDUCATIONAL INNOVATION PROPOSAL IN THE EARLY CHILDHOOD EDUCATION AND SOCIAL EDUCATION DEGREES OF THE UNIVERSITY OF JAÉN

The experience developed has taken the form of the implementation of an innovative didactic proposal with students from the Social Education degree (1st and 2nd course) and Early Childhood Education degree (1st course). In Table 1 is shown the number of students participating and the subjects where the activity was carried out. It is worth mentioning that the performance of the escape rooms was developed in a different way in each degree.

Table 1. Characteristics of participating students

Degree-Course	No. of participating students	Subject
Early Childhood Education degree (1st course)	90	General Didactics in Early Childhood Education
Social Education degree (1st course)	75	Permanent Education
Social Education degree (2nd course)	72	Organization and Management of Educational Institutions for Social Education

3.1 Description of the Didactic Proposal

The decision of implementing escape rooms as a methodological alternative in the classroom originated from the teaching interest to know and analyze the acquisition of contents of the subject General Didactics in Early Childhood Education, an annual basic subject of great importance around which, the rest of the subjects of the degree are articulated. After the positive results of the experience, it was transferred to the Social Education degree, with important modifications: in this case the students design, develop and implement their own escape rooms. Then, a more detailed description of the procedure is given in every degree.

3.2 Early Childhood Education Degree

The activity was developed during the second semester of the subject. Until then, a total of five complete themes were given in class lessons, which were focused on the development of the contents referring to innovative methodologies in the classroom. In order for the students to be able to find a connection between the theory learned and a real and lived experience, the escape room began to be designed. Furthermore, it also served to articulate the narration, including challenges related with the contents given. The creation of the story, characters and challenges took a month, and the use of ICT was essential for that purpose. Below appear the tools used:

- Design and creation of video, audio and images: iMovie, Audacity, Renderforest and VLC.
- Design and creation of emblems, wild cards and challenges: Canva.
- Design of the tests of every challenge: eduescaperoom.com, on line crossword puzzles and word search games, metaverse and MergeCube.

3.3 Social Education Degree

After the positive results obtained with students of the Early Childhood Education degree, students of the Social Education degree were suggested to design escape rooms related with the contents given in the subjects of Permanent Education and Organization and Management of Educational Institutions for Social Intervention, from the 1st and 2nd course respectively. In this case, due to the own idiosyncrasy of the degree and the basis of the students, as many of them came from Advanced Vocational Training Modules, it was

decided that they should create their own escape room working in collaborative groups. In particular, in the first course two escape rooms were performed, and in the second course, a total of nine. In Table 2 appear the selected themes for each team.

Table 2. Narratives and themes of escape rooms in Social Education

	Theme-contents	Narrative	Main aspects
Permanent Education (1st)	Education in Adults and Older People	The Aging Villain	Based on a story of superheros and villains, they work on empathy towards older people.
		Alice in Wonderland	Through the story of Alice in Wonderland, the intention is to work on the education-employment advice for women of 45+ who want to access the employment market.
Organization and Management of Educational Institutions for Social Intervention (2nd)	Conflict settlement and mediation in school environments.	Money Heist	Based on the story of Money Heist, it addresses the topic of violence and conflict management in secondary education.
		SAW	Related with the gore story of the film, students articulate a narrative in order to work on the cooperation among individuals and the emotional management in secondary education.
		CSI	A kidnapping serves as a base to work on moral values and teamwork in secondary education.
		Egypt	A treasure hunt set in ancient Egypt to work on environmental education with primary education students.
		Harry Potter	The world of Harry Potter serves to develop the acceptance of individual differences and the respect for others, addressed to students of primary and secondary education.
		Peter Pan	Addressed to the students of Infant Education, this theme intends to encourage imagination, creativity and emotional expression.
		Pirates of the Caribbean	A world of pirates serves to work on immigration and interculturality with baccalaureate students.
		The Purge	Based on the narrative of the movie, students tried to work the different aspects of social exclusion and inequality of opportunities in secondary education and baccalaureate.
		The Theft of the Mona Lisa	In the prelude to a possible III World War for the theft of the Mona Lisa, the intention is to work on the respect for the culture and value the informal and non-formal education. Addressed to students from the last courses of secondary education and baccalaureate.

3.4 Some Results

The gamified activity (escape rooms) was only the final product of the innovation proposal carried out. Project-Based Learning (PBL) was the general methodology for the design and implementation of escape rooms in the Degree in Social Education, students had to carry out a project on school mediation for compulsory education, where they proposed gamification as final activity. On the other hand, in the Degree in Early Childhood Education, the methodology used was Flipped Classroom to present the lessons's content, the design and application of the escape room was destined to know the degree of knowledge acquisition, and its application to real contexts, about the work done in the classroom. Beyond the subject content itself and the methodology followed, the use of technology was established as a fundamental element, both for the design and for the implementation of innovation. The students affirmed the need to integrate ICT in their future professional practice.

Likewise, after carrying out the evaluation of the subjects of the Degrees in which the proposal was developed, an increase in the academic performance of the students was observed, as well as an increase in the ability to solve problems. For this, the results obtained in objective tests (exams), rubrics, co-evaluation targets and a final group debate to know the students' perceptions were taken into account.

Therefore, this section are reflected the perceptions of the students in a general way, as the analysis of the results is yet in preparation. A priori, students highlight the increase of the motivation, the boost of creativity and imagination and the development of the digital competence when using different resources and tools during the implementation process of the activity. More than 95% of the students consider that escape rooms are gamified activities that benefit the teaching-learning process and allow them to apply their knowledge in hypothetical environments that could be found in their future work.

4. CONCLUSIONS

The first experiences of escape rooms carried out in Higher Education, were performed in degrees like Medicine (Kinio, Dufresne, Brandys, & Jetty, 2017; See, Lam, & Lau, 2016), Nursing (Adams, Burger, Crawford, & Setter, 2018), Engineering and Information Technology (Borrego, Fernández, Blanes, & Robles, 2017) and Chemistry (Dietrich, 2018).

In conclusion, escape rooms promote communication, collaborative and cooperative work, the development of lateral and critical thinking, as well as the need to pay attention to details. Moreover, any individual can access them, regardless of age. Regarding this, teams that maintain a high level of success are those composed by people of different age ranges, with a variety of life experiences, skills and abilities, whether physical or mental (Nicholson, 2018). Furthermore, the development of the digital competence is essential for the elaboration of resources, not only for this kind of activities, but also for life in general. Hence, it is considered that the proposal is beneficial and highly potential for the acquisition of the competences that are actually requested in order to function within society and its different spheres.

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GAUGING THE USAGE OF THE INTERNAL MARKETING BY TEACHERS FOR EFFECTIVE TEACHING AND COMMUNICATION

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ABSTRACT

With a whole new array of technological developments in and around the world ----” The Technology means” are the strongest way to communicate and create long lasting impact on peoples’ minds. As far as teachers are concerned technology enabled teaching environment can positively reinforce their teaching methodology. The internet which is an internetwork of networks and integrates Information and communication technologies, can be used as an effective means for communicating with the students This study assesses the internet usage by teachers of high schools and higher secondary schools along thirteen different categories of uses of the internet for various teaching learning processes. The data was collected from three zones constituted by 14 districts in the Indian state named Kerala. The data was analysed using Friedman's two-way analysis of variance test to gauge the teachers ranking of thirteen popular uses of the Internet. The rankings revealed that the most popular use of the internet was accessing course content, followed by teaching of subjects, performance evaluations and communicating with subject experts. The least ranked categories of use were gaining computer skill, presentation, searching information and communicating with stakeholders like students, parents and teachers. These rankings are indicative of teacher preferences relating to the usage of Internet resources for various teaching learning activities. The results raise several concerns regarding the areas where there is potential for better use of the internet in the future.

KEYWORDS

Internet, Technology Enabled Teaching, Communication with Subject Experts, Access to Course Content, Performance Evaluation

1. INTRODUCTION

Developments in communication technology are having a deep and distinct impact on the traditional educational system both in elementary schools and higher education institutions. Teachers play a crucial role in helping individuals gain adequate expertise in using the learning networks audaciously and accessing information available on the Internet. Study tried to assess the popular uses of the internet by teachers for various teaching learning processes. The assessment categories included access to course content, presentation, lesson plan preparation, performance evaluation, communication, new content creation, bookmarking and collaboration. The paper aims at ascertaining the teachers perception on the usefulness of the internet in streamlining various teaching learning processes especially along dimensions like the use of internet as an reservoir of content for enhancing the classroom teaching environment, the use of Internet as a means for communicating with different stakeholders who are part of the teaching learning process, the use of Internet for creation of new educational content, use of internet for preparation of lesson plan and the use of Internet for monitoring student progress.

2. LITERATURE REVIEW

With the internet reaching beyond the boundaries of both domestic and public environments, it upholds great challenges as well as opportunities for improving the education system. The opportunities come by way of free and open communication, identity, wide spread literacy and participation while the challenges come by way of fear of exclusion, inappropriate content and digital divide (Livingstone, 2003). (Uluyol & Sahin, 2014) the authors suggested that teachers play a significant role in integrating information and communication technology (ict) in schools, and motivated teachers reflect higher levels of ICT use in their classroom. The discussion that accrued from the study helped to understand the current state of teachers' technology use and their motivations for using technology. The development of the internet has brought about a revolutionary change in the perspective of teachers towards the use of information and communication technology in teaching, as the tools that were offered by technology, today are becoming more and more reliable. (A.K. Jager & A.H. Lokman, 1999) emphasized that although teachers consult each other more frequently, the teacher eventually decide on the educational practice in their class room. Education and teacher are tied to a specific content of education, timetables, amount of face-to-face instruction, instruction time, class rooms etc. even the teacher's status is laid down (Wolf, 1998). Contemporary Information and communication technology aides are able to provide strong support for all these requirements and there are now many outstanding examples of world class settings for competency and performance-based curricula that make sound use of the affordances of these technologies (Oliver, 2000). The integration of information and communication technologies can help revitalize teachers and students. The rapid development of the internet, although has greatly raised teacher interest in technology tools provided by internet for teaching learning purposes, little is known about their actual use of it. (SHIN, 2007). The role of teachers in motivating and guiding students' use of technology is of primary concern, as a study reported that students acceptance of internet based learning medium was greatly influenced by both the extrinsic factor called perceived usefulness as well as the intrinsic factor perceived enjoyment while the ease of use of technology, according to the author did not have a significant influence on the use of it (Matthew K.O. Lee, 2005). Teachers could therefore build up their classroom and curriculum activities integrating various internet based tools so as to enhance the students' perceived usefulness of technology as well their perceived enjoyment of it.

3. METHODOLOGY

Exploratory research was carried out for the purpose of the study. In order to study internet usage pattern of teachers, initially various stakeholders were interviewed and focus group discussions were held to ascertain the major categories of use that internet could serve teachers. Gradually the search revealed thirteen various categories of use that seemed were mostly preferred by teachers. Descriptive design was adopted in the next stage of the study which falls into a conclusive design. A questionnaire was formed based on the responses collected in the exploratory phase and the same was used to collect the data for the study. The researcher collected data on the basis of these thirteen categories of internet use relating to various teaching learning processes. The respondents were asked to rate each category of internet use on a scale of ranging from a minimum score of one to a maximum score of 10. These ratings were beneficial to the researcher in tabulating the relative ranking for each of these thirteen categories of internet use. All high schools and higher secondary government and aided schools in the Indian state of Kerala were considered for this study. A total of 342 respondents were part of the survey in all from the three zones of the state.

3.1 Respondent Profile

The survey comprised of 342 teachers from across the state apportioned across three zones. Out of the total sample, 147 respondents were undergraduate teachers out of which 27 were males and 120 were females while 195 of the teachers were post graduates out of which 50 were males and 145 were females as in the table 1.

Table 1. Gender & Qualification details of respondents: source(primary data)

Gender and Qualification			
	Qualification		
	UG	PG	Total
Male	27	50	77
Female	120	145	265
	147	195	342

3.2 Teaching Experience

The researcher included teachers who had average teaching experience of 15 years so that they would be able to judge better the transition of the teaching learning environment of the schools to the technology enabled era.

Table 2. Teaching Experience of Teachers : source(primary data)

Years of Experience			
		Frequency	Percent
Valid	less than 12.5yrs	149	44.0
	13-24.5yrs	165	48.0
	>25yrs	28	8.0
	Total	342	100.0

The table 2 depicts that 48% of the respondents possessed a teaching experience of 13 to 24 years.

3.3 ICT Use by Subject

Teachers: It was found that technology usage was mostly predominant among science teachers, this was followed by the use of technology means by teachers teaching ICT as a subject itself.

3.4 Time spend by the Teachers in the Use of ICT Tools

It was observed that only 34% of the respondents spent around 5-7 hrs a week in using various technology tools while majority reported using the same for about less than 5hrs as seen in the table 3.

Table 3. Time spend in using ICT tools by Teachers: source(primary data)

Use of TechnologyTools in School			
	Frequency	Percent	
Valid	less than 5 hrs	152	44.4
	5-7 hrs	115	34.0
	more than 7 hrs	75	21.0

3.5 Internet usage by Teachers

Based on previous studies that assessed ICT usage of teachers, thirteen broad categories of Internet usage were defined for the study. Teachers were asked to rank the above mentioned thirteen categories of uses of internet for educational purposes and these responses were used to analyse the most preferred and the least preferred usage category. Friedman's rank order test was carried out to analyse the luxury buying preference of consumers on the selected product categories. Here K related samples mean the test was used to compare the eleven variables measured on the same respondents.

3.5.1 Pair-Wise Comparisons (Nonparametric Tests)

Related-samples Friedman's two-way analysis of variance test was conducted in order to identify if the internet usage categories vary according to the respondents. K-sample non-parametric tests produce a distance chart and comparisons table when pairwise multiple comparisons are required.

Pairwise comparisons were carried out using the following hypothesis.

HO: The distributions of computer skills, searching information, presentation, lesson preparation, communication with students, communication with teachers, communication with parents, performance evaluation , preparation of reports bookmarking course contents, contact experts and teaching subjects are the same.

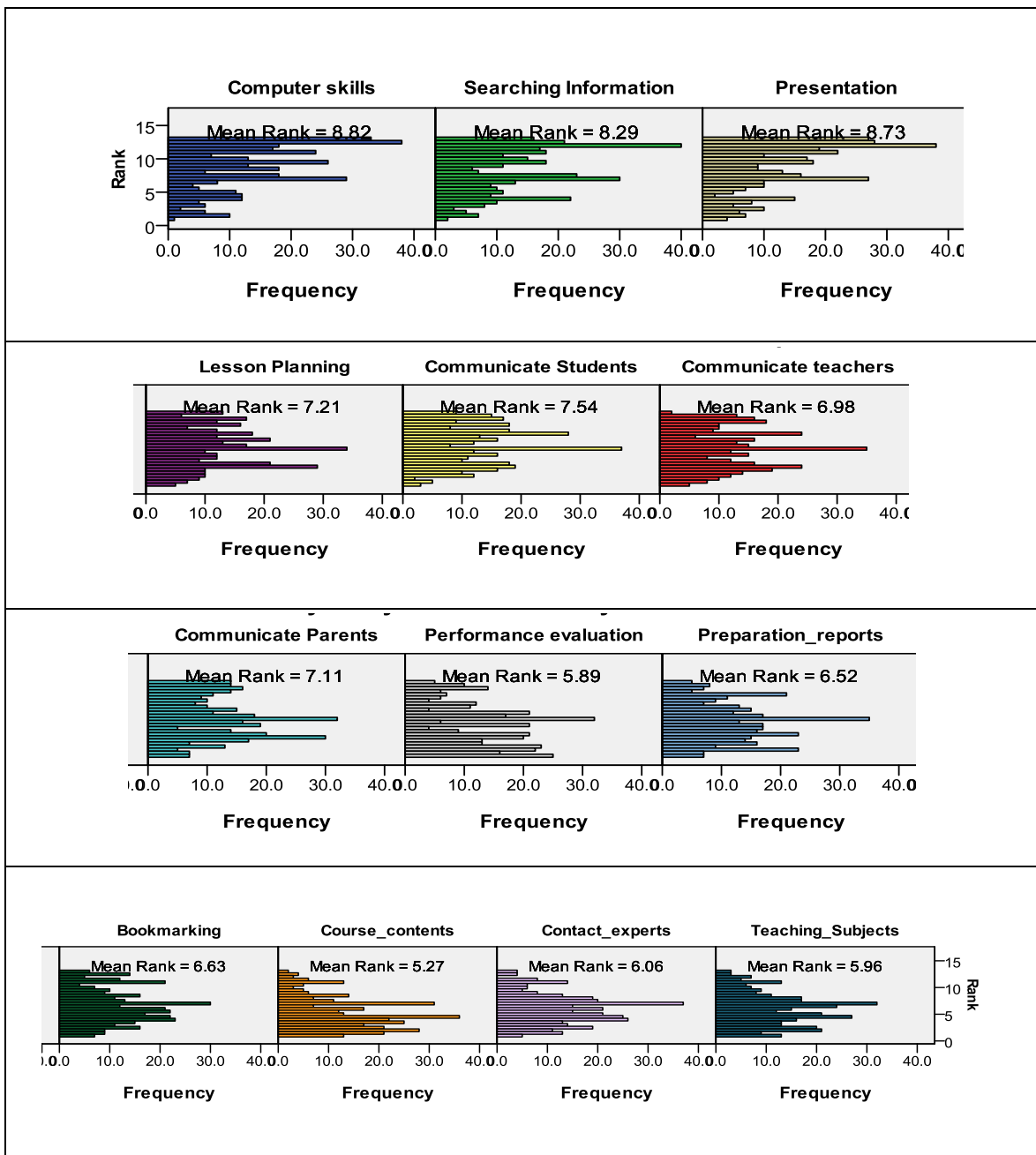
H1: The distributions of computer skills, searching information, presentation, lesson preparation, communication with students, communication with teachers, communication with parents, performance evaluation, preparation of reports bookmarking course contents, contact experts and teaching subjects are different

Table 4. Mean Ranks of the Internet Usage Categories (*Source: Survey Data*)

Hypothesis Test Summary			
Null Hypothesis	Test	Sig.	Decision
1 The distributions of computer skills, searching information, presentation, lesson preparation, communication with students, communication with teachers, communicationwith parents, performance evaluation , preparation of reports bookmarking course contents, contact experts and teaching subjects are the same.	Related-Samples Friedman's Two-Way Analysis of Variance by Ranks	.000	Reject the null hypothesis.
Asymptotic significances are displayed. The significance level is .05.			

The hypothesis test result proves that there is the significant difference between at least two internet usaget categories (as $p < 0.001$); therefore the null hypothesis was rejected.

Both Figure 1 and Table 5, depicts the mean ranking pattern. The Friedman test ranks each person's score from lowest to highest (as the first rank was assigned to the most popular internet use category and eleventh rank were assigned to the least popular internet use category) and bases the test on the sum of ranks for each column. Hence the category with the least mean ranking score will be the most popular use of internet among the teachers. Here the test statistic summarizes how differently the internet usage categories were rated in a single number. Friedman test signifies that the categories were rated differently with test statistic 411.191 & $p = 0.000$ (Figure 1).



Total N	342
Test Statistic	411.191
Degrees of Freedom	12
Asymptotic Sig. (2-sided test)	.000

Figure 1. Mean Rank of Internet Usage Category on the Basis of their Popularity

Table 5. Mean Ranks of the Popular Internet Usage Categories

Internet Use Category	Mean Rank	Rank
Course contents	5.27	1
Teaching subjects	5.96	2
Performance evaluation	5.89	3
Contact experts	6.06	4
Preparation of reports	6.52	5
Bookmarking	6.63	6
Communicate with teachers	6.98	7
Communicate with parents	7.11	8
Lesson Plan Preparation	7.21	9
Communicate with students	7.54	10
Searching Information	8.29	11
Presentation	8.73	12
Computer skills	8.82	13

Source: Survey Data

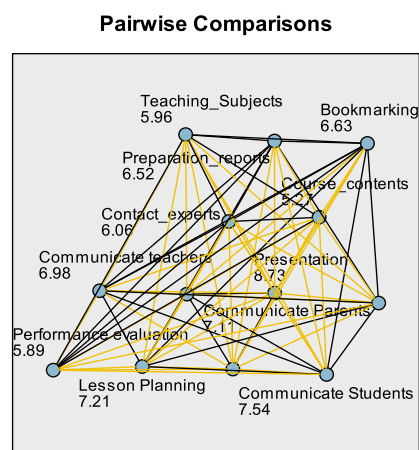


Figure 2. Pair-wise Comparison of the Internet Usage Categories

The pairwise comparison of various Internet usage categories is pictorially depicted in Figure 2. Each node in the figure shows the mean rank for each of the usage categories. The distance network chart is a representation of the comparison table in which the distances between nodes in the network corresponds to

differences between samples. Yellow line corresponds to statistically significant differences between the pairs; black lines correspond to non-significant differences. In Figure 2, it could be seen that the most preferred usage category accessing course contents with the mean score (5.27) significantly varies from usage categories like presentation, bookmarking, communication with teachers, communication with parents and communication with students. Interestingly there is significant difference between the usage categories 'accessing course content' and 'searching information', 'teaching subjects' and 'presentation'.

4. IMPLICATIONS AND CONCLUSION

This study was an attempt to assess the various beneficial categories of uses that the internet could serve for teachers in their quest for making teaching learning processes more and more effective. The research survey was initiated with the premise of thirteen popular uses of the internet that teachers claimed to benefit from. The rankings derived from the respondents' feedback revealed that the most popular uses of the internet were to access course content, teaching of subjects, performance evaluations, report preparation and contacting experts which were the most highly ranked categories of use. While the least ranks were assigned to use of internet for communication with various stakeholders like students, parents and teachers, upgrade computer skills and presentation. The implications of this study are important for both researchers as well as practitioners. The current study, hints at the existing perception of its use among the teachers who are yet to explore the internet to its full. Therefore it is recommended that the educational institutions provide greater backbone support in terms of infrastructure, time, flexibility and adequate training to the teachers who would then leverage the benefits of this vast information and communication network.

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HEURISTIC USABILITY EVALUATION APPLIED TO EDUCATIONAL GAMES

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ABSTRACT

The article analyzes the success of interactive methods for evaluating digital tools and digital games with a focus on usability. To do so, it maps out the game's heuristic evaluations of usability, called playability. In this context, a bibliographic review was performed, seeking to encompass the most prominent authors as well as the articles that help in understanding the best way to apply software evaluation and the best timing for such evaluation. Heuristic evaluation of usability is a useful tool for developers to improve interactive tools. Many developers have adopted interactive game-based learning because of its characteristics, and have been able to motivate mobile learning systems. After the consolidation of these papers and heuristics, three digital games geared toward music teaching were selected. The results show that it is possible to identify and analyze problems of playability, allowing designers to make corrections that can improve user experience, such as the possibility of contributing to the learning process. The qualitative study was beneficial, as it helped to understand usability problems that occur in interactive tools.

KEYWORDS

Playability, Usability Heuristics, Digital Games, Interactive Tools

1. INTRODUCTION

These days, games stand out on the market for having characteristics such as learning, skill development, and concepts combined with pleasure. Learning while playing is an effective and attractive strategy. (Ibrahim, 2014). According to Federoff (2002), companies in other sectors can benefit by seeking to understand and apply the reasons why games are successful and benefit from constructing motivational tools. Learning and implementing the techniques that games use in order to make software fun can help tools make a business interesting, and improve their purchasing power.

An important point to consider is the aspect of why interactive game-based learning fails to obtain the motivation and the space to be used in learning systems. There is little consensus regarding game resources that truly aid in education and engage students; there is a risk of designing systems that are unable to instruct or engage the student to the point where learning actually occurs, and difficulty in designing games that are both appealing and instructional at the same time. On the one hand, there is concern about violent themes that constitute certain games, as well as the intensity of involvement and the amount of time young people devote to games. On the other hand, they are thought to be quite instructive and enlightening and just as appealing as games (Garris, Ahlers and Driskell, 2002).

For a meaningful experience, it is important to be concerned with interactive learning as well as the user interface presented. The interface should favor the use of the software so that the user can concentrate on learning and having fun, i.e., the purpose that the software proposes and that enables the user to have a positive experience. (Korhonen e Koivisto, 2007). One way to assess whether the user interface is appropriate and includes features that captivate users is through the use of usability evaluation methods. According to Nielsen (1994), the methods for evaluating user interface specifications are the following: Heuristic evaluation (the most informal method, involving usability specialists who assess whether each element of the dialogue follows the predetermined guiding principles); Cognitive walkthrough (more focused on the process of solving problems that a user encounters at each stage of the dialogue, simulating the user's goals; the content of the memory should lead to the next correct action); Formal inspections (uses clearly defined functional procedures that combine heuristic evaluation and a simplified form of cognitive guidance); Pluralistic walkthrough

(meetings in which users, developers and human factors go through a scenario, discussing each element of the dialogue); Features inspection (a list of sequences of features intended to carry out typical tasks, verify long sequences, complex steps that would not be easy for users to evaluate, and steps that require broad knowledge and experience to evaluate a set of features); Consistency inspection (validation made by different designers who inspect an interface to see if they do things the same way as their own designs); and standards inspection (inspects the user interface's compliance with current standards).

Among these methods, the characteristic of being fast and cost-effective for evaluating tool usability problems is by means of heuristic evaluation. Usability inspection is a method that evaluates user interfaces to find usability problems. Evaluators analyze the user interface based on a set of pre-established rules called heuristics. Heuristic evaluation has been generalized and many evaluators have chosen to create their own sets of heuristics to be used in their analyses, so there are several lists of heuristics. This creates doubt and confusion when defining which list to use (Nielsen, 1994). Also, according to the Brazilian Association of Technical Standards (ABNT) (2011), usability is the ability of a software package to be used by specific users and meet all three characteristics: efficiency, effectiveness and satisfaction in a given context. Moreover, heuristics are guidelines for creating and evaluating easy-to-use software; game heuristics should include design elements that ensure user satisfaction. Additionally, the heuristics should not be obvious or irrelevant (Fedoroff, 2002).

Usability evaluation of the game is also known as playability. However, according to Desurvire (2004), playability is much more than usability evaluation. It encompasses four categories: 1) The game, which is the combination of difficulties and provocations that a user must face to overcome challenges; 2) Game mechanics involve programming that provides the framework whereby the units interact with the environment; 3) The story of the game is the story of the plot and persona; 4) Game usability includes the interface and covers the elements that the user can use to interact with the game (e.g. mouse, keyboard, controller, game shell, heads-up display).

This article focuses on the usability heuristics used in the process of evaluating games and tools. Therefore, according to the literature review, relevant studies related to usability heuristics and those focused on interactive learning applied to digital games were compiled and listed. Subsequently, a description of how these heuristic evaluations can be applied in educational tools is presented.

2. RELATED STUDIES

Drawn by the reasons why computer games are interesting, and features of the games that can be used to captivate users, Malone (1982) developed his work to provide a list of usability heuristics for the purpose of evaluating educational tools. His work was developed based on an elementary math game called Darts. It was found that the heuristics identified also served for other interfaces and could be used in the design of toys and tools. The features that make games enjoyable can help one learn. This is why Malone (1982) suggests dividing usability heuristics into three categories: challenge (activities with objectives, the outcome of which is uncertain), fantasy (mental images of physical objects or social situations that are not present in reality and that are embedded in the systems), and curiosity (requires the environment not to be too complex or too simple, because it should surprise and bring novelty without being incomprehensible, which can be done using visual and audio effects).

It is noteworthy that Jakob (1994) conducted a usability study and consequently obtained two lists that cover all usability problems: main heuristics to explain all usability problems (including consistency, language familiar to the user, clear user input, making user actions visible, a simple and minimalist design, shortcuts and connection to the real world, contributing to error recognition and recovery, allowing one to reverse wrong actions, and offering advanced set of evaluable actions) and main heuristics for expressing serious usability problems (which make user actions visible, have consistent and accurate feedback, have an advanced set of evaluable actions, allow one to reverse incorrect actions, use concrete analogies, have clear user input, care to avoid errors, and each mechanism has only one goal).

A few years later, in 2002, Federoff (2002) sought implicit and explicit heuristics from a leading game development company to study what developers are concerned about when designing user entertainment, as well as what usability evaluation process was used in the development cycle. The article argues that software builders in general could benefit from understanding what to consider when designing a system for fun and thereby make their products more attractive.

Among the heuristics, Fedoroff (2002) highlights aspects related to fast and responsive user involvement, the use of visual and audio effects to pique player interest (including to provide meaningful feedback), the presence of intuitive and mapped actions, the ability to check one's score at any time, pay attention to the learning curve, avoid mistakes, and save the game.

Desurvire (2004) found that heuristic evaluation is most highly recommended for use in the early stages of building a game. The list was divided into four categories: game, history, mechanics and usability. However, this work will focus on usability heuristics geared toward games and will work with immediate responses, ability to quit, save or shut down the game at any time, consistency, mandatory use of an intuitive menu, sufficient instructions to start the game, concern about sound characteristics, non-intrusive interface, quick and effective user engagement, and allowing players to recognize art in the game.

Korhonen and Koivisto (2007) presented a list of heuristics designed to evaluate games for mobile phones. After the heuristics survey, validation was performed on five games. For the evaluation, three heuristic categories were considered: usability, gameplay, and mobility. Finally, they concluded that mobility and usability problems are more noticeable, since the evaluation is similar to those already used in software evaluation. However, gameplay problems are more complex, which hinders the perception and resolution thereof, requiring greater concentration by evaluators. These authors surveyed heuristics that deal with visual and audio effects, as well as interface efficiency, which should provide visible indicators and clear vocabulary. It also addressed consistency in similar situations and controls, as well as immediate feedback, error prevention and absence of any need to memorize actions, and system help.

Other authors who worked with heuristic evaluation were Pinelle et al (2008). They presented a set of usability heuristics that can be used to evaluate the usability of video games. The heuristics list was created based on usability issues found in the game ratings of a popular games website (Gamespot). They also point out that usability heuristics are best applied early in development and the prototypes. The rating was applied to 108 games that contained six different genres. In the end, a list of 10 heuristics was compiled, and the authors concluded that simple usability problems can be avoided through this kind of evaluation, and if the evaluation had not been done, these problems would not even be remembered. Pinelli et al. (2008) highlight heuristics such as consistency of actions, settings of elements (audio, sound, speed and difficulty), player-accessible views, ability to skip frequently repeated content, ease of control, system layout for obtaining help, and ease of visual interpretation.

Soomro, Ahmad and Sulaiman (2012), through an interview and questionnaire applied to college students and game users, compiled a list of usability heuristics for mobile games. In all, 100 questionnaires were distributed, each containing three sections with 20 questions. The goal was to identify usability problems and create a list of heuristics that would help game developers during the design phase. Among the heuristics are the aspects of skipping non-reproducible content, as well as the customization of the difficulty level.

Ibrahim et al. (2014) presented a set of usability heuristics regarding educational video games based on educability, with a focus on the characteristics required to achieve an appropriate design of the video game. Through heuristic evaluation, it is possible to achieve an efficient level of usability, which ensures player motivation. During the design phase, educational usability attributes were identified, which were grouped into sets of attributes and rated to assess whether the game offers fun and learning. The heuristic sets were divided as follows: game objective (defines that there must be interaction with the game content, whether entertaining or educational, in order to make it more attractive by keeping the player immersed, interested and motivated, i.e. engaging, simple and enjoyable, paying attention to the effectiveness of the educational component); balance (regarding the balance between fun and education); game challenges (aimed at maintaining motivation and providing solutions to remain in the game); feedback (as to the level and amount achieved in relation to the entertainment and educational aspects); interactivity (whether the user feels part of the game); adaptability (difficulty levels are adapted to the user's performance); game control (ease of control to build confidence and self-esteem); ethics (acceptable in the context of the game, in view of the beliefs and attitudes included therein); realism (ability to simulate real-life situations that facilitate learning); game reward (bonuses and advantages aimed at improving user performance); structuring (structure related to motivational content and the introduction of challenges at each level of the game); and player knowledge (encouraging and activating the player's previous knowledge).

These approaches presented above are consolidated in Table 1 below:

Table 1. Summary of the papers cited

Authors	Year	Device	Games or Tools
Malone	1982	Personal Computer	Tool
Nielsen	1994	Personal Computer	Both
Federoff	2002	Video games	Games
Desurvire	2004	Video games, personal computers, board games.	Games
Korhonen and Koiviso	2007	Mobile devices	Games
Pinelle et al.	2008	Video games	Games
Soomro et al.	2012	Mobile devices	Games
Ibrahim et al.	2014	Video games	Tool

3. HEURISTIC EVALUATION APPLICATION

Based on the studies presented, it is proposed the application of heuristic evaluation in music education applications aimed at mobile devices.

The present study was developed following the following steps:

- Selection of applications to be evaluated;
- Selection of heuristics that will be used for application evaluation;
- Heuristic evaluation of the application;
- Evaluation of results.

3.1 Selecting Apps to Evaluate

For this study, we chose to evaluate apps aimed at teaching music. These apps are available online at the Google Play Store. The apps were selected by searching the phrase "Music Education" on October 30, 2019 through the Google Play Store. The apps were selected according to the following criteria: be free-of-charge, be interactive, and require the use of audio to perform the activities. Based on these criteria, three apps were chosen at random.

The first one, Ear Training (Figure 1), is an app focused on the teaching of musical perception, aimed at differentiating the duration and pitch of sounds. It is divided into three sections with rhythmic and melodic lessons, and the difficulty level of the exercises increases with each exercise. It is worth noting that it is possible to choose the desired exercise, and users can skip forward to the more advanced exercises, depending on their prior knowledge.

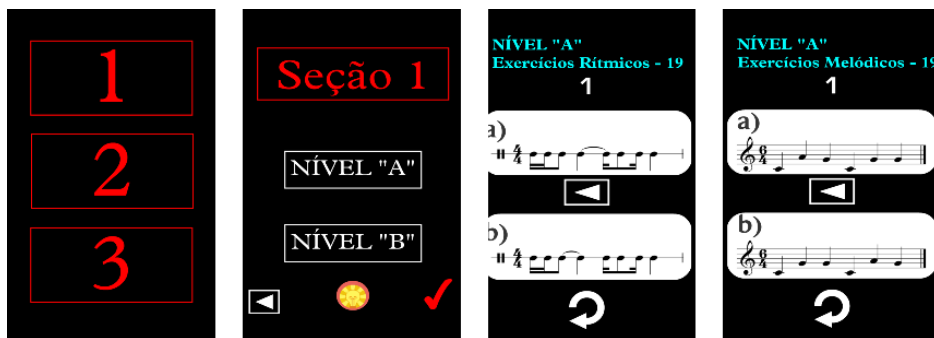
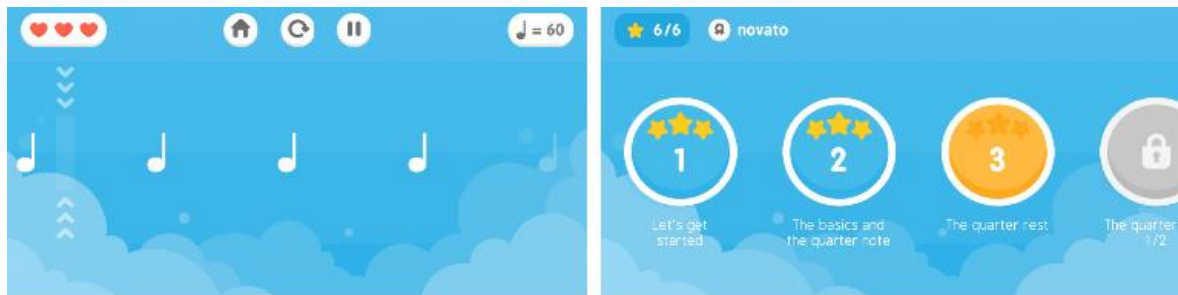


Figure 1. Section and Levels of the Ear training

The second one was Jungle Music (Figure 2), an app designed to learn the musical notes on the staff. This system allows the user to choose the clef they want to exercise. The story of the game consists of a mission that takes place in the jungle of a desert island, where the user must feed a chameleon by pressing the notes. As the user progresses in the game, the chameleon increases in size.

Figure 2. Screens of the *Jungle Music*

The last one, Beat the Rhythm (Figure 3), is an app that allows users to learn rhythm. The exercises are time based, and the system detects the touch on the screen and checks whether the user is counting the notes correctly and at the right tempo.

Figure 3. Screens of the *Beat the Rhythm*

3.2 Heuristic Evaluation of Audio, Sound and Educational Aspects

Based on the literature review presented, a list of heuristics was established to assess the quality of audio, sound and interactive learning issues in the selected apps. Since apps require the audio capability in order to perform the exercises, it was considered essential to have high-quality sound capabilities.

Based on these assumptions and the literature review, a list of heuristics was established:

- The game uses audio effects to kindle interest. (Malone, 1982; Federoff, 2002; Korhonen & Koivisto, 2007);
- Use of different tones for hits and errors (Malone, 1982);
- The game's sounds are significant (Desurvire, 2004);
- The system uses various features to provide feedback (music, vibration, sound effects etc.) (Ibrahim, 2014);
- The system uses sound to provide meaningful feedback (Federoff, 2002);
- The system allows for audio and sound configuration (Pinelle, 2008);
- The system facilitates the learning process (Ibrahim, 2014);
- The system allows user involvement in the challenges (Ibrahim, 2014);
- The system enhances the user's skills and experience (Ibrahim, 2014);
- The system evaluates and seeks to recognize the user's prior knowledge (Ibrahim, 2014);
- There is a balance between fun and education (Ibrahim, 2014);
- Educational content is consistent with the needs of users, stages and status of the System (Ibrahim, 2014);
- The reward is on par with the player's progress (Ibrahim, 2014).

In addition to the heuristics found in the studies analyzed, it was noted that two problems involving audio may interfere with system quality, so two heuristics were added to the list:

- The system informs the user that the audio is turned off when using the app;
- The sound used is pleasant.

3.3 App of Heuristic Evaluation and Results

To classify the heuristics throughout the qualitative evaluation, we used the Scale of Severity Ratings for Usability Problems, developed by Nielsen (1995).

0 = The heuristic was satisfied, so the system has no problems;

1 = Simple problem: simple problem, does not need to be fixed urgently;

2 = Minor usability problem: Medium problem, should be fixed with low priority;

3 = Severe usability problem: Serious usability problem, important to fix, so high priority should be given;

4 = Usability catastrophe: a catastrophic usability problem needs to be fixed before the product can be released.

In this regard, Table 2 is shown with the heuristics and the scores attributed to the apps evaluated.

Table 2. Heuristic Evaluation Results

Heuristics	Ear Training	Jungle Music	Beat the Rhythm
The game uses audio effects to arouse interest ^{1,2,3}	0	0	0
Use of different sound tones for errors and hits ¹	0	0	2
Game sounds are significant ⁴	0	0	1
The system uses various features to provide feedback (music, vibration, sound effects etc.) ⁵	1	1	2
The system uses sound to provide meaningful feedback ²	0	0	1
The system allows audio and sound configuration ⁶	2	1	2
The system facilitates the learning process ⁵	3	3	3
The system allows user involvement in the challenges ⁵	0	1	0
The system enhances user skills and enhances user experience ⁵	0	0	2
The system evaluates and seeks to recognize the user's prior knowledge ⁵	0	0	1
There is a balance between fun and education ⁵	2	0	0
Educational content is consistent with the needs of users, stages and status of the System ⁵	0	1	3
The reward is adherent to the progress of the player ⁵	1	0	2
Sum of Grades	9	7	19

¹[Malone 1982]; ²[Federoff 2002]; ³[Korhonen & Koivisto 2007]; ⁴[Desurvire 2004]; ⁵[Ibrahim 2014]; ⁶[Pinelle 2008]

Considering the bibliographic study conducted, as well as the analysis and evaluation of the apps (*Ear Training*, *Jungle Music*, and *Beat the Rhythm*), it can be said that heuristic evaluation not only contributes to the perception of different aspects of the apps, but also is a relevant, well-structured and efficient instrument for analyzing different types of digital games, such as those related to music education (covered in this article). Although heuristic evaluation is straightforward and simple, it allows one to verify the improvements that can be made and the criticality of the problems encountered. When experimenting with digital games, one can see the importance of using sound, ranging from immediate feedback to indication of hits and errors.

Regarding the tests and evaluations performed, it is worth noting that none of the three games alert the user when the audio is off and there is relevant information, since the activities presented depend on the sound feature. The system could – as with the WhatsApp instant messaging app – detect when the audio is off and give a warning, or when the user accesses the app, generate a warning that the device requires the sound feature to be enabled.

It was also found that the *Beat the Rhythm* game had more problems related to the sound feature (Ibrahim, 2014). The system could – like the other two apps – make better use of sound features to provide feedback or even differentiate users' hits and misses (Federoff, 2002; Pinelle, 2008).

Another point concerning sound refers to the sound setting options; the three apps could provide options for inserting different sounds and ringtones. *Jungle Music* offers sound configuration, but it needs to have improvements in this aspect (Federoff, 2002).

The system could use solid resources to promote learning. All three systems could enhance the issue of providing an interactive learning service (Ibrahim, 2014). However, they fail to do so because they are designed to support music lessons, when they could (for example) have explanations so that the user can understand the meaning of each feature offered and learn from the system, and not just serve as reinforcement for learning.

Also with regard to learning, it was noted that the *Ear Training* app is not fun, but it is able to engage the user with its exercises and also allows the user to skip ahead to more advanced steps, which makes it interesting (Ibrahim, 2014). On the other hand, there is *Jungle Music*, which is a fun app and has an interesting plot, but fails by requiring that the user repeat the same exercise three times in each step and does not allow the user to skip steps (Ibrahim, 2014). Lastly, the *Beat the Rhythm* app has simple content and minimalist design, but fails to provide user learning (Ibrahim, 2014).

4. CONCLUSIONS AND FURTHER WORKS

This study mapped the usability heuristics of digital games available in the literature, in order to gather significant studies in this area. Subsequently, heuristics were compiled that are directly linked to the issue of the evaluation of digital games for music teaching. Finally, heuristic evaluation was performed in three music education apps, aimed at evaluating the use of sound and audio capabilities to improve learning.

The study showed how important it is to use a form of evaluation of educational tools; such evaluation using heuristics contributes to the detection of system problems and can show parts of the system that are working well and need not be changed. The suggested heuristics, after the literature review, can be used to evaluate other apps geared toward teaching music, since these apps must be concerned with sound and audio quality. The issue of learning must also be carefully reviewed.

It is recommended to use heuristic evaluation in the software development process – i.e., prior to launching the app – so that problems can be found and fixed in a timely manner, thereby ensuring high-quality delivery.

For further studies, we intended to extend the evaluation by expanding the number of apps for the top 100 digital music education games that received the highest ratings in the Google Play store. Similarly, we intend to verify the mirroring of this set for the Apple Store, making it possible to establish a state of the art for this type of educational app. Moreover, artificial intelligence mechanisms will be established to automate the heuristic evaluation process. Likewise, a digital game for music education will be developed, based on the heuristics identified for further testing with users.

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STUDENTS' CONCEPTION OF LEARNING AND LEARNING BEHAVIOR FROM MULTIPLE-GOALS PERSPECTIVE

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ABSTRACT

The purpose of this study was to examine conception of learning and learning behavior for each goal orientation type from the multiple-goals perspective and to clarify the characteristics of each type. Questionnaire surveys were conducted with fourth-year undergraduate students, and responses for 340 students were analyzed. We created four types, namely, <Low-goals>, <High-goals>, <High-Performance-Avoidance-goals>, and <High-Learning-goals>, and each type of conception of learning and learning behavior were examined. The results suggested that conception of learning differs by type. <High-goals> tended to have multiple conceptions of learning, <High-Learning-goals> tended to have Active conception of learning, and <Low-goals type> and <High-Performance-Avoidance-goals> tended to have Passive conception of learning.

KEYWORDS

Multiple-Goals Perspective, Conception of Learning, Learning Behavior

1. INTRODUCTION

1.1 Conception of Learning

Conception of learning is defined as learners' ideas and beliefs about learning. Research on conception of learning began in the 1970s, primarily in Europe (e.g., Säljö, 1979; Van Rossum & Schenk, 1984). Säljö (1979) observed following five conceptions of learning: an increase in knowledge, memorization, acquisition of facts and procedures that could be retained and/or used in practice, abstraction of meaning, and an interpretative process to understand reality. He defined the former three as the passive accumulation of knowledge, obtained externally as the passive accumulation of knowledge obtained from the outside, and the latter two as the active acquisition, interpretation, and application of knowledge obtained internally. Marton et al. (1993, 1996) described the following six categories: an increase in knowledge, memorizing and reproducing, applying, understanding, seeing something in a different way or as, and changing as a person. They organized the former three conceptions as the surface conception of learning and the latter three as the deep conception of learning. In subsequent studies on conception of learning, the former is "quantitative conception of learning" or "fragmental conception of learning," and the latter is "qualitative conception of learning" and "cohesive conception of learning" (e.g., Dart et al., 2000; Ellis et al., 2008); thus, conception of learning has been perceived as dualistic concepts.

Purdie et al. (1996) observed that a duty, the development of social competence, and a process not bound by time or place could be added to the six conceptions of learning presented by Marton et al. (1993). Takayama (2000) observed the following nine conceptions of learning based on data from a survey completed by Japanese university students: memorizing, an active investigation, lifelong learning, natural acquisition, an increase in knowledge, growing and improving, applying, acquiring and repetition, and a duty. Learning as a process not bound by time or place (Purdie et al. 1996) and learning through natural acquisition (Takayama 2000) are new conceptions of learning incompatible with the dualistic concepts by Marton et al. (1993, 1996).

Based on the classification of conception of learning in the literature, conception of learning can be organized into the following three categories (Table 1): (1) Active conception of learning: Learning is for changing and growing oneself and/or learning should be performed actively using thoughts; (2) Passive conception of learning: Learning is forced by others and/or learning is the passive processing of learning content; (3) Experiential conception of learning: Learning occurs in everyday experiences.

Table 1. Three categories of conception of learning

	Marton et al. (1993)	Purdie et al. (1996)	Takayama (2000)
(1) Active conception of learning	Understanding Seeing something different way or as Changing as a person	The development of social competence	Applying Acquiring and repetition Growing and improving Lifelong learning An active investigation
(2) Passive conception of learning	Memorizing and reproducing An increase in knowledge Applying※	A duty	Memorizing An increase in knowledge A duty
(3) Experiential conception of learning		A process not bound by time or place	Natural acquisition

※It means applying mechanically.

Van Rossum and Schenk (1984) conducted an empirical study on learning behavior in relation to reading materials. Students who perceived learning as memorizing adopted a superficial learning behavior in which they only read a summary, whereas students who perceived learning as the abstraction of meaning or an interpretative process aimed to understand the reality of adopted deep learning behavior and read the sentences while processing the relationships between the paragraphs. Dart et al. (2000) suggested that students who had conceptions such as personal fulfillment and as a process were not bound by time and were more likely to use deep approaches to learning compared with students who had conceptions, such as an increase in knowledge, who were more likely to rely on superficial approaches. Takayama (2002) suggested that learning as an active investigation, learning as growing and improving, and learning as acquiring and repetition have positive effects on deep learning behavior such as associating new learning with prior knowledge or confirming an individual's understanding; by contrast, learning as a duty has a negative effect. Considering the relationship between the results of these studies and the three aforementioned conceptions of learning, the Active conception of learning tends to promote adaptive learning behavior, and the Passive conception of learning suppresses adaptive learning behavior.

Purdie & Hattie (2002) and Alamdarloo et al. (2013) have examined the relationship between the number of conceptions of learning and academic performance. They demonstrated that the higher the number of conceptions of learning that students have (i.e., the more multiple conceptions of learning that students have), the higher their academic achievement.

1.2 Goal Orientation

Goal-achievement theory (Dweck 1986), which accounts for differences in learning behavior in terms of each students' goals as they execute tasks, classifies such goals into two categories: learning and performance goals. The purpose of the former is to acquire new knowledge and skills through challenging activities, whereas that of the latter is to seek positive and avoid negative evaluations. Students with learning goals tend to select challenging tasks and persevere even when they encounter failure, regardless of their confidence in their abilities. Performance-oriented appear similar to students with the learning orientation, provided they are confident in their abilities; however, if they lack confidence, they are less likely to persevere to completion. Elliot and Dweck's (1988) findings support the latter statement. Ames and Archer (1987, 1988) demonstrated that learning goals have a positive effect on academic achievement and endogenous motivation; learning goals are generally considered superior for attaining learning achievement.

Elliot and Harackiewicz (1996) divided performance goals into performance-approach goals, in which a student attempts to outperform others, and performance-avoidance goals, or attempting to avoid performing

worse than others. Elliot and Church (1997) and Rawsthorne and Elliot (1999), among others, have demonstrated that performance-approach goals lead to positive effects on endogenous motivation and academic performance, but performance-avoidance goals have negative effects, demonstrating the importance of distinguishing between the approach and avoidance utilities.

1.3 Multiple-Goals Perspective

According to the multiple-goals perspective (e.g., Elliot, 1999; Harackiewicz et al., 2002; Pintrich, 2000), a student has multiple goals, rather than a single goal. Pintrich (2000) and Daniels et al. (2008) have classified students into the following four types according to the combination of learning goal orientation and performance goal orientation: (1) High-goals (i.e., high learning goal orientation and performance goal orientation), (2) High-Learning-goals (i.e., high learning goal orientation), (3) Low-goals (i.e., low learning goal orientation and performance goal orientation), and (4) High-Performance-goals (i.e., high performance goal orientation).

Pintrich (2000), Daniels et al. (2008), and Valle et al. (2003) have demonstrated that students classified as having Low-goals and High-Performance-goals have a similar tendency to have negative perceptions (e.g., “boredom” with schools and classes) and do not use adaptive learning behavior, whereas the High-goals and High-Learning-goals students have a similar tendency to have positive perceptions (e.g., “enjoyment” regarding schools and classes) and use adaptive learning behavior. High-goals students have been shown to have the best academic performance among the four types (Daniels et al., 2008; Valle et al., 2003). Considering that these goal orientation types differ in school and class perceptions, learning behavior, and academic achievement, differences are likely to be observed in conception of learning, depending on the student’s combination of goal orientation.

This study proceeded based on the following hypotheses derived from findings in the literature. First, Low-goals and High-Performance-goals students who tend to recognize activities in schools and classes negatively would have Passive conception of learning. High-Learning-goals students who tend to recognize activities in schools and classes positively would have Active conception of learning. Considering the results in the literature that students with multiple conceptions of learning perform well (1.1), High-goals students who tend to recognize schools and classes positively and show good academic performance would have multiple conceptions of learning including Active conception of learning.

Regarding learning behavior, referring to the results of Pintrich (2000), Daniels et al. (2008), and Valle et al. (2003), High-goals and High-Learning-goals students would show adaptive learning behavior, whereas their Low-goals and High-Performance-goals counterparts would not.

1.4 Purpose

The purpose of this study is to verify the hypotheses on conception of learning and learning behavior for each goal orientation type and clarify the characteristics of each type.

We investigated graduation thesis research conducted at a university, on which most students work regardless of their faculties or specialties. The ratio of graduation studies as compulsory subjects at universities in Japan is as high as 80%, indicating that approximately 90% of students work on graduation studies (Association of Private University in Japan, 2011). Students were required to set their themes and objectives, consider methods for the objectives, conduct literature research or experiments according to those methods, and summarize the results. Many opportunities were available for students to make judgments. Hence, we hypothesized that how the students actively engaged in this type of learning may be greatly influenced by the students’ learning orientation.

2. METHOD

2.1 Subjects and Procedures

The survey was conducted with fourth-year students from the School of Integrated Arts and Sciences at a Japanese public university in February 2018 and February 2019. The participants answered questionnaires during the presentation session of their graduation thesis. The data of 340 students (2018: 161, 2019: 179) were analyzed.

2.2 Measures

The participants were asked to indicate their agreement or disagreement with each item in the questionnaires on a 5-point Likert scale.

Goal Orientation

The questionnaire comprised 18 items from Yokoyama and Miwa (2018) translated from the Achievement Goal Scale developed by Elliot and Church (1997).

Conception of Learning

The questionnaire comprised 24 items from Yokoyama and Miwa (2018) partially modified from Takayama's (2002) scales.

Learning Behavior

The questionnaire comprised 8 items from Yokoyama and Miwa (2018) modified from scales by Mitsunami (2010) and Hatano & Mizoue (2013). The items were modified to measure students' learning behavior in the context of undertaking graduation work.

3. RESULTS AND DISCUSSION

3.1 Structure of the Scales

Goal Orientation

As a result of factor analysis (principal factor with promax rotation), three factors consistent with Yokoyama & Miwa (2018) emerged: Learning Goal (4 items; $\alpha = .75$), Performance-Approach Goal (3 items; $\alpha = .72$), and Performance-Avoidance Goal (5 items; $\alpha = .81$). An average value of the items was regarded as the respective value of each factor.

Conception of Learning

As a result of factor analysis (principal factor with promax rotation), four factors consistent with Yokoyama & Miwa (2018) emerged: Autonomous Development (5 items; $\alpha = .88$), Duty and Memorizing (5 items; $\alpha = .84$), Growing as a Person (4 items; $\alpha = .78$), and Effort (4 items; $\alpha = .79$). An average value of the items was regarded as the respective value of each factor.

Learning Behavior

As a result of factor analysis (principal factor with promax rotation), one factor consistent with Yokoyama & Miwa (2018) emerged (8 items; $\alpha = .80$). An average value of the eight items was regarded as the learning behavior variable.

3.2 Goal Orientation Type

First, cluster analysis (Ward's method, square Euclidean distance) was performed using the three goal orientation variables. With reference to the goal orientation types of Printrich (2000) and Daniels et al. (2008), we adopted four clusters and created four goal orientation types (Figure 1). These four types are consistent with the classification of Printrich (2000) and Daniels et al. (2008). Type 1 (N = 93) corresponds to the Low-goals type because all three goal orientations are lower than average. Type 2 (N = 83) corresponds to the High-goals type because all three goal orientations are higher than average. Type 3 (N = 132) corresponds to the High-Performance-goals type because performance-avoidance goal orientation is higher than average. Type 4 (N = 32) corresponds to High-Learning-goals type because learning goal orientation is higher than average. Hereinafter, Types 1 to 4 are referred to as <Low-goals> <High-goals> <High-Performance-Avoidance-goals> <High-Learning-goals>.

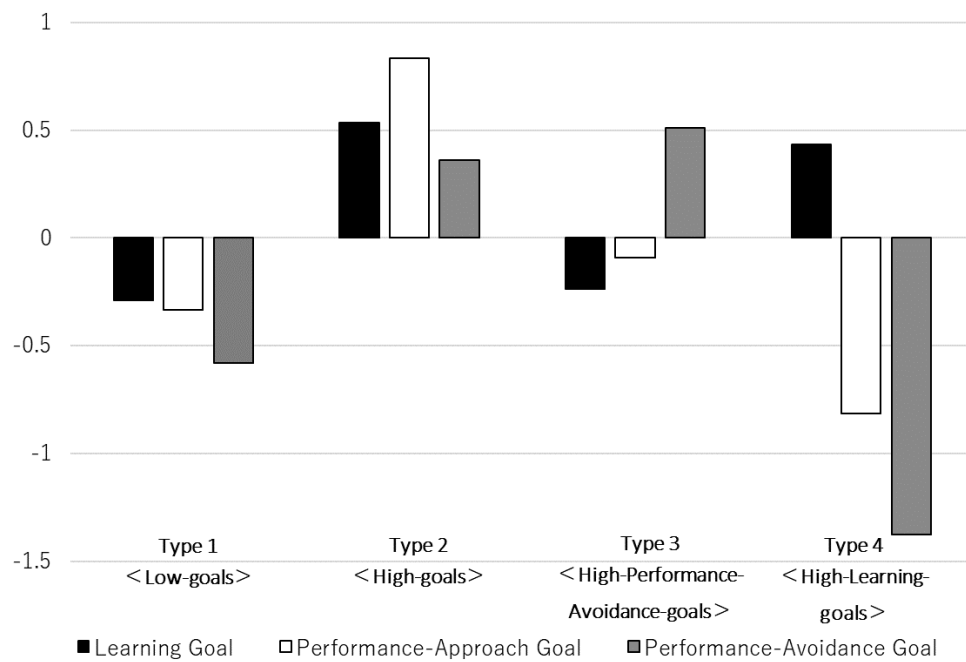


Figure 1. Goal orientation types

3.3 Conception of Learning and Learning Behavior for each Goal Orientation Type

To examine the difference in conception of learning and learning behavior between each goal orientation type, a one-way ANOVA was performed with goal orientation type as the explanatory variable and each conception of learning and learning behavior as the explained variables. In all cases, the goal orientation type factor was significant; hence, multiple comparisons (Turkey method, 5% level) were performed. The results are presented in Table 2.

Table 2. One-way ANOVA Results

		Type 1 Low-goals	Type 2 High-goals	Type 3 High-Performance- Avoidance-goals	Type 4 High- Learning-goals	F value (df=3,336)	Multiple comparisons
Autonomous Development	<i>M</i>	4.18	4.51	4.10	4.53	10.65	1, 3 < 2, 4
	<i>(SD)</i>	(0.66)	(0.42)	(0.67)	(0.46)	***	
Duty and Memorizing	<i>M</i>	2.28	2.46	2.45	1.59	14.40	4 < 1, 2, 3
	<i>(SD)</i>	(0.71)	(0.81)	(0.67)	(0.45)	***	
Growing as a Person	<i>M</i>	3.59	4.08	3.71	3.59	10.59	1, 3, 4 < 2
	<i>(SD)</i>	(0.72)	(0.51)	(0.63)	(0.58)	***	
Effort	<i>M</i>	3.93	4.29	4.01	3.73	6.67	1, 3, 4 < 2
	<i>(SD)</i>	(0.74)	(0.57)	(0.63)	(0.88)	***	
Learning Behavior	<i>M</i>	3.59	3.88	3.69	3.82	4.70	1 < 2
	<i>(SD)</i>	(0.63)	(0.52)	(0.48)	(0.61)	**	

p < 0.01 *p < 0.001

<Low-goals> and <High-Performance-Avoidance-goals> had lower Autonomous Development scores than <High-goals> and <High-Learning-goals> and had a higher Duty and Memorizing scores than <High-Learning-goals>. These results support the hypothesis of this study: these two types would have Passive

conception of learning. Daniels (2008) demonstrated that these two types tend to perceive classes as “boredom” rather than “enjoyment.” As observed from these conceptions of learning, the fundamental reason why students perceive their classes negatively may be that they perceive learning as being forced by others rather than an autonomous process.

<High-goals> had a higher Autonomous Development score than <Low-goals> and <High-Performance-Avoidance-goals>, had a higher Duty and Memorizing score than <High-Learning-goals>, and a higher Growing as a Person score and Effort score than the other three types. In other words, the scores of all four conceptions of learning were high, suggesting that they have multiple conceptions of learning including Active conception of learning, as hypothesized in this study. <High-Learning-goals> had a higher Autonomous Development score than <Low-goals> and <High-Performance-Avoidance-goals> and had a lower Duty and Memorizing score than the other three types. This result partially supports the hypothesis of this study: High-Learning goals students would have Active conception of learning. In studies with the multiple-goals perspective, <High-goals> and <High-Learning-goals> have had similar trends in learning perception and behavior (e.g., Printrich, 2000; Daniels, 2008). The results of this study indicate that these two types of students differ. An inference is that <High-goals> students learn from multiple perspectives, have a wide range of adaptability, and apply learning behaviors according to the situation. By contrast, an inference is that <High-Learning-goals> students that apply learning behaviors based on their belief that learning is not forced by others but is performed autonomously.

<High-Goals> had a higher learning behavior score than <Low-goals>. This result is consistent with that of Daniels (2008) for academic achievement. This result partially supports the hypothesis that High-goals and High-Learning-goals students would show adaptive learning behavior, whereas Low-goals and High-Performance-goals students would not. Ueki (2002) described an ideal learner as having multiple conceptions of learning and using appropriate learning behaviors according to the situation. <High-goals> students have high scores in all four conceptions of learning and learning behavior; therefore, they tend to have multiple conceptions of learning and use adaptive learning behavior. This type of student is similar to the ideal learner proposed by Ueki (2002).

4. CONCLUSION

In this study, we created four goal orientation types based on goal orientation combinations, namely, <Low-goals>, <High-goals>, <High-Performance-Avoidance-goals>, and <High-Learning-goals>, and examined conception of learning and learning behavior of each type. The results suggest that conception of learning and learning behaviors differ by goal orientation type. Studies have demonstrated differences in the perception of classes and learning behavior on the basis of goal orientation type, and this study is significant because it suggests differences in learning beliefs are an impetus. In addition, although the recognition and learning behavior of <High-goals> and <High-Learning-goals> have been shown to be similar in previous studies, we demonstrated that these two types of conception of learning differ, and clarified the characteristics of each type. In this respect, this study added new empirical findings.

The limitations of this study are as follows. First, we measured students' goal orientation, conception of learning, and learning behavior by a single time point survey. However, a preferable method is to perform follow-up based on surveys at multiple time points to examine conception of learning and learning behavior from a goal orientation perspective, namely, a measurement of goal orientation before starting graduation research and a conception of learning and learning behavior at the end of graduation research. Second, we used self-evaluation by students as a measure of learning behavior. Barnett & Hixon (1997) and Klein (1998) confirmed that self-evaluation by students is reliable; however, to further guarantee objectivity, we should have added a more objective viewpoint such as an evaluation by teachers.

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APPENDIX

Goal Orientation

• Learning Goal

I hope my knowledge is broader and deeper when I am done with classes. / I want to learn as much as possible from my classes. / I prefer course material that really challenges me so I can learn new things. / I prefer course material that arouses my curiosity, even if difficult to learn.

• Performance-Approach Goal

I strive to demonstrate my ability in relation to others. / I am motivated by the opportunity to outperform my peers.

Outperforming other students is important to me.

• Performance-Avoidance Goal

I worry about getting a bad grade. / I often think to myself, "What if I do badly?" / My fear of performing badly often motivates me. / I just want to avoid a bad grade. / I am afraid that if I ask my teachers a "dumb" question, they might think I am not very smart.

Conception of Learning

• Autonomous Development

Learning is something we continue to do as long as we live. / Learning continues after I become a member of society.

Learning is something that continues throughout life. / Learning is attempting to understand what you are deeply interested in. / Learning is actively exploring your interests.

• Duty and Memorizing

Learning is forced without the freedom. / Learning is forced by parents or teachers. / Learning is being forced to do things that you do not want to do. / Learning is accurately memorizing the content of materials. / Learning is memorizing the textbook content at a desk.

• Growing as a Person

Learning means living a life like a human being. / Learning involves human beings' forming a spiritual core. / Learning is not accumulating knowledge but forming an attitude. / Learning means absorbing a wide range of knowledge.

• Effort

Learning is what you acquire with effort. / Learning takes much time and effort. / Learning is necessary to become a member of society. / Learning means absorbing more knowledge.

Learning Behavior

I tried to improve the quality of my graduation thesis as much as possible. / Although it was difficult, I worked on it without giving up. / I studied what I did not know, or I asked my teacher and my friends about it. / I set goals and plans. / I often tried to read and understand the contents. I was prepared to respond to any questions in the presentation. / I worked on the research merely to earn credit. / I often got bored quickly and quit.

ANALYSIS OF STUDENTS' SELF-ASSESSMENT AND GENERIC SKILLS USING DAIFUKU-CHO AND PROG TEST

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ABSTRACT

The present study analyzes the relationship between a teacher's evaluation of students' self-assessment by "Daifuku-cho," which is used for teacher-and-student interaction in PE class, and their competency improvement using PROG test scores. It turns out that there is a correlation between them, and the higher the teacher's evaluation of students' comments is, the higher the students' scores in "Competency" part of PROG test are. Compared with athletic skills, competency improvement in PE class is difficult to assess, but this study suggests that by evaluating students' self-assessment in "Daifuku-cho," we could possibly estimate their competency improvement.

KEYWORDS

Self-Assessment, Generic Skills, Daifuku-cho, PROG Test

1. INTRODUCTION

School education in Japan is rapidly transforming today. One-way lecture-based style used to be the teaching norm, in which teachers one-sidedly give students a lot of information and knowledge of academic subjects. Today active-learning style education is flourishing, in which students collaboratively find problems and try to solve them. To encourage students learn actively, we have carried out Active Learning (AL) [Niemi 2002, Hassan 2015], Mastery Learning (ML) [Kularbphettonga 2015, Shafie 2010, Kulik 1990], and Problem/Project Based Learning (PBL) [Rodríguez 2015, Fernandes 2014] and tried to foster students' literacy and competency at Institute of Technology (KOSEN), Sendai College (Sendai KOSEN). We also have evaluated students' achievements in various measures. [Takahashi 2016, Kubota 2017]

Although evaluation of students' academic achievements so far have been based on examination scores which assess their mastery of teaching contents and also their literacy and competency test scores, students themselves have been unable to assess what they are learning and how much they are growing in their abilities. Therefore, this evaluation method is not adequate for students to work on continuous self-assessment. Therefore, we need a framework to encourage students to assess their own daily growth and enhance their learning continuously.

The present study especially focuses on students' competency, and discusses how students' own review and reflection, or self-assessment, and teachers' feedback promote the students' personal growth, comparing individual student's growth using the annual test results of competency evaluation. We report that the students' reflective use of "Daifuku-cho," a kind of shuttle card between teachers and students which contains records of students' learning and teacher's comments on them, enhances their learning [Kogo 2006, Kogo 2007]. By comparing the contents of "Daifuku-cho" and grades and the results of PROG test, we suggest that the better students reflect themselves using "Daifuku-cho," the better their competency becomes.

2. RELATED WORKS

In Japan, Cabinet Office is asking colleges and universities to develop human resources with high skills which full-fledged members of society are required to have. Ministry of Education, Culture, Sports, Science and Technology, Japan (MEXT) is also promoting the introduction of AL into Japanese schools and colleges to cultivate human resources who can think and act on their own [MEXT 2014]. Quite a few number of high schools and universities all over Japan are now working on AL.

As for the skills members of society are required to have, in UK, the three basic skills, which comprise a national Key Skills Qualification, include that communication, numeracy or the application of numbers and use of information technology. The three wider key skills are working with others, improving own learning and performance and problem-solving [Confederation of British Industry 1998], and they are called core skills. In Canada, they are called Employability Skill [Conference Board of Canada], and are categorized into Fundamental Skills, Personal Management Skills and Teamwork Skills.

OECD is also analyzing the results of various international surveys and existing studies, and abilities of students and adults. PISA Surveys investigate literacy, how people can make use of knowledge they acquired [OECD 2003], and DeSeCo is working on research about abilities and notions of foundation of sustainability as key competencies [OECD 2005]. In Hong Kong, the new Hong Kong three-year senior secondary curriculum (NSS) is aiming to improve students' abilities to think critically and creatively. Ka-Cheng and et al. are trying to improve The Hong Kong Diploma of Secondary Education (HKDSE) Examination, the official evaluation approach, since it is inadequate to measure Generic skills [Leung 2014].

PROG test is used in many Japanese educational institutes for quantitative assessment and it is used to evaluate students' competencies compared with those university graduates are required to have [Kawaijuku]. Ito et al. report that university students' Grade Point Average (GPA) and PROG have weak correlation [Ito 2014]. Fujiki et al. examine the effectiveness of "Fundamental Competencies for Working Persons" advocated by Ministry of Economy, Trade and Industry, Japan, in KOSEN's first-year education using PROG test [Fujiki 2016]. As described above, attempts to improve generic skills and to measure their effectiveness have been carried out all around the world.

The use of shuttle-card "Daifuku-cho," which is used by students to review and reflect classes and to communicate with teachers, was proposed [Oda 1991]. "Daifuku-cho" has columns for students to fill in and ones for teachers to write some comments for students. After each class, students write what they felt in class or some questions in a column and submit it to the teacher. The teacher in return writes some comments and returns it to the students in the next class. "Daifuku-cho" enables teachers and students to interact, and students can review what they learned in the class and learn from the teacher's comments. Kogo reports that the communication between students and teachers through "Daifuku-cho" leads to the students' introspective review of the class and higher class attendance rates. Moreover, he reports the use of "Daifuku-cho" in e-learning courses where face-to-face communication is hard and verifies that it contributes to reducing the distance between students and teachers. "Daifuku-cho" proves effective to encourage students to look back on their daily learning.

As described above, a lot of methods of evaluating competency and of improving learning outcomes by students' daily reflection have been proposed. In the present study we take physical education (PE) class as a test bed, in which we can see little difference among students' abilities of comprehension, and examine the relationship between the quantitative evaluation method and effectiveness of students' daily reflection of learning.

3. EVALUATION BY CORRELATION BETWEEN PROG TEST AND GRADES BASED ON "DAIFUKU-CHO"

3.1 Outline of Evaluation Using PROG test and "Daifukucho"

In the present study, we conducted a follow-up review of 2nd-year students (16 years old) and 4th-year students (19 years old) using PROG test and "Daifuku-cho." PROG test evaluates both "Literacy" and

“Competency,” and in this study we use “Competency” such as “ability to deal with environment surrounding in a practical manner” or “personal traits like policy of decision-making and action to cope with their surroundings” as one evaluation index, because it is more important than “Literacy” in “Fundamental Competencies for Working Persons.” We used “Daifuku-cho” shown in Figure 1 as the other evaluation index and focused on PE class, in which each student’s understanding does not lead to their grades straightforward. In the present study, we will show the effectiveness of “Daifuku-cho” as a tool for students to review their daily learning by examining the correlation of these two indices.

3.2 Structure of “Daifuku-cho”

Figure 1 shows the structure of the "Daifuku-cho" form. It is a double-sided, A4-size thick sheet of paper. The form is divided into several sections:

- (a)** Student ID: grade, class, student number, and name.
- (b)** Class number and Date: the date of the class.
- (c)** Goal of class: Students describe their personal goal of the class, what and how they are going to work on in the class, how they are going to improve themselves and contribute to the class, and so on.
- (d)** Review of class: The most important part of “Daifuku-cho.” In terms of their own goal and class contents, students write:
 - How they understand the present state they are in and identify the problems: how far they have achieved or have not achieved.
 - Setting up the tasks to achieve their goals: What factors are helping their achievement or preventing them, and what tasks are needed to solve the problems they are facing.
 - Reflecting and describing their practices and challenges: To overcome the factors which preventing their achievement, what resources and methods they can try. Questions to the teacher or comments on the class.
- (e)** Teacher’s feedback to what the student wrote. Adding special knowledge or answering the student’s questions.
- (f)** Assessment: Teacher assesses what the student wrote in (d), whether they are helpful to take concrete steps to achieve their goals, whether they think logically and so on, on a scale of one to four and the full marks in one semester are 60.

Figure 1. Structure of “Daifuku-cho” utilized in PE class

“Daifuku-cho” is a double-sided, A4-size thick sheet of paper and 15 columns for one semester are printed on it. As shown in Figure 1, it consists of parts (a)-(f).

- Student ID: grade, class, student number, and name
- Class number and Date: the date of the class
- Goal of class: Students describe their personal goal of the class, what and how they are going to work on in the class, how they are going to improve themselves and contribute to the class, and so on.
- Review of class: The most important part of “Daifuku-cho.” In terms of their own goal and class contents, students write:
 - How they understand the present state they are in and identify the problems: how far they have achieved or have not achieved.
 - Setting up the tasks to achieve their goals: What factors are helping their achievement or preventing them, and what tasks are needed to solve the problems they are facing.
 - Reflecting and describing their practices and challenges: To overcome the factors which preventing their achievement, what resources and methods they can try. Questions to the teacher or comments on the class.
- Teacher’s feedback to what the student wrote. Adding special knowledge or answering the student’s questions.
- Assessment: Teacher assesses what the student wrote in (d), whether they are helpful to take concrete steps to achieve their goals, whether they think logically and so on, on a scale of one to four and the full marks in one semester are 60.

3.3 Comparison Between the Results of PROG test and the Evaluation by “Daifuku-cho”

Table 1. Each student’s PROG competency and grade in Daifuku-cho

StudentID	2 nd grade: Competency	4 th grade: Competency	2 nd grade: Daifuku-cho	4 th grade: Daifuku-cho
1	5	6	0.89	0.92
2	5	6	0.89	0.93
3	5	6	0.50	0.92
4	2	4	0.93	0.85
5	5	6	0.79	0.83
6	4	5	0.89	0.97
7	5	6	0.93	0.83
8	2	3	0.96	0.88
9	1	7	0.89	0.88
10	4	6	0.93	1.00
11	4	5	0.68	0.77
12	3	6	0.75	0.95
13	1	1	0.86	0.85
14	1	1	0.61	0.68
15	3	3	0.82	0.85
16	4	4	0.93	1.00
17	3	3	0.93	0.83
18	4	4	0.86	0.85
19	1	1	0.89	0.80
20	3	3	0.86	0.88
21	1	1	0.75	0.78
22	1	1	0.89	0.87
23	1	1	0.86	0.85
24	6	2	0.79	0.82
25	4	3	0.86	0.88
26	2	1	0.86	0.83
27	5	4	0.93	0.82
28	5	4	1.00	0.98
29	4	1	0.93	0.92
30	4	3	0.89	0.93
31	6	5	0.89	0.80
32	3	2	0.96	0.90

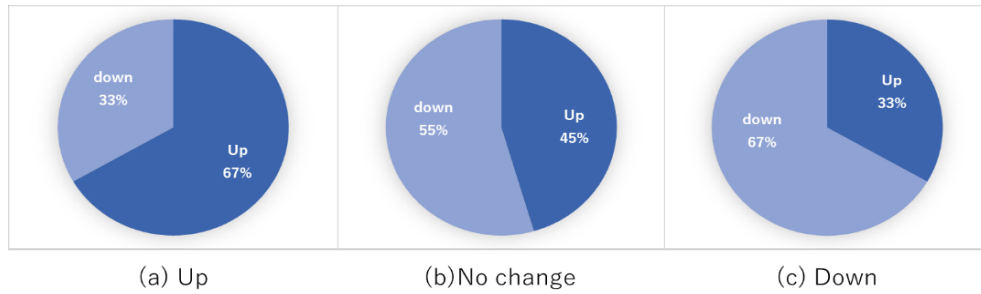


Figure 2. Relationship between PROG competency and grade in Daifuku-cho

Table 1 shows the results of PROG test and scores of “Daifuku-cho” of students in one class when they were in the 2nd grade and in the 4th grade. The students from 1 to 12 show the improvement of their competency in two years from their 2nd grade to 4th grade (Up group). The students from 13 to 23 do not show any change in their competency (No change group). The students from 24 to 32 show drop in their competency scores (Down group).

Out of the 12 students in the Up group, eight students got better in “Daifukucho” assessment, that is, 67% of the students got better, but four did not change. Five students out of 11 No Change group members got better, which means 45% of them, but the other six dropped in “Daifuku-cho.” Three out of nine of the Down group, which is 33% of them, but the other six dropped. Figure 2 shows the percentages in each group. The percentage of students who got better is the highest in (a), and the lowest in (c).

Figure 3 shows the amount of change in students’ grades of each group between their 2nd year and 4th year in box-and-whisker plot. The boxes show interquartile range (Q25-Q75) of each group, the bold lines the Median, the upper whiskers Max, the lower whiskers Min, and the dots indicate outliers. As it shows, the Up group got better in the average grade. The result of Tukey-Kramer test shows that there are significant differences among the average scores of each group using a level of significance of $p < .05$.

Therefore, those who improved in their competency showed the tendency to get better in “Daifuku-cho” scores, while those who decreased in their competency scores had the tendency to go down in the average scores.

3.4 Discussion

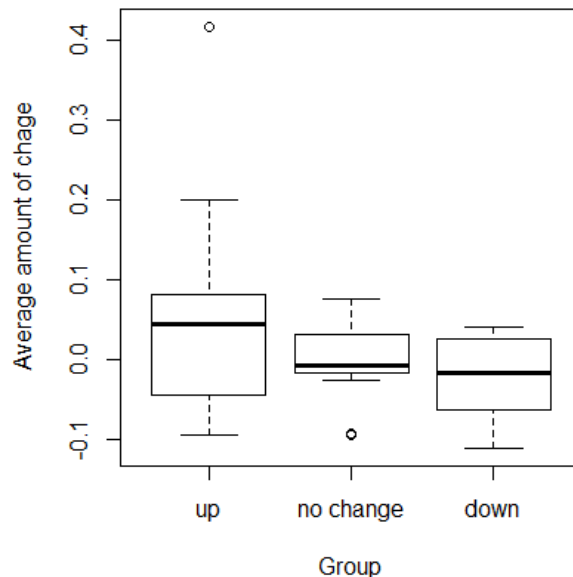


Figure 3. Competency and improvement in grade

The results of the present study indicate that the better the students get in their competency, the better their grades become, and vice versa.

We focused on the relationship of “Daifuku-cho” scores and “Competency” in PROG test, and assessed students’ grades in PE class. Assessing students’ athletic skills is a regular part of PE, but on the other hand, it is relatively difficult to assess students’ cognitive skills in PE class. We, however, were able to show the possibility of assessing the improvement in students’ competency through the use of “Daifuku-cho.”

Ito et al. shows that there is a weak correlation between GPA and PROG [Ito 2014]. In the present study, we also found out that there was a weak correlation between PROG and PE class grades, which suggests that we can assess the improvement in students’ competency through the assessment by “Daifuku-cho.”

So far, “Daifuku-cho” has been used as a communication tool between teachers and students, and also as a reflective tool for students. Our present study shows another potential of “Daifuku-cho” as a tool to measure the improvement in students’ competency.

4. CONCLUSION

“Daifuku-cho” is used as a tool for students’ own review of daily learning and teachers’ feedback. The present study aims to investigate the learning effects by “Daifuku-cho” in terms of individual student’s growth in competency.

We conducted a two-year follow-up review of 32 students and examined the correlation of grading by “Daifuku-cho” and the quantitative evaluation of their competency using PROG test. The students were divided into three groups: those whose competency scores improved in two years, those whose competency scores showed no change, and those whose competency scores dropped. There were significant differences among the average scores of “Daifuku-cho” of each group and those whose competency scores improved also showed improvement in their “Daifuku-cho” scores. It suggests a possibility that we could estimate a student’s competency improvement according to the evaluation of his/her “Daifuku-cho.”

The present study shows that there is a correlation between the evaluation of students’ “Daifuku-cho” and their competency improvement. Among future issues, we need to analyze the scores of each group qualitatively based on the entries to “Daifuku-cho.” By clarifying the features of entries to “Daifuku-cho” in terms of competency improvement, we hope to show some new evaluation points of “Daifuku-cho,” which may lead to “Fundamental Competencies for Working Persons.”

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METACOGNITIVE STRATEGIES AND LEARNING QUALITY: A SYSTEMATIC MAPPING STUDY

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ABSTRACT

The purpose of this study was to identify, analyze, synthesize and evaluate research papers aimed at the application of metacognitive strategies to improve the quality of learning in secondary school students. This document is a systematic mapping (SM) which offers a comprehensive overview of the methods, indicators, strategies, techniques and instruments used in those research. A literature review was conducted in seven widely recognized databases in the educational and scientific community worldwide; 722 documents were found and from these 19 were relevant to the search objective. 57.89% applied metacognitive strategies as follows: 15.78% to learning quality 42.10% to learning processes or skills; 31.57% on learning quality, and 10.5% on learning processes without the intervention of metacognitive strategies. The results confirmed the application of metacognitive strategies such as: planning, monitoring, evaluation, underlining, self-evaluation, modeling, thinking aloud, consciously choosing, reflection and reflecting on learners' ideas, keeping journals, predictions, among others. Learning processes such as: motivation, understanding, transferring, evaluation, selective attention, knowledge association and advanced organization were intervened. Indicators of the learning quality were also used: potential, processes, results, the academic performance, peer evaluation, intrinsic motivation, understanding, knowledge construction indicator, teacher's expectation indicator, the Students' growth indicator, the superficial level of learning, and the deep level of learning, the level of learning achievement. There was a knowledge gap in the application of metacognitive strategies to improve the learning quality of secondary school students, which confirms the need to conduct studies with this type of classroom interventions.

KEYWORDS

Metacognition, Strategy, Quality, Learning, Acquisition, Indicators

1. INTRODUCTION

Metacognition is the cognition of cognition or the ability to consciously know, regulate and intentionally control one's own cognitive processes, Khan and Khan (2013), Flavell's studies on memory in the 70s were pioneers in these research issues, which eventually would be approached from pedagogy and other fields of knowledge, Flavell and Wellman (1975).

Flavell (1979) Proposed a cognitive process model for monitoring and regulation, which highlights what happens in the process of knowing, access to their own cognitive processes which would allow controlling and improvement of these processes. The elements involved in this model are metacognitive knowledge, metacognitive experiences, knowledge of goals or tasks and knowledge of strategies. According to Brown et al. (1982), there are two types of metacognitive knowledge: i) declarative knowledge about the person, the task and the strategy; and ii) a procedural knowledge of the cognitive process regulation expressed in planning, control and evaluation of them.

For Aguirre (2016), metacognition is the ability of thinking that allows knowing what is known, planning strategies to do the action of knowing, being aware of thoughts during the knowledge process, and reflecting and evaluating the moments and actions of the knowledge process. McCluskey, Treffinger, Baker and Lamoureux (2013) Says that metacognition is the awareness of the learning processes itself, the strengths and weaknesses when solving a problem or a task, and the organization supervision, regulation and evaluation of these processes.

Metacognition has two main components or dimensions: knowledge of cognition and regulation of cognition. The metacognitive strategies according to Osses and Jaramillo (2008), are actions aimed at knowing

our operations and mental processes, knowing how to use them, readjust them and / or change them, according to the goal demandings. For Nosratinia and Adibifar (2014) metacognitive strategies are general skills that allow students to manage, direct, regulate, monitor and evaluate their learning; therefore they can contribute to improve the learning quality of students.

The learning quality construct is a complex and relatively new concept in the theoretical educational body of literature. In the last three decades, several authors have made efforts to study and theorize on this issue. Pérez (2008) states that the learning quality can be assessed through the following quality criteria: i) quality as a goal (outcome evaluation) (Kinzie, 2019; Iyer and Moore, 2017); ii) consistency (process evaluation) Biggs (2004); iii) volume of data remembered; iv) information explained from a personal understanding; v) ability to solve problems, among others. This same author, Perez (2008), states that the learning quality should have a purpose of change on students, being able to solve problems in context and generalize them, making decisions and learning autonomously, diversely, actively, cooperatively, reflectively and critically.

According to this, a research study was proposed about the quality of learning tackled from the consistency perspective, that is, from the learning processes. In this case the learning acquisition process of students has been selected, using metacognitive strategies to improve three acquisition learning sub-processes: understanding, retention and transformation. The present work shows the initial phase of this research aiming at developing a systematic mapping study (SM) which will allow a comprehensive overview of the methods, indicators, strategies, techniques and instruments used in existing research done on this specific area of knowledge.

This document is organized as follows: section II details the research method used, section III shows the results; Section IV describes the possible threats to this study validity, finally, section V presents the conclusion and further work issue.

2. RESEARCH METHOD

For the review of literature, the method of systematic mapping (SM) was used, which according to Kitchenham and Brereton (2013) consists on identifying, evaluating and interpreting the studies linked to a research question, issue, discipline or phenomenon. These authors propose a process involving five procedures: 1. Definition of the research question, 2. Doing the research tracking, 3. Classification of the studies, 4. Extracting relevant data and 5. Elaboration and publishing the report. The adaptation of the model proposed by Costa, Amorim and Salvador (2019) was followed with the first four steps.

2.1 Defining the Research Question

Five research questions were defined for this systematic mapping study:

RQ1: What evidence does indicate the use of metacognitive strategies to improve the learning quality of secondary students?

RQ2: What kind of metacognitive strategies have been applied for secondary students' learning process?

RQ3: What learning processes from secondary students have been intervened through the use of metacognitive strategies?

RQ4: What indicators are used to measure the learning quality of secondary school students?

RQ5: What evidence does indicate the completion of studies about the Learning Acquisition Process and its sub-processes (Comprehension, Retention and Transformation) from secondary school students?

The RQ1 aims at selecting research done in regard to the use of metacognitive strategies to improve learning quality from secondary school students. RQ2 seeks to identify the metacognitive strategies applied to secondary school students' learning process. The purpose of the RQ3 is to inquire about learning processes intervened using metacognitive strategies from secondary school students. RQ4 searches for indicators to assess the learning quality from secondary school students. RQ5 intends to identify research tackling the learning acquisition and its sub processes from secondary school students.

2.2 Tracking the Information

In this section, the tracking process of relevant search chains of studies was established. Kitchenham and Brereton (2013) Proposes guidelines for designing efficient search strings. With this purpose keywords related to the research questions were selected and three search strings were defined. See table 1.

Table 1. Searching strings and key words

#	String	Total
String 1	“Metacognitive Strategies AND Learning Quality” OR “Metacognitive Strategies” OR “Learning Quality” OR “Acquisition process quality” OR “The Acquisition Process” OR “The retention process” OR “The Assimilation Process”	393
String 2	“Metacognitive Strategies” AND “Learning Quality” OR “Acquisition process quality” OR “The Acquisition Process” OR “The retention process” OR “The Assimilation Process” OR “The understanding process” OR “School learning processes”	12
String 3	“Learning comprehension” OR “Understanding of knowledge” OR “Acquisition of learning” OR “Acquisition of knowledge” OR “Assimilation of learning” OR “Assimilation of Knowledge” OR “Learning retention” OR “Knowledge retention” OR “Learning Transformation” OR “Knowledge Transformation”	317

Seven databases were used to do the systematic mapping: Scopus-Elsevier, Science Direct-Elsevier, Springer Link, Web of Science, IEEE Xplore, Taylor & Francis and Wiley Online Library. The studies found in each database searching process were 722, these can be seen in table 2.

Table 2. Studies found in each database

Digital Library	Retrieved	Relevant Papers	Papers	Year of Publication							
				2012	2013	2014	2015	2016	2017	2018	2019
Scopus	314	7	15, 16, 17, 26, 28, 29, 32				32	28	26	15, 16, 17, 29	
Springer Link	68	4	18, 27, 30, 31		27	31				30	18
Web of Science	88	5	19, 20, 21, 22, 23				20			19, 23	22
Science Direct	138	2	24, 33	24	33						
Taylor & Francis	15	1	25						25		
IEEE Xplore	60	0									
Wiley Online Library	39	0									
Total	722	19	19	1	2	1	2	2	2	4	5
Percentage	100%	2,63%	100%	5,2%	10,5%	5,2%	10,5%	10,5%	10,5%	21%	26,3%

Table No. 2 describes the amount of publications found (722). Number of relevant publications related to the main issue, methods and populations (19), year of research publication, which mostly were between 2018 and 2019 (7 = 36,8%) and only four papers were published between 2012 and 2014. This searching process was conducted between August and October 2019.

2.3 Studies Classification

Selection process of papers was done using both inclusion and exclusion criteria. According to Costa et al. (2019) the objective of this process is to select relevant documents related to the purpose of the study and the research questions proposed in the previous step in order to reduce useless publications. Six inclusion criteria and six exclusion criteria were used. These criteria are presented in Table 3.

Table 3. Inclusion and exclusion publication criteria

Inclusion Criteria	Exclusion Criteria
IC-1: Relevant studies.	EC-1: Papers not written in English, except if the research was conducted in Colombia.
IC-2: Studies conducted between 2012 and 2019.	EC-2: Publications without access to full-text.
IC-3: Studies conducted using quantitative approach and experimental methods applying, metacognitive strategies to learning.	EC-3: Qualitative, exploratory or descriptive studies or papers tackling philosophical aspects excepting research aimed at reporting learning quality or learning acquisition process and its sub-processes.
IC-4: Research conducted using secondary or high school students as target population.	EC-4: Research conducted with university population. Only for the metacognitive strategies variable.
IC-5: Research documenting improvements in the quality of student's learning.	EC-5: Studies conducted in fields other than education, except if the research was developed in the health area or the research is related to the topic, method and population of this research.
IC-6: Studies presenting findings related to the process of student's learning acquisition and its sub-processes.	EC-6: Research conducted with teacher population.

2.4 Data Extraction

In this stage, the papers were completely and detailed read in order to answer the above-mentioned research questions, and in this way to obtain the evidence supporting this mapping study.

3. RESULTS

Firstly, dissemination media, type of research method and the target population of selected papers were analyzed. It was found that 57, 89% (11 papers) of the relevant papers were published in journals. 26.3% (5 papers) were published in conferences and 10.5% (2 papers) were book chapters. Regarding the research methodology, 63.15% (12 papers) used quasi-experimental, pre-experimental or experimental designs with intervention; 10.5% (2 papers) used mixed designs; 10.5% (2 papers) made correlational approximations; 5.2% (1 paper) used longitudinal design; 5.2% (1 paper) used action research design and 5.2% (1 paper) used another type of design. Regarding the target population, it was found that 63.15% (12 papers) were conducted using secondary school students; 10.5% (2 papers) were developed with university students; 10.5% (2 papers) were carried out with an open education population, this same amount of papers were conducted with a disable population and 5.29% (1 paper) was carried out in primary school.

3.1 Answers to Research Questions

In this section, answers are given to the previously asked questions.

RQ1: What evidence does indicate the use of metacognitive strategies to improve the learning quality of secondary school students? Among all the retrieved research, just three studies were identified (Susantini, Sumitro, Corebima and Susilo, 2018; Yusnaeni, 2018; Mulyono and Hadiyanti, 2018) answering this question.

In Susantini et al. (2018), the authors verified the effects of metacognitive strategies (MS) on general techniques for improving thinking skills through: i) Four stages: differentiate, refine, elaborate and interrelate; ii) Six phases: to clarify learning objectives and to explore pre-existing knowledge, to organize the students' learning process, to monitor students' conceptual change, to introduce important concepts, to verify student understanding, to provide feedback, and to encourage self-control and self-assessment; iii) Four activities: questioning, clarifying, summarizing and predicting. For this, the Self-Understanding and Evaluation Sheet (SUES) was used. The authors found that students with high capacity developed higher metacognitive skills, high levels of knowledge in the specific area and better academic achievements in students with a low capacity were identified.

In Yusnaeni (2018) the effects of the models Search Solve Create and Share (SSCS), were analyzed: this same model associated with the use of metacognitive strategies (SSCS + MS), and traditional learning, for the improvement of learning quality of secondary students were taken into account. Underlining Metacognitive

strategies were used when reading text and self-assessment, to identify students' strengths and weaknesses, to monitor and assess their learning. The authors found that (SSCS + MS) may increase student learning outcomes, as they provided better learning outcomes in students with lower academic levels than those with SSCS and traditional models.

This study Mulyono and Hadiyanti (2018), was conducted to test and analyze the quality of learning based on problem solving of secondary school students in mathematics and science. In this, students were grouped according to their metacognitive level into four: tacit using level, conscious using level, strategic using level and reflective using level. The learning quality test was carried out tackling the planning, process and outcome phases. The authors state that the high level of students' metacognition is directly proportional to the ability to solve problems. Students with tacit using levels completed the tasks without understanding the reason for using the strategy; instead those from conscious using level solved the problem and were able to build new knowledge through problem solving.

RQ2: What kind of metacognitive strategies have been applied to secondary school students' learning process? It is reported that 57.89% (11 studies), applied metacognitive strategies in their interventions. However, the contributions of (Cai, King, Law and McInerney, 2019; Makela et al. 2019; Erdoğan and Şengül, 2017; Lei, Sun, Lin and Huang, 2015) are highlighted, since they made a detailed explanation of the strategies used and the methodological process carried out during the intervention.

Regarding Cai et al. (2019), it was examined how future objectives, metacognitive strategies and achievements dynamically influence each other over time. To do this, they used a Self-Learning Scale (SLS), which is composed of three metacognitive strategy sub-scales, which are: i) changes to improve: ways in which students try to improve their learning by identifying their mistakes ii) monitoring: regular self-test of students' learning and understanding; iii) planning: activities: prepared by learners for future work. Authors found that metacognitive strategies influenced the further searching for future objectives.

In Erdoğan and Şengül (2017) the level of metacognitive awareness of sixth grader students in mathematics was measured, in the knowledge and regulation dimensions. The metacognitive strategies used were: i) modeling; ii) thinking aloud; self-appraisal; iii) metacognitive instruction; iv) putting action cards online; v) problem solving and thinking aloud; vi) choosing consciously; vii) reacting to comments and reviewing; viii) writing ("thinking aloud" on paper); ix) Reflecting about and reflecting on learners' ideas; x) keeping journals; xi) and predicting. These strategies were measured with the Junior Metacognitive Awareness Inventory (Jr. MIA) version B. The authors affirmed that, participation in debates where thoughts are reflected about, thinking aloud and promoting strategies, can facilitate the development of metacognitive skills in students such as planning, monitoring and evaluation.

In the study Lei et al. (2015) the influence of metacognitive strategies: planning, monitoring and evaluation in searching behaviors and learning about performance on YouTube videos related to animal understanding, a questionnaire using the Chiu (2006) modified metacognitive strategy (MSUQ) was applied to evaluated fifth grader students. It was reported that children with better evaluation and planning skills efficiently identified the videos that met the task requirements.

In Makela et al. (2019) it was verified that children with fetal alcohol spectrum disorder (FASD), based on the metacognitive approach: problem identification, planning, fragmentation and reinforcement, could acquire 26 metacognitive strategies. In this, a metacognitive strategy checklist was used based on the Flavell learning stages: what is taught, requested, spontaneous and mastered. It was found that with the right training these 26 metacognitive strategies improved children performance during sessions.

RQ3: What learning processes in secondary school students have been intervened through metacognitive strategies? It was found that 21.05% (4 articles) carried out interventions with metacognitive strategies focused on learning processes.

In Al-Jarrah, Mansor and Rashid (2018) the influence of using metacognitive strategies in the development of EFL writing skills in secondary school was researched taking into account five stages: i) preparation, students associated their previous knowledge with contents, they were taught about the details, the advanced organization and the selective attention; ii) presentation, students were given personal preparation strategies, as well as self-control and self-evaluation strategies for their application; iii) practice: students planned their writing compositions in accordance with the self-planning strategy. Evaluation: phase of effective understanding about what has been learned, about reevaluation, self-evaluation, coevaluation, hetero-evaluation and self-questioning; iv) expansion, included transference strategy to other contexts (practicing, combining, evaluating, estimating and incorporating the learned strategies); v) writing tests,

students showed their writing skills, whose instructions on using metacognitive learning strategies were found that improved students' writing abilities.

In Muñoz and Ocaña (2017), metacognitive strategies of planning, supervision and evaluation were implemented in secondary school children to improve reading comprehension processes. The following sub-processes of reading comprehension were intervened: vocabulary understanding, detailed understanding, understanding to perform text macrostructure, and understanding for main ideas identification. In addition, the following inferencing processes were also intervened: inference in expository texts: lexical inferences, causal inferences, comparison inferences, specification inferences, inclusion inferences, macrostructural inferences. Through a pedagogical intervention in the three reading moments: before, during and after reading. The authors evidenced significant improvement on children's textual comprehension by applying metacognitive strategies such as planning, supervision and evaluation of reading.

In Tajalli and Satari (2013), the effectiveness of metacognitive strategies for improving reading skills of students with hearing disorders was identified. These impaired children improved significantly their reading skills using metacognitive strategies.

In Wagaba, Treagust, Chandrasegaran and Won (2016), the intervention effects for the improvement of secondary schoolers metacognitive abilities focused on motivational processes to get achievement and understanding were evaluated. Interventions included: focused results, collaborative activities, improvement in their reading abilities of scientific texts, and draw concept maps; The evaluation of the metacognitive capacities was measured through the Metacognitive Strategies Questionnaire (MStQ) and the Metacognitive Support Questionnaire (MSpQ). It was found that there were no significant rates in any of the scales of the (MStQ), but did have significant gains in all scales of the (MSpQ) which implies that most children perceived that their science classroom environment is oriented for using metacognitive strategies, but hardly ever they used.

RQ4: What indicators are used to measure the learning quality of secondary learners? Only 31.57% (6 articles) from the selected documents provided evidence of learning quality indicators. The studies (Stracke, 2017; Zhao, Wu, Chen and Wan, 2016) tackled the learning quality from open education. In Stracke (2017) improvement indicators were: potential indicators, process indicators and results indicators; additionally three levels of learning and education indicators were used: macro (organizational), meso (institutional) and micro (individual student process). In Zhao et al. (2016) were taking into account the following criteria for assessing the quality of learning: student's participation and their academic performance in forum, the emotions of being part of these activities, and the fact of searching videos and their academic performance.

The research (Yogica and Helendra, 2018; Ermolayev, Keberle and Borue, 2013), were developed at university level with the purpose of improving quality of learning, using motivational processes. In Ermolayev et al. (2013) they applied peer evaluation to improve extrinsic motivation, taking into account the quality of the reports submitted by the students. The quality of the cross-evaluation and their objectivity. In Yogica and Helendra (2018) they applied the method called "they do it, they get it and they know it". The learning quality indicators were intrinsic motivation and understanding.

The studies (Yang and Dong, 2017; Zou, Li, Chen, Zhong and Wang, 2014), were carried out in secondary school to apply the Bloom's taxonomy and the SOLO (Structure of the Observed Learning Outcome) taxonomy, respectively. In Yang and Dong (2017) a set of student learning progress indicators based on the Diffuse Cognitive Map was proposed to comprehensively describe the progress of learning. For this, a Student Attribute Model (SAM) was taken into account to incorporate performance-based learning (PA) and non-performance-based learning attributes (NPA). In this study, a different version of Bloom's taxonomy that classifies psychomotor domains into 7 levels was applied. To analyze the learning progress they established the following groups: learning attributes students, subjects, learning stages, and study and performance groups. The indicators used were: knowledge construction indicator (KCI), teacher expectation indicator (TEI) and student growth indicator (SGI).

In Zou et al. (2014) they applied the taxonomy SOLO and their learning approach levels: superficial, deep and achievement level to establish their relationship with the learning quality. Data Indicators on learning approaches were obtained through the Student Learning Process Questionnaire (SLPQ), which contains six scales: grading about the surface learning motive, grading about the deep learning motive, grading of reasons for learning by achievements, grading about the strategy of superficial learning, grading about deep learning strategy and grading about learning strategy by achievements.

RQ5: What evidences are there about studies aimed at learning acquisition process and sub processes of Comprehension, Retention and Transformation in secondary school students? 10.55% of the papers (2 articles) could answer this question. Wäschle, Gebhard, Oberbusch and Nückles (2015) was aimed at verifying the effects of writing reflective journals to critically reflect on scientific issues. It was trained in using learning strategies during the writing process with two cognitive instructions with the objective of stimulating reading comprehension sub-processes: elaboration and organization, and two metacognitive instructions with the purpose of stimulating the understanding when monitoring and planning corrective strategies. It was evidenced that writing reflective journal proved to be more successful than any other traditional writing tasks for self-regulated learning. In Hong et al. (2013), based on the dual process theory, the Solitaire and Heart Attack games were used to determine their effects on the retention sub-process of secondary students learning process. It was found that Solitaire game was more effective in increasing long-term memory retention rates.

4. THREATS

According to the contributions of Costa et al. (2019) the SM method is a formal research process, highly conceptualized and with a quite precise approach applied to the literature review; but validity problems can be presented if any appropriate key words selection is applied and also it is necessary to plan an effective design of searching strategy.

5. CONCLUSION

With the use of the SM method, a detailed searching was conducted in seven widely recognized databases in the field of educational research. 722 articles were selected and 19 of them were relevant to this research.

From the papers retrieved several applications of metacognitive strategies in the dimensions of knowledge and regulation were found such as : planning, monitoring, evaluation, underlining, self-evaluation, changes to improve, modeling, thinking aloud, consciously choosing, reacting to the comments and reviewing, writing ("thinking aloud" on paper), reflection on and reflecting about learners' ideas, keeping diaries, predicting, among others.

Regarding the learning processes intervened by metacognitive strategies, they were: motivation, understanding, transference, evaluation, selective attention, knowledge association, advanced organization and inference.

From relevant publications, it was possible to show that the indicators of learning quality used were: potential, processes, results, academic performance, peer evaluation, intrinsic motivation, understanding, knowledge construction indicator (KCI), teacher expectation indicator (TEI), student's growth indicator (SGI), superficial level of learning, deep level of learning and level of learning achievement.

Only three studies applied metacognitive strategies to improve learning quality in secondary students and seven applied strategies related to other aspects. This confirms that research contributions in this particular knowledge area are very scarce.

In regard to studies aimed at the learning acquisition processes and its sub-processes any paper was found tackling these characteristics, only interventions were applied in the comprehension and retention ones.

This confirms the existence of a knowledge gap in the application of metacognitive strategies to improve learning quality of secondary students, therefore, it is essential to carry out studies with these types of interventions in classroom settings which will provide greater relevant knowledge in the pedagogical area at school and contribute to the improvement in the educational field.

These findings may contribute to decision-making processes on methodologies, indicators, strategies, techniques and instruments to be used in conducting research aimed at researching on metacognition and secondary students' learning quality.

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UPPER SECONDARY SCHOOL TEACHERS' FIRST ENCOUNTER WITH THE ACTIVE LEARNING CLASSROOM: WHAT CAN WE LEARN FROM A PERSPECTIVE OF POWER AND CONTROL?

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ABSTRACT

This paper reports on a research and development project based upon problems in upper secondary school, namely students' lack of engagement, passive learning and students' absence from school. Looking to solve this problem, a group of upper secondary school teachers came across and saw potential in the concept, physical space and method of the "Active Learning Classroom (ALC)", a concept from higher education. The aim of this particular study was to explore teaching in the ALC from the perspective of power and control. The research questions embrace issues on both the physical learning environment of the ALC, teacher practices in the ALC and what kind of teacher practices enhance active learning. The theoretical framework was based on Bernstein's concepts of power and control. The study applied methods of video recorded classroom observations and field notes. The findings indicate a designed physical learning environment where power was conferred to the students. That placed demands on the teachers with regard to how they handled control in practice. Findings further indicate that when teachers had more active control over pace and sequencing, this increased productivity and more active learning among the students.

KEYWORDS

Active Learning Classroom, Teacher, Pace, Sequence, Power and Control

1. INTRODUCTION

Most people have an experience of classroom teaching with a teacher at the front of the classroom talking to silent students sitting in straight lines, facing the teacher, similar to Freire's (1970) banking model. Such teaching has been labelled as traditional teaching or teacher-centred learning (Barr & Tagg, 1995; Carlgren et al., 2006). In contrast, a student-centred learning (Barr & Tagg, 1995) approach is reported in terms of so-called active learning, based on student-driven tasks including assignments where students create understanding, meaning, and new ideas. Further, being active in learning means a learning approach that helps students expand their thinking beyond consumption type behaviour and traditional reproduction of existing knowledge where students apply or create new knowledge to solve a problem by using both peers and, not frequently, various information and communication technologies (ICT) (Jahnke et al., 2017).

This study focuses on a school development project initiated by teachers in one Swedish upper secondary school, who witnessed students' lack of engagement, passive learning and students' absence from school. From their daily practice in the school, they saw a need to expand their repertoire of teaching methods from the use of teacher-centred learning methods to teaching methods where students' active learning increased. During, and as part of the development process, the teachers came across and saw potential in a method and model developed in higher education called Active Learning Classroom (ALC) (Baepler et al., 2016). Accordingly, the school decided to create a room designed using principles from the ALC model with regard to furniture and ICT. In the first phase of the project, the teachers designed the room according to some ALC principles of using round tables for groups of students, access to whiteboards, and digital facilities such as smartboards, interactive pens, projectors, and student laptop access. In the second phase, teachers started to teach students in the ALC.

This paper focuses on the second phase and what happened to teacher practices when they shifted space from the familiar and ordinary classroom space to the new experience of the ALC. The aim is to explore teaching in an active learning classroom from the perspective of power and control at upper secondary school level. The following research questions were addressed: 1) How can the physical space of the ALC be described and understood? 2) How can teacher practices in the ALC be described and understood? 3) What kind of teaching practices enhance active learning in the ALC?

The next section presents literature related to active learning and teacher practices before continuing with the method and the theoretical framework.

2. LITERATURE

The key concept in this project is active learning, which has been addressed in policy documents (OECD, 2013) as well as in the work of John Dewey and his progressive pedagogy. The term active learning classroom can be understood as a two-fold principle with regard to both active learning pedagogies and principles about the physical classroom space (Baepler et al, 2014). Regarding active learning pedagogies, previous definitions of active learning touch upon dichotomies between teacher-centred learning and student-centred learning, for example by limiting activities based on transmission of information and instead increasing student discussions and analysis (Bonwell & Eison, 1991). Recent research positions active learning explicitly as a sub-term to student-centred learning, where active learning is defined as teaching and learning that is individualised and adaptive (Bernard, Borokhovski, Schmid, Waddington and Pickup, 2019).

When considering active learning in relation to physical classroom spaces, an extensive number of studies from the context of higher education report on the active learning classroom (ALC) (Whiteside, et al, 2010; Brooks, 2011; Baepler et al, 2014; Baepler, et al, 2016; Hyun et al, 2017). Active learning in higher education can broadly be understood as a shift in the teacher-student relationship, where students in their role become more of a teacher and take responsibility for knowledge construction. Other characteristics concern the use of the flipped classroom, where lectures are consumed before entering the ALC. Research results convincingly shows increased students' performance in the ALCs compared to traditional classroom settings (Whiteside et al, 2010; Brooks, 2011; Baepler et al, 2014; Lundahl, et al, 2017). Other benefits of ALCs concern improved student attendance and attitudes (Hyun et al, 2017).

Literature on active learning in the context of K12 education has been scrutinised in Bernard et al.'s (2019) systematic review and meta-analysis of 299 studies. Bernard et al. (2019) report on effect size regarding the categories: 1) teacher role, 2) flexibility, 3) pace, and 4) adaptability. Further, these categories were used to show how control was either retained by the teacher (e.g. when lecturing), or distributed to the students (e.g. when the teacher acts as a facilitator who clarifies and encourages). Similar to what has been found in other meta-studies (Hattie, 2008), the most important skill for active learning seems to be in the teacher role with abilities to facilitate students' process by acting as a "guide on the side" rather than a "sage on the stage" (King, 1993). To be a guide on the side can, for example be related to teachers' ability to monitor pace, as Bernard et al. concluded: "pacing of instructional events in a classroom is more productive when it is less student-centred than when it is more student-centred" (Bernard et al, 2019, p. 23). In qualitative studies, findings from one-to-one computing classroom research shown that, among other things, pace was also connected to how teachers sequenced material (Bergström et al, 2019; Bergström, 2019; Bergström & Mårell-Olsson, 2018). These studies showed that when pace and sequence was less student-centred, teachers' communication and actions were focused on having students busy in activities, at the expense of a lack of insight into the quality of students' learning.

In this particular study, a group of upper secondary school teachers recontextualised the ALC concept developed in higher education and put it into their context of an upper secondary school. The study explores the teachers' experience of teaching in the ALC by focusing on expected power relations arising from the ALC space as such, as well as teachers' control in relation to pace and sequencing of lessons in that space.

2.1 Theoretical Framework

Bernstein (2000) argues that education and educational situations are relays of power relations and regulatory principles. The school teaches knowledge and conveys values of how to behave as a student. To illustrate power and control mechanisms, Bernstein used the concepts of classification and framing. Classification addresses symbolic borders and power relations between categories, for example between school subjects or between objects in a space. Classification categories hold relative power positions, either strong (C+) or weak (C-) classification or degrees in between, and any attempt to change the degree of separation in the relationship will reveal the power relationship on which the classification was established (Bernstein, 2000). The concept of framing indicates how strong or weak the teacher controls, say, the knowledge content, the knowledge acquisition and the communication in the classroom (Bernstein, 2000). The framing can be strong (F+) or weak (F-) or degrees in between. For example, strong framing means that the teacher largely regulates and controls what students should work with and at what pace it should take place, while weak framing means that the students have a great influence over this. In previous research, classification and framing have been used in various analyses of educational practices including analyses of physical learning environments and teachers' practices (e.g. Bergström et al 2019, Bergström, 2019). In our analysis of power and control in ALC, we look at how the organisation of, for example, furniture and equipment in the physical space gives signals of power relations between students and teachers (classification) (RQ1). We also look at the extent to which teachers control classroom practice (framing) (RQ2). Thus, we apply Bernstein's theoretical concepts at the micro level of the classroom, with the support of a model that Bergström et al. (2019) and Bergström (2019) have developed and where Bernstein's concepts of classification and framing are operationalised. Regarding the analysis classification — expected power relations arising from the space — four classroom-specific classification categories were used: “desks” (how desks are placed in the room), “inside-outside the classroom” (how the classroom space is restrict to other school spaces), “digital resources” and “material resources” (how these are placed in the classroom space). Each of these categories gives signals of how power is expected to be distributed among students and teachers in the classroom. Table 1 illustrates the classification category “desks” and how, according to Bergström's model, this distributes power between students and teachers based on how the desks are organised in the classroom space.

Table 1. Extract from one of the classification categories

Theme	Strong classification (C+)	Weak classification (C-)
Desks	From front to back: desks in straight lines, corridors From left to right: separation of students	From front to back: variations in the organization, for example desks in groups, no clear path From left to right: opportunities for student-student interaction

Regarding the analysis of teachers' control in practice (RQ2) we looked at the framing categories “pace” (to what extent the teacher controlled the pace during lessons) and “sequence” (to what extent the teacher controlled in what order tasks are to be done). Table 2 illustrates, according to Bergström's model, an extract of what guided the analysis in the category “pace” regarding the use of strong and weak control over time.

Table 2. Example of an extract from the category ‘pace’

Category	Indicator	F++	F+	F-	F--
Pace	Teacher-student communication in practice	The teacher monitors strongly the learning activities and change activity when he/she has said what is needed	The teacher has a clear aim of what students shall accomplish during the lesson, but the teacher monitors the start/stop of a new activity in relation to students’ progress	The students monitor the time they need for an activity, but the teachers press them to finish work	No time determined in the exploring of texts; time depends on pupils’ pace and there is no pressure from the teacher

Example of how transcripts have been categorised in relation to strong and weak framing

F++ “I will give you the instructions one at the time. For the first step you have 10 minutes, the next step 20 minutes, and for the last step you have 30 minutes”

F+ Student: we are about 20 minutes behind the others

Teacher: yes, but you can make it

F- “Have you pushed the material to GIT?”

F-- “I thought we should work until the break, at least, and then we consider how far you reached, and if you are not finished we will continue after the break”

3. RESEARCH METHOD

This study took place at an upper secondary school with 18 teachers and 200 students. The study was based on a qualitative research design where a group of three teachers collaborated with researchers for three years, starting in the autumn of 2017. During the first year the Active Learning Classroom (ALC) was designed and built. Thereafter the teachers started to use the ALC and the researchers followed them during a period of six months when they started to use the ALC. We observed and filmed the teachers in practice and participated in their planning meetings where they evaluated and planned lessons. During this period, the researchers did not intervene with a predetermined purpose. Instead, the researcher’s role was to listen to the teachers and asked pedagogical questions regarding the teacher’s enthusiasm and struggles based on experience of using the ALC.

The three teachers were all experienced, having been working for between 6-12 years. One teacher taught Swedish native language and English language, while two teachers taught software engineering and physics. The teachers were teaching on the technology programme, the electronics programme and the aesthetics programme. The class size in the observations varied between 8–18 students. Such a research setting is not without consequences. For example, the teachers’ different subjects as well as the different upper secondary school programmes, both academic and vocational, have different cultures and traditions (Karaseva et al., 2013) and the fact that subjects are relays of different power and control relations (Bernstein, 2000).

The data in use here consists of 12 video recorded classroom observations of lessons in the ALC and field notes of the observations. One teacher (Joe) carried out five lessons, another teacher (Ken) carried out four lessons, and the third teacher (Aron) carried out three. The classroom observations were recorded with a Canon XA11 video camera equipped with two channels audio recordings. Thus, audio was captured through the use of two microphones, 1) one microphone on the teacher and 2) a second microphone on the camera capturing class audio. The empirical material was processed in four steps. In the first step, the first author watched and described all video recordings broadly in an excel sheet. During this step, the sequences of the classroom observation were described as a time-line in terms of: a) the activity taking place, b) the duration of the activity, c) interactions (teacher-student and student-student), d) type of setting (individual work, groupwork or mixed), e) communication quotes of teacher-student and student-student discourse. In the second step, the excel sheet describing the classroom observations was circulated around the research team and discussed. When the entire data sheet had been discussed, the research team selected typical parts that represented i) the introduction of the lesson, ii) a typical sequence when students were working, and iii) how the lesson was closed. In the third step, the selected parts were fully transcribed, both in terms of the audio and in terms of the movement, actions

and gestures. In the fourth step, the transcriptions of the selected parts were imported to the Nvivo® software. In Nvivo®, the transcriptions were organised and analysed jointly based on a theory driven approach (Stebbins, 2001) as described and illustrated in section 2.1. The analysis presented in this paper is based on the complete data sheets and the selected transcribed data.

4. FINDINGS

The following section presents the findings from the practice of these upper secondary school teachers in the Active Learning Classroom (ALC). The findings follow a structure that takes starting point in a photograph. The design, configuration and furnishing of a physical space, like a classroom, indicate expected power relations in that space, and the photograph is used to illustrate the expected power relations between students and teachers in the ALC. After the description of the physical ALC space (4.1) the following section (4.2) highlights the teaching practices of the teachers in the ALC with a focus on to what extent control was retained by the teacher or distributed to the students. In order to illustrate different power and control relationships, the teachers' voices are given life via frequently used quotes. The names of the teachers are replaced with pseudonyms: Joe, Aron and Ken.

4.1 Power Relations in the Physical ALC Space

This section reports on how the physical space of the ALC indicated power relationships between teachers and students.



Figure 1. The physical organization of the ALC

Figure 1 illustrates how the physical space of the ALC in this study was organised in all (N=12) classroom observations. As illustrated in figure 2, all of the four classification categories (desks, inside-outside classroom, digital and material resources) were weakly classified: 1) desks were organised with four round tables for group student work, each desk providing space for up to 6 students, 2) no clear borders separated the ALC space from other school spaces, 3) when ICTs (e.g. the projector or smartboard) were used they were placed at student desks and used by students to show and discuss solutions among themselves and with the teacher, 4) whiteboards were placed at each student desk and used by students to show and discuss issues among

themselves and with the teacher. In summary, all four categories indicated weak classification, thus the ALC space as such indicated a space where power was conferred to the students to a great extent.

4.2 The Distribution of Control

This section reports on the control of sequence and pace in the ALC over the 12 lessons. Across these 12 lessons, the analysis indicates that the teachers used a similar approach, as well as that a change was indicated in their use of control based on how they handled sequence and pace. When reporting on the findings, the analysis goes back and forth between the wider illustration of the lesson and the fully transcribed chunks of text from the selected micro sequences from the selected parts.

During the first six classroom observations the teachers typically either asked the students to continue with the task from the previous lesson (often carried through in an ordinary classroom), or gave the students a series of tasks to accomplish in groups during the observed lesson. In the words of one teacher: *“When you have found the document in Google Classroom you will find the questions for discussion. You should use the same process as earlier. Discuss and be sure that everybody is allowed to talk, don’t forget to take notes and then we run to 10:55 AM”* (Ken, ALC #1). When referring to *process* in Ken’s quotation, it indicates that the teacher asked students to accomplish the task with a similar approach as they would have done in an ordinary classroom. When considering sequence and pace, the teacher asked students to dedicate about 45 minutes for group discussion. Another teacher allocated an even longer sequence of about 70 minutes: *“I imagine that we will work with the task at least until the break and then we will take a look how far you have got”* (Aron, ALC #1). These two quotes indicate one long sequence before the teacher asked the students to report back. Such use of pace indicates weak framing and distribution of control from the teacher to the student: the students were given the responsibility of accomplishing the task before the time was up, and they could decide on how much time should be spent on each sequence. In the sixth classroom observation, with Aron, the approach was similar to that described above with group work and weak framing in both pace and sequence. During that lesson it was observed how the students struggled and did not make any progress, becoming more and more passive and destructive.

The seventh classroom observation, also a lesson conducted by Aron, demonstrated a stronger framing of pace and sequencing of the group work. The lesson was divided into three sequences and the teacher communicated how much time the students had for each sequence and what the students needed to accomplish in that time. At the beginning of the lesson Aron asked the students to appoint a team leader in each group and instructed them: *“You are team leader, you read through the instruction and explain to the group. You have 15 minutes for the first part and to set up and start using the technology [smartboard and laptop].”* This quote indicates stronger framing in both sequence and pace where it became explicit what students should do in this specific sequence and how much time they had before the sequence ended, which illustrates the teacher in control.

The next two classroom observations (#8 and #9), conducted by Aron and Ken, demonstrated a practice with characteristics that might be described as a mix of the above described first six and the seventh classroom observations, we noted situations of both stronger and weaker framing in sequence and pace.

During the last three classroom observations, the teachers made a joint effort to take pace and sequencing into explicit consideration when planning their lessons. They carried out one 80 minute lesson each, splitting the lessons into a greater number of sequences than they had done previously. For example, Aron and Joe split their lessons into 3-4 sequences lasting between 10-30 minutes, and Ken used a varied approach: first 4 sequences lasting 1-3 minutes, then one 30 minute sequence and thereafter a final 3 minute sequence. A typical start was to set up some rules, for example: *“Aron shares the task for the first sequence, on paper, with the students and says, you are allowed to use the projectors [and one student laptop each], you are allowed to look at what other groups are doing. You have 10 minutes for the first task and after that we will have a break and see what we have”* (Aron, classroom observation #12). This quote was a typical example of how these three lessons were introduced with a clear reference to how much time the sequence should take and what comes next. Such communication indicated strong framing in both sequence and pace, which illustrates how control was retained by the teacher. Ken used a variety of sequencing during the lesson, and used a timer for keeping pace and keeping up with the sequencing plan. When working with one-minute sequences, Ken said for example: *“Okay let’s start, speaker number one you have one minute.”* This quote indicates how the teacher’s focus was on controlling the activity and keeping order. In comparison to the use of one-minute sequences, Joe and Aron used 10 minutes sequences which created different conditions and frameworks for

the students. Maybe, it was a surprise for Joe, but 4 minutes into the planned 10 minutes sequence one group said: *“we’ve finished”*. Joe walked to the group, stopped and considered what they had written on the whiteboard and said: *“when you have the list of categories, what can you see in each of these categories?”* (Joe, classroom observation #10). As illustrated in the quotation and in comparison to Ken’s short sequences, a longer sequence can give the possibility for manoeuvring space where the teacher has the possibility of interacting with the students’ process, for example when Joe asked the students to develop their answers, and then communicated this change to all four groups. Again, Joe started to move around between the groups and seemed to study what progress they were making. After another 4 minutes, he said all the groups to *“Soon time will be up, one thing strikes me now when I see your list and what the list could be used for. Please, try to rank your categories in an order for what purpose you would use these things when you aim to understand a text”* (Joe, classroom observation #10). This quote indicates another intervention into students process by asking them gently to make a last effort before whole class discussion. After another 2 minutes Joe breaks and finalises the sequences. The quotes from Joe’s communication indicate the use of strong framing of sequence and pace, where it was the teacher who controlled the order in which things should be done, as well as how fast a task should be accomplished.

5. DISCUSSION

The aim of this study was to explore teaching in an active learning classroom (ALC) from the perspective of power and control, highlighting the organisation of the physical learning environment of the ALC and teacher practices within the ALC, and discussing what type of practices enhanced active learning. Considering the physical space of the ALC, the analysis of the four classification categories (desks, inside-outside the classroom, digital and material resources) indicated weak classification. The classroom design with round tables and student access to both digital and physical resources provided an environment suited to student-centred group work. Along with Bernstein (2000), we argue that the organisation of the physical space indicated a shift in power from teacher to student, and distribution of symbolic power to students.

Considering the teacher practices, the findings indicated that the design of the ALC supported student-centred activities and student discussion and analysis (cf. Bonwell & Eison, 1991). However, as students were more in control of the classroom activities, the outcome from teaching and learning was not obvious and the teachers became frustrated. The analysis further indicated that when control was taken back by teachers in terms of more strict control over pace and sequencing, the students’ productivity increased, something that other studies have also found (Bernard et al, 2019). Our understanding is that that the physical space built for student-centred group work (RQ1) "forced" the teachers in practice to work with pace and sequencing to handle control (RQ2), and that this in turn actually led to increased productivity and more active learning among the students – the students worked more intensively in groups with the tasks when the teacher had more active pace and sequencing control (RQ3).

6. CONCLUSION

In general, this study aimed to contribute an understanding of teaching in a context of the Active Learning Classroom (ALC) that put pressure on teachers to use this new learning environment, to use ICTs and to apply new pedagogies. This study is one of the first where teachers in upper secondary school recontextualised the ALC as both space and practice. This was accomplished, first, by entering a physical classroom space designed for group work and which signalled a shift in power from teacher to student, and secondly, through a shift in teaching practice that involved teachers’ work on control over sequence and pace. The findings from this study can be used to help teachers design active learning by using the categories as design elements in planning.

This study contains some methodological limitations based on the research project’s characteristic of being both a research and a development project. This made us as researchers be involved to some extent in the teachers’ process. Another limitation concerns the unequal amount of classroom observation between the teachers, based on their personal feel, and comfort, of throwing themselves into the ALC. Another limitation concerns the wide spread between academic and vocational programmes at the outset, and towards the last classroom observations only focusing on one programme. A stronger focus on, for example, solely the technology programme might possibly provide other types of findings.

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REPORTING AN EXPERIMENT LIVE-STREAMING CLASSES IN A DISTANCE LEARNING COURSE

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ABSTRACT

This paper aims to identify limitations and opportunities for using live streaming for distance learning classes in a course offered at a Brazilian public university. The number of videos on social networks in different fields and about various topics increases each year. Real-time classes are also increasingly being used in distance learning courses. Live streaming through YouTube enables an interactive experience because it allows for images, videos, music, and screenshots to be used during the broadcast. This enhances the experience and interaction between the spectator and presenter and enables real-time discussions. A distance learning course was offered in the first semester of 2019 (between May and July) to foster discussions about pedagogical architectures for the construction of digital competences in Distance Learning (DL). During the course, six classes were live-streamed and broadcast via YouTube. There was one class per week, lasting an average of 40 minutes each and covering distinct topics. This is a qualitative case study with 14 subjects between the ages of 35 and 64. They were primarily female and mainly their mobile devices to watch the classes. Different types of data collection instruments were applied including an online questionnaire and YouTube video platform metrics. The students reported that the classes were essential for interaction and helped to answer their questions due to real-time feedback, which qualifies the teaching and learning processes. The metrics from the YouTube platform revealed that the videos were watched mainly in Brazil and the United States, with over 1,500 views so far, 10% of which had live interactions through chat. This example shows both the range and engagement of students with the live streamed classes as well as the possibilities for interaction. Therefore, live-streamed classes are important for DL courses and should be integrated in planning in order to contribute to the distance learning process.

KEYWORDS

YouTube, Live Streaming Classes, Distance Learning

1. INTRODUCTION

Digital technologies are increasingly becoming a part of people's daily lives, primarily with online videos. Video channels are also growing in popularity on the Internet. This has even prompted the emergence of a new profession, YouTubers, who run these channels and market products.

Today the most diverse videos are available, ranging from full-length series and films to video lessons on how to use products, Do It Yourself projects, and much more complex content including academic studies, mathematical formulas, tutorials, etc. This reality extends to virtual classes, where teachers are using this resource to get closer to their target audience by interacting with them through live videos called live streaming. Therefore, this type of resource should also be included in educational processes, allowing for even more content to be covered and available online.

Live streaming, which can be performed through YouTube, enables an interactive experience because it allows images, videos, music, screenshots, and other features to be included during transmission. The goal is to improve the interactive experience between the spectator and presenter, fostering discussions about the topic at hand.

Hence, during the first semester of 2019, a distance learning course was offered with the objective of fostering discussions about the planning of pedagogical architectures for the construction of digital competences in DL. Approximately 350 people registered for the 30 available spaces and the course concluded with 14 students. The class took place from May to July 2019, consisting of six live classes. The video classes made available on the YouTube platform were an alternative so that students who could not take the course

could also learn about the subject. Thus, in addition to conducting live classes via video streaming on the YouTube channel, they were also made available for later viewing.

This paper aims to describe the experience of this class as a whole, as well as to present the limitations and opportunities of using live streamed video lessons in a distance learning course at a public university in Brazil.

This study is divided into 5 sections. The first is the introduction, the second the theoretical framework, the third presents the methodology, and the fourth data analysis. Finally, the fifth section presents the conclusions.

2. LIVE STREAMING VIDEO: A NEW APPROACH TO DISTANCE LEARNING

Using videos for distance learning is not necessarily novel. Simultaneous transmission of video and audio has occurred since the first generations of DL, allowing content and information to reach the most remote locations and the largest amount of interlocutors.

The earliest forms of video transmission for DL, known as teleclasses or video lessons, were transmitted via television signal. This is considered an important phase in distance learning in Brazil, since people's access to new media such as television significantly expanded and replaced the use of radio in DL. However, interaction between participants was almost nonexistent using this format, because there were only transmitters and receivers (ALVES, 2009).

Subsequently, videoconferencing made visual and audio contact possible among people who were geographically distant. Through satellite lines and the use of cameras, microphones, videos, transmitters, electronic whiteboards and different software, interactions became increasingly possible. Yet they remained restricted to a small number of people who had these tools or through physical presence in a distance learning center (MACHADO, MORAES, 2015).

Currently, there are many opportunities for interaction using new and varied technologies, which allow for the expansion and diversification of strategies. They also enable almost face-to-face interaction between teachers and students, as in the case of tools such as YouTube, that were unimaginable until recently. Through an extremely popular platform, which is used by nearly two billion users worldwide, it has become possible for any platform user to participate in an extension course or a video class. This has increased interaction and virtual presence. According to Coelho and Bottentuit Junior (2019), using YouTube as a teaching tool allows classes to be held in a language that is closer to the students' reality, making the process of assimilation occur in a lighter and more relaxed way. Likewise, it enables greater participation from viewers, since it is a tool that is part of people's daily lives.

Dotta et al. (2018, p. 608) notes that “one of the challenges faced by teachers in DL is to develop effective strategies for conducting dialogue and engaging students in the learning processes.” In addition to these challenges, the level of technical fluency also often makes it difficult for students to participate in a course, contributing to their low participation and even leaving the class. However, according to the authors, conducting classes through YouTube favors feelings of empathy and encourages participation, through screen sharing, interaction through image, voice and text, organization of groups, and collaborative activities.

It should be noted that this tool can be used through Internet browsers or applications installed on smartphones or tablets. It is accessible and free, not requiring subscriptions and registrations. Dotta et al. (2018, p. 4), however, warn that classes held in this format should be carried out by a multidisciplinary team, “whose roles are divided so as not to damage the conduct of the class, ensuring the maintenance of interaction between teacher and students and the invisibility of the technical apparatus.” Thus, even with the ease enabled by today's tools, the team promoting the class must have the technical and pedagogical knowledge to make the best use of the current possibilities. Therefore, this experiment was carried out with the intention of engaging, reaching out and interacting with the students in the course through an entirely distance learning extension course. The methodology of the research is presented below.

3. METHODOLOGY

A qualitative case study approach was used for this study. Fourteen students who completed an extension course offered at a Brazilian public university on the subject of digital competences in education participated in the research. The following instruments were used for data collection:

- An online questionnaire composed of 21 objective and short answer questions, aimed to inquire about the pedagogical strategies used in the live streamed classes.
- YouTube video platform metrics: Comments were used, as well as likes, and views on the videos on the YouTube channel.

The study was developed in three steps, as described below.

STEP 1 - Theoretical Framework

Here a survey was conducted of studies that referred the use of live streamed classes as a pedagogical strategy in virtual classes.

STEP 2 - Extension Course

The course was planned and offered with the objective of enabling discussions on how to map and build digital competences in distance learning and was held between May and July 2019 for a total of 60 hours. It was organized in a virtual learning environment, offering weekly content, activities and guidelines for the live streamed lessons. Six classes were held once a week covering the following subjects involving distance learning: digital competences, pedagogical architectures, student profile, technological tools, pedagogical strategies, and evaluation. The classes were taught by a total of eleven graduate students and collaborators (Post doctoral) from the university. All of these individuals had a background in education and the use of digital technologies in the DL context. The classes were disseminated through the social networks of the university nucleus, with the support of the university's Department of Distance Learning (SEAD).

In synchronous meetings the students, as well as other participants, could follow the class in real time and ask questions that were answered directly by the teachers, either orally or in writing, through the comments posted on the channel. The university made a studio available for the transmission of classes along with help from a technical team, using the Open Broadcaster Software (OBS Studio) tool for the streaming. The streaming option was chosen for its interactive possibilities, such as the insertion of images, videos, and live screen sharing that the YouTube Live option alone does not offer.

Textual information was gathered during these classes and questionnaires were also distributed which highlighted the weaknesses and opportunities of this type of strategy for DL.

STEP 3 - Data Analysis and Data Disclosure

This step was intended to gather and analyze the data collected in the previous step. Moraes' (1999) of content analysis technique was also used. The data analysis is presented below.

4. ANALYSIS OF RESULTS AND DISCUSSION

The class consisted of 14 students between the ages of 35 and 64. They were mostly female (n = 10) and mainly used mobile devices and personal computers to watch the live streamed classes on the YouTube channel. The profile identified was heterogeneous, as the participants had different backgrounds, but had all completed some graduate studies (they either had a specialization, certificate, or Master's degree).

To analyze the potential and limitations of using live streamed video lectures, it was necessary to separate the short answer and objective responses into categories: Organization, YouTube Live Classes, and channel metrics.

In the category of organization, students pointed out that the planning was adequate and consistent with the proposed objectives. One student stated, "the guidance given to the students was sufficient and everyone could understand the purpose of the activities and do them" (A6). Yet some participants suggested one platform instead of two, being that both a virtual learning environment and the YouTube channel were used.

Comments from students A9 and A3 reveal some general difficulties. "It is important that the entire course be presented on just one platform, so that the student would not have much difficulty finding what they wanted. When I wanted to access the page to watch the video lessons on Monday at 10am there was no time. I was in a rush to find out where everything was, as I often didn't remember where to find the right page" (A9). Another student, A3, agreed, "I believe there could have been a single page/place/environment with all the information. It was all very separate, with many pages." It is therefore important, when using a live video channel on YouTube, to clearly flag only this type of communication so that there is no confusion regarding environments and tools. In addition, using YouTube requires a computer or mobile device (smartphone) with an Internet connection that enables audio and image.

Students also signaled the need to make classes available at more diverse times, as many worked at the time of the live video streaming. One student pointed out, "I suggest that live classes be made available at more than one time" (A1).

The live streamed classes on YouTube were considered pertinent and necessary. The students indicated that they were also satisfied with the type of methodology used. According to student A4, "I believe classes on YouTube were essential during the course." It was also highlighted that this type of approach enables greater interaction between the teacher and student in distance learning because it is possible to establish synchronous social exchanges through the comments that make it possible to answer the questions that may arise at the time from the issues being addressed. As student A12 stated, "the greatest integration I believe was with the videos, they are the ones that brought us closer."

Moreover, the students pointed to the possibility of enriching knowledge through the live classes. Some students (n = 5) stated that the use of the YouTube channel helped in their understanding the course content. "YouTube lessons, resources, and readings were sufficient for understanding the content" (A7). Also, A9 commented that "the video feeds on YouTube were very well presented." And A11 agreed, "I enjoyed and used the weekly video lessons the most. They met the needs I had regarding the subject the best."

The videos were considered innovative, because the interactive classes made it possible to discuss with teachers and guests from the field. This enabled new possibilities and rereading's on the subject. Student A10 and 12 agreed, both stating "the videos innovated a lot!"

Moreover, the metrics available from the YouTube channel platform revealed that the videos were watched mostly in Brazil and the United States. There have been over 1,500 views so far, of which 10% included live interactions through chat. The three main sources for external traffic were Facebook, the University Website, and WhatsApp, as shown in Figure 1:

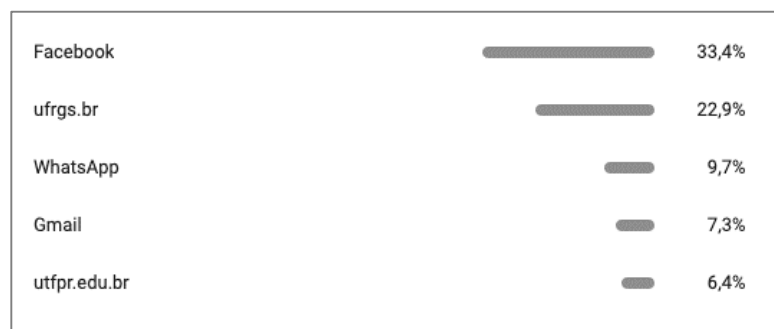


Figure 1. Traffic Source: External
Source: YouTube (2019)

YouTube metrics found that the traffic was primarily from Pedagogical Architectures in Distance Learning, Student of Distance Learning, Pedagogical Strategies, Technological Tools in DL and Digital Competences Class, as shown in Figure 2.

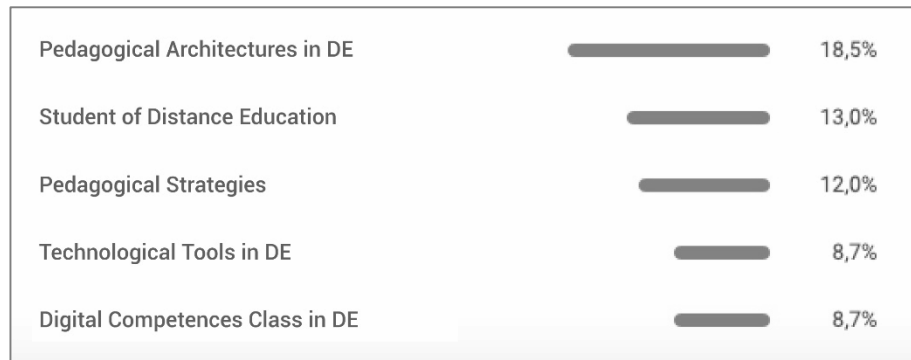


Figure 2. Traffic Source: Suggested Videos
Source: YouTube (2019)

The origin of traffic from Facebook has to do with how live classes are shared on the research center’s page that organized the course using social networks and links that were sent via WhatsApp and shared through social networks. In addition, video sharing was mainly done through WhatsApp and Facebook. The most accessed videos, as shown in Figure 3, were the first two about Digital Competences and Pedagogical Architectures in DL.

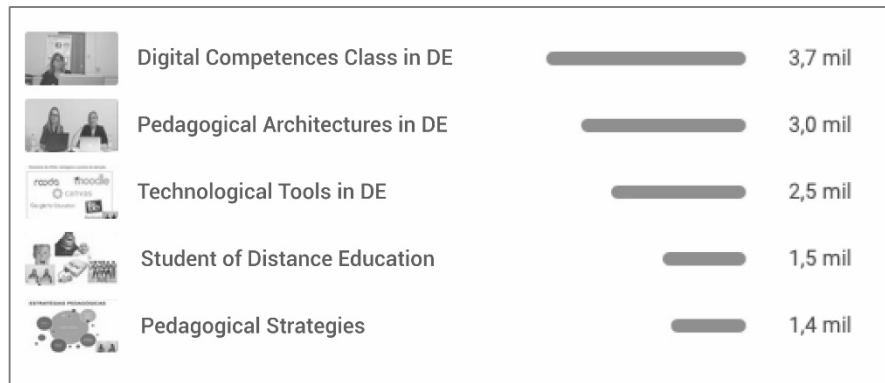


Figure 3. Most accessed videos
Source: YouTube (2019)

Impressions and how they influence watch time, as shown in Figure 4, are related to the most viewed videos and also depend on video watch time, clicks, average view length, and impressions at viewing time.

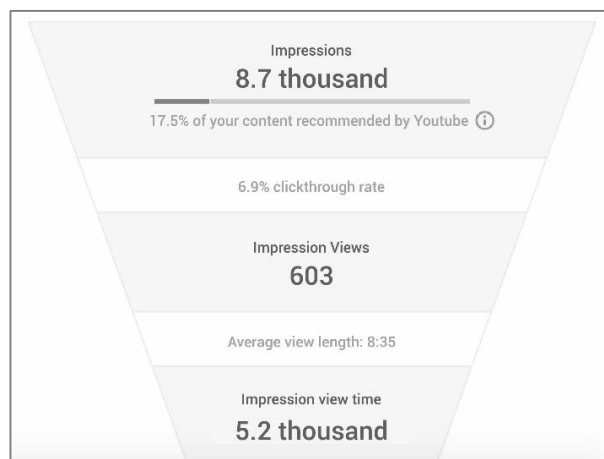


Figure 4. Impressions
Source: YouTube (2019)

As for the display time in minutes, which can be seen in Figure 5, there was a total of 14,300 minutes with an average view length of 8 minutes. The figure shows that the peak of views is mainly related to when the videos were live streamed, that is, when the classes took place there were higher numbers of views, which continued through the week until the next video class.

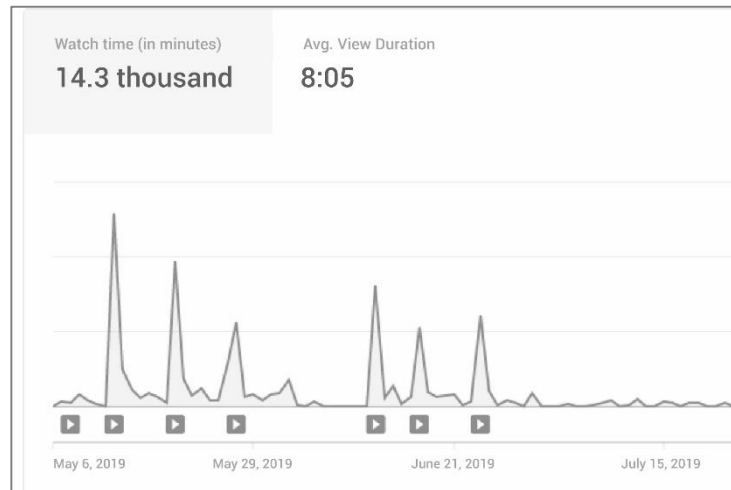


Figure 5. Video display time in minutes
Source: YouTube (2019)

There has been an increase in subscriptions on the YouTube channel and likes on the Facebook page since this research was conducted. Thus, based on the analysis, it is possible to consider the participation of students through smartphones or tablets as an opportunity. It is also possible to interact with teachers and ask them questions to better understand the content that has already been covered in the course. Finally, when recorded and made available through the YouTube channel, students are able to review classes as needed.

When it comes to the limitations, many students did not participate in the classes due to the time they occurred, always on Monday mornings. The course also focused on two platforms, YouTube and the virtual environment. This was satisfactory but students still had difficulties. The use of different resources generated an excess of information, making it difficult for them to organize. Thus, when thinking about conducting live streamed classes, the teacher needs to provide students with a balance between the student profile and the tools defined for the course.

5. FINAL CONSIDERATIONS

As DL becomes a more frequent choice, new strategies and resources focusing on interaction should be enhanced, increasingly becoming the primary option for continuing education for many people. The use of live streamed classes on YouTube was the recommended option for this experiment conducted in a fully distance extension course. This article presented the experiment and identified the primary limitations and opportunities found when using live streamed video lessons in a distance learning course offered at a public university in Brazil. Clearly this strategy is pertinent for virtual classes because it can be used for a larger number of people and also allows for more opportunities for synchronous interaction with students and participants in general.

The study found an increase in users in the social networks of the research group and, through the analysis of metrics available by the YouTube platform, the videos were watched mainly in Brazil and the United States. There have been over 1,500 views so far, of which 10% had live chat interactions.

The video lessons are still available and can be viewed by the general public, thus constituting material for other students and teachers interested in the subject. In addition to the results presented by the platform, the students in the course stated that the classes were essential for interaction and answered their questions through real-time feedback, which qualifies the teaching and learning processes. Based on the data, adjustments will be made to the proposal of live streaming classes and, in 2019/2, a new course will be offered, seeking to

broaden the discussion about the subject and the use of the YouTube platform. This is as an important support tool for the teaching and learning process, especially in distance learning courses. Finally, it is noteworthy that DL has shown concrete results in breaking down the barriers of non-physical presence, by increasingly taking advantage of the potential of technologies. At the same time, it is essential for teachers to understand the importance of training to investigate and share solutions using different and emerging technologies.

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CHANGING EDUCATIONAL POLICIES: IMPLICATIONS FOR ICT INTEGRATION IN SCIENCE INSTRUCTION AND PERFORMANCE OF STUDENTS IN GHANAIAN SENIOR HIGH SCHOOLS

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ABSTRACT

Every country's educational policy directs the implementation and success or otherwise of education outcomes. This study analysed some educational policies of the Ministry of Education of Ghana to determine the current state of use of Information and Communication Technologies (ICTs) in science instruction in senior high schools and its implications for students' learning outcomes. Most of the policies aimed at promoting functional learning through use of ICTs. However, the various senior high school science syllabuses are not explicit on the use of ICTs such as computer, mobile technologies, print, audio-visual, radio and TV broadcasts as some of the means of integrating ICTs in teaching and learning. It was found that local stakeholders' engagement in developing the various curricula is minimal as policy documents were developed by Non-Governmental Organisations (NGOs) with occasional involvement of few personnel from the Ministry. Despite the many policy directions and training workshops given to teachers, use of ICTs in instruction has remained at the policy stages with little or no ICTs integration into school science teaching. Also ICTs integration in science teaching at the senior high school levels has been constrained by uncoordinated and a flurry of policy implementation procedures and directions given by donor agents. Students' performance in science examinations has not yielded the expected learning outcomes. It is recommended that education should be democratised to engage local practitioners of education rather than the many donor agencies seeking to correct the shortcomings of science teaching and learning.

KEYWORDS

ICTs Integration, Educational Policy, Learning Outcomes, Science Examinations, Donor Agencies

1. INTRODUCTION

In integrating Information and Communication Technologies (ICTs) in science instruction teachers, students and education authorities are the major stakeholders. Teachers' knowledge of the new technologies and pedagogical strategies for integration of ICTs need to be developed, while education authorities ready themselves with appropriate text books and syllabuses for professional development workshops. The concept of use of ICTs in instruction has not functionally gained grounds in Ghana despite a number of policies that have been promulgated and implemented through professional development workshops for teachers. This paper analysed some policy documents whose main thrust was on ICTs integration into teaching and learning of, especially science at the senior high school level. Also the science curricula syllabuses were studied to determine the extent to which the use of ICTs integration in instruction has been recommended in them. The paper then closely connected the senior high school leaving certificate examination results in science to the inability of science teachers to use ICTs in instruction.

2. EDUCATIONAL RIGHTS OF INDIVIDUALS

The 1992 Constitution of Ghana of the Republic of Ghana (Amendment) Act, 1996 under Educational Rights, Article 25, section 1, subsections (b) and (e) is enshrined with the rights of every child to secondary (senior high) school education. It explicitly states that "25. (1) All persons shall have the right to equal educational

opportunities and facilities and with a view to achieving the full realisation of that right; (b) secondary education in its different forms including technical and vocational education, shall be made generally available and accessible to all by every appropriate means, and in particular, by the progressive introduction of free education; (e) the development of a system of schools with adequate facilities at all levels shall be actively pursued” (Constitution of Republic of Ghana, 1992, pp. 24 - 30). Due to the rights of individuals enshrined in the Constitution a number of education policy documents have been developed to cater for the educational needs of all persons in Ghana.

3. EDUCATION POLICY DOCUMENTS

There has been a number of education policy documents developed and each one was expected to be a review and improvement on the previous ones. In 1987, a World Bank funded educational reform was initiated by the military-political regime of the Provisional National Defence Council (PNDC). The reforms aimed at restructuring the educational system, revising the curriculum to ingrain skills needed for school leavers and also review education financing (Little, 2010). However the hurried manner in which the reforms were implemented made some school authorities and some social groupings feel left out and hence opposed the reforms (Little, 2010). Some stakeholders felt that the reforms should have been piloted so that implementation difficulties would be detected and rectified before a wholesale implementation country-wide. This was not to be the case.

Tuition-free basic and secondary education is enshrined in the National Education Reform Report 2007 based on the 1992 Constitution of Ghana. The Report prescribed free access to education for a large number of school-going children. The current age structure of the Ghanaian population estimates that out of the 30.3 million people about 10.2 million (36.5 %) are children below the age of 15 years (Ghana Population, 2019). In response to increased access to senior high school education the total intake of students throughout the country increased from 274,255 in 2016 to 316,980 in 2018 (WAEC, 2018). This represents an increase of 15.6 % over a three-year period. In the 2018/2019 academic year there was double intake into the senior high schools countrywide with 472,000 students, representing 31 % increase in intake (Graphic, 2018). The population explosion in the SHS led to the introduction of a shift system dubbed the ‘Green and Gold’ tracks for two batches of students, due to an immense infrastructural deficit that resulted. The Green and Gold track students alternate, while one group is on holidays the other is in school. The increase in numbers had dire consequences for science teaching as the science laboratories could not be modernised due to lack of ICT equipment.

The 2007 Report as well recommended provision of computer laboratories, internet and network connectivity to schools, supply of laptops to teachers and students and teachers’ capacity development. As part of the process of equipping secondary (senior high) schools with modern state-of-the-art teaching and learning materials a number of policies were put in place by the Ghana Government. Some of the policies that expressed government’s commitment to achieving ICT in education, were: (1) The Ghana ICT for Accelerated Development (ICT4AD) Policy in 2001, (2) Information and Communications Technology in Education: A Policy Framework (2002), (3) The Education Strategic Plan (2003), (4) The Ghana e-Schools Initiative High Level Business Plan (August, 2003), (5) The ICT in Education Policy (2015) and (6) Education Strategic Plan (2018 – 2030). Each of the documents prescribed the use of ICT in Education. The main thrust of ICT in education was anchored on three main pillars which were “(i) ICT as learning and operating tool, (ii) ICT as integrated into the teaching and learning and, (iii) ICT as a career option for students” (Ministry of Education, 2015, p. 3).

The more recent Education Strategic Plan (ESP) (2018 - 2030) comprising strategic goals based on three key guiding principles was developed with one of the principles as “improved quality of teaching and learning and science, technology, engineering and mathematics (STEM) at all levels” (MoE, 2017, p. 15). Efforts at improving learning outcomes were to include “improving the skills and motivation of teachers, providing a more relevant curriculum (supported with TLMs), developing skills such as information and communication technologies (ICT)” (MoE, 2017, p. 15). The document also noted among the main problems to address over the period (Table 3.2.1, under section SE 2.1) p. 36 as: “Poor internet connection facilities in the senior high schools, Inadequacy of computers and inadequate integration of ICT in teaching and learning at SHS”. The strategies proposed to solve the problems were “SE 2.1.1: Invest in TLMs and equipment in SHS”. However, efforts at equipping senior high schools with ICTs and introducing STEM teaching in science are still at their initial stages.

4. FUNDING OF POLICY DOCUMENTS

The development of educational policies has been funded by a number donor organisations or development partners, as they are currently termed, who bring their experts from abroad. The ESP (2018 – 2030) document was funded by the Global Partnership for Education (GPE), and the UK Department for International Development (DFID) acted as the grant agent for the GPE grant, and the United States Agency for International Development (USAID) acted as the coordinating agency.

Since 1997 approximately US \$400 million has been loaned or granted to the Education Sector in Ghana. There was an ODA (now DFID) grant of US \$8 million equivalent for Adult Literacy and teacher education; KfW and GTZ gave US \$20 million equivalent for up-grading of 35 teacher training colleges; Switzerland supported senior secondary school science equipment supply; Saudi Fund for supporting secondary school development; GTZ fund for supporting vocational school development; and Japan International Cooperation Agency (JICA) fund for supporting science, mathematics and girls education in senior high schools.

5. POLICY IMPLEMENTATION STRATEGIES RECOMMENDED

The Ministry of Education has indicated that equity, access and quality were their priorities in deploying ICTs in Education. Thus, a number of workshop were organised across the length and breadth of the country to raise the capacity of stakeholders, particularly teachers. In 2001 training workshops in ICTs use in teaching and learning were organised nationwide for teachers. Other workshops to discuss policies and their implementation strategies were the ‘Ghana e-Schools Initiative High Level Business Plan’ organised in August, 2003, the drafting of ‘The 2015 ICT Policy’ document which spanned the period 2009 to 2015.

The teaching syllabuses developed for teaching the various science subjects at the senior high schools were reviewed a number of times with the latest being the 2010 versions. The aim was to incorporate the 21st century skills expected to be acquired by science students on completion of their programmes at the senior high school level. However, the teaching syllabuses for senior high school elective science subjects such as physics, biology and chemistry are not explicit on the use of ICTs in teaching and learning. The only mention of ICT is in the Chemistry syllabus. For example, items (ix) under General Aims which states that “develop the ability to communicate ideas, plans, procedures, results and conclusions of investigations orally, in writing and/or in electronic presentations” (MoE, 2010, p. ii) and under Pre-requisite Skills items (ii) and (xii) which state that “(ii) use scientific calculators; and “(xiii) use of the internet and search engines” (MoE, 2010, p. iii). The elective physics and biology syllabuses have no mention at all of ICT incorporation into teaching and learning of science.

6. EXPECTATIONS OF THE MINISTRY OF EDUCATION

It was the expectation of the Ministry of Education that with the incorporation of ICTs into education, teachers and students would develop new ways of accessing and analysing information. In a re-affirmation of government’s intention to ensure that ICTs made impact on teaching and learning, the then Minister of Education stated “It is the government’s desire that through the deployment of ICT in Education, the culture and practice of traditional memory-based learning will be transformed to education that stimulates thinking and creativity necessary to meet the challenges of the 21st century” (Ministry of Education, 2005, p. 9). More than a decade since this intention of the Government of Ghana was made known, the teachers in the senior high schools are bereft of the knowledge of ICT integration into teaching and learning and hence science is taught without ICT integration. A number of teachers have undergone training but the nature, depth and relevance of such training for teaching and learning of science at the senior high school level remains questionable.

The expectations of excellent academic performance in the science subjects due to the deployment of the ICTs in instruction appear far from being achieved. The pass rate results for three consecutive years in the West African Senior School Certificate Examination (WASSCE) taken by senior high school students have been displayed in Table 1. Here, the pass rates are grades A1 to C6, which would qualify students to enter universities or equivalent tertiary institutions to pursue degree programmes.

Table 1. A three-year trend in pass rates in WASSCE at grades A1 - C6

Elective Science Subjects	2016	2017	2018
Biology	58.26 %	61.94 %	47.48 %
Chemistry	62.95 %	65.17 %	47.50 %
Physics	62.00 %	53.62 %	62.20 %

Source: WAEC Report on trends in statistics, 2018

From Table 1, it is observed that less than half of the population of students that took the examination in biology and chemistry in 2018 met the university entry requirement. Also for the three-year period less than two-thirds of the science students who took the examination met the university entry requirements. It is, however, the expectation of the Ministry of Education that not less than 85 % of senior high school students would enter universities and other tertiary institutions (MoE, 2018).

7. KEY ACHIEVEMENTS OF SOME POLICIES

As at 2015 there were 300 Science Resource Centres (SRCs) that had been built across the country (Dapatem, 2015). These Centres and a National Information Communication Technology (ICT) Centre set up in Accra were to serve as capacity building centres to facilitate and make the study and teaching of science in schools more ICT-oriented. The National ICT Centre was to coordinate activities with the Science Resource Centres, which were located in selected schools to serve a cluster of schools in the districts. The Japanese International Cooperation Agency (JICA) provided a grant for the completion of the SRC project whilst Phillip Harris of UK financed the construction of the buildings to house the centres. The main reasons for building the SRCs were due to lack of science equipment and the defective teaching of science at the senior high school level, as government was unable to supply science equipment to all schools (GNA, 2004).



Figure 1. (a) Typical scene in SRC



Figure 1. (b) Aftermath of the SRCs

Figure 1 (a) depicts a scene in a Science Resource Centre where senior high school students are seen at a science practical session. These students have to share the few thermometers available at the resource centre. Only the determined and aggressive students lead the practical sessions throughout while others look on. Such situations do not allow for students to have hands-on practice that the ICT policies have envisaged. As the pieces of equipment are not sufficient to go round the entire class, teachers' imagination and initiatives are overtaken.

The use of the SRCs by the satellite schools really did not last as their operations were fraught with myriads of problems. The Ministry of Education supplied buses to transport students from satellite schools to the centres but problems of fuelling of the buses could not be surmounted as schools hardly had funds to honour such obligations. Further, the distances to the centres were so long that a day's visit to a centre disrupted the school time-table for the class concerned for the day. It should be noted that the curriculum in Ghana is examination driven so teachers would not compromise completion of their subject syllabuses for a day-long laboratory practical activities. The resultant effect of the problems associated with travelling to the SRCs is depicted in Figure 1 (b) where students are taken through science practical activities while glued to their desks.

Since 2012 the Government of Ghana has made efforts at decongesting classrooms to reduce the students to teacher ratio which, stood at "46: 1 as in the 2015 - 2016 academic year" (MoE, 2017, p. 7). In 2012 the Government planned to build 200 community-day senior high schools to bring education closer to the rural communities and also to decongest the classrooms and to improve teaching and learning. The shape of the

school blocks that were built was in the form of letter E and hence they were christened as E-Block Schools (Figure 2). As at the beginning of 2019 less than half of the 200 E-block schools had been completed with most of them not occupied due to change in government and subsequent change in policy.



Figure 2. An E-Block senior high school building in Ghana

In 2018 the government decided on admitting the large numbers of students who qualified for entry into senior high schools from the junior high schools. This led to what has been described as ‘double intake’ and the students were divided into two groups – the ‘Green’ and ‘Gold’ tracks. One track was to spend four months in school while the other track remains at home for a changeover to be made at the end of the four months. In effect there was a two-semester term for each of the tracks. This step was taken to overcome the deficit in accommodations for classrooms, dining halls, dormitories and laboratories.

8. MAJOR CHALLENGES

The UNESCO Report (2015) which is contained in Information Paper No. 25, compared the e-readiness of Sub-Saharan African countries to integrate ICT into Education. The report indicated that evolving ICT landscape showcased a number of new technologies that the education sector policymakers widely accepted could help enhance learning and provide students with new sets of skills for them to function globally. However, the proliferation of computer hardware and software made it difficult for education authorities to decipher the appropriate and relevant ICTs to select and recommend. Similarly, it was difficult for users of ICT, such as teachers and learners, to decide on which types of ICTs to learn and use in the teaching and learning of science. There were challenges of implementation such as erratic power supply, inadequate maintenance of ICT staff, unsafe environment, infrastructural deficit and technical support (UNESCO Report, 2015). Ghana is no exception to the challenges unearthed by UNESCO.

Other challenges faced in implementation of educational policies were over-reliance on donor support to implement a number of educational projects. From 1989 to 1993 the Education Reform Programme was supported by the donor agencies: IDA, USAID, DFID, UNICEF, CIDA, EU (grants), and AGDB (loans). The multiplicity of donor agencies made the efforts of the donor agencies appear not coordinated. However, donor assistance was beneficial as it created a strategic demand for the review of educational policy documents (Mettle-Nunoo and Hilditch, 2000). It appeared, however, that the different agencies had different aims. The failure of the foreign agencies to liaise with each other and with the Ministry of Education and the Ghana Education Service (GES) led to the deployment of the ICT integration in education in only some selected schools and hence majority of schools were left out. Subsequently a number of the projects did not live beyond the implementation periods. This was due to the fact that most of the projects did not incorporate local counterpart funding aspects or if such arrangements existed they were not sustainable for a relatively poor government.

Though a number of teachers were trained to superintend the Science Resource Centres, the numbers were inadequate and even for the trained personnel there was a lack of incentives such as well-spelt out conditions of service and their future prospects. Some trained resource personnel at the SRCs found the work at the Centres more tasking than what existed at the mainstream senior high schools and hence sought transfers to the classrooms.

A number of the school curricula, which were revised to accommodate integration of ICT only mentioned that ICT should be used to teach but the procedure for integration was not incorporated into the curricula. This left teachers stranded as to how to implement the integration. The nature of the science syllabuses gave no directions to teachers as to how to implement ICT integration in their teaching. Despite the effort by the Ministry of Education to continuously review the science syllabuses with the aim of incorporating more of the soft skills of the 21st century not much has been achieved in that direction.

The implementation of the 'double track' system was met with a lot of opposition from civil organisations. For example, the teachers unions and concerned group like Ghana National Education Campaign Coalition (GNECC) called on government to suspend the wholesale roll-out of the double track. The reasons given were that communications concerning the roll-out were replete with inconsistencies and also the plan had not been piloted. Government's insistence on implementing the double track led to friction between government and school authorities with some of the latter being dismissed, suspended or transferred.

The lack of research on ICT integration did not augur well for ICT literacy and use among senior high school science teachers. The UNESCO Institute for Statistics (UIS) 2015 report, which monitored ICT integration in education for countries in Sub-Saharan Africa, did not have data on Ghana. This certainly is an indictment on Ghana's failed attempts at bringing into reality her numerous educational policies concerning integration of ICTs in science teaching and learning in the senior high schools.

9. CONCLUSION

The involvement of donor agencies in education led to the reformulation of a number of education policies in the country. For example, the new ICT policy document developed in 2015 and titled 'ICT Integration into Science Instruction' and the review of the senior high school science syllabuses were done with the aim of incorporating ICT skills acquisition. However, the apparent lack of coordination among the various teams led to early demise of a number of the education projects embarked on. In particular the SRCs quickly collapsed as supervision plans and sustenance measures were lacking. There was a lack of maintenance culture in the various laboratories and SRCs in terms of storage, repairs and refurbishment of science equipment. Staff trained in ICTs use did not remain at the SRCs due to low morale and poor conditions of service. The many workshops organised on ICTs integration in science instruction for some teachers did not yield good results as most of the schools lacked basic infrastructure such as electricity supply, internet connectivity and availability of computers. The opposition mounted against the implementation of a number of the educational policies and the lack of infrastructure to support the large number of admissions made some of the policies not workable. The integration of ICT into science instruction in the senior high schools has not made the desired impact as examination results in science have remained poor and teachers' skills in use of the ICTs have remained in doubt. Thus, policy intentions may not necessarily translate into their realisation. This study, therefore, recommends coordinated efforts by all groups attempting to charter the cause of integration of ICTs into science instruction in senior high schools in Ghana. Also government should be seen to be on top of educational policies and reduce its over-dependence on donor agencies whose activities have been seen as un-coordinated.

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ERRORS IN THE STUDY OF THE VARIATIONAL BEHAVIOR OF FUNCTIONS IN THE UNIVERSITY ENGINEERING STUDENTS

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ABSTRACT

The study of the variational behavior of functions constitutes an important element in the understanding of the change of phenomena in real life. His understanding is an essential axis in the mathematical training of university students, especially those who pursue engineering careers. This article presents the results of a study whose objective was to determine the mistakes made by engineering students about the variational behavior of functions. The Duval Semiotics Records Theory was taken as a reference and a questionnaire was prepared with questions about identification of regions of variability for “x” and “y”; regions of growth, decrease, stability, extreme values and, analysis and description of the behavior of the function. The evaluation of the answers was done in a quantitative-qualitative way, from an exploratory and descriptive perspective, with 100 students participating in the civil engineering career. The results indicate that students do not make a real reflection on the variational behavior in intervals of the variables or in a global way. They have difficulty discriminating between the behavior of the function and the location of the function. They present cognitive difficulties that do not allow them to make an adequate conversion from one register to the other. Errors related to mathematical language were found, to the limitations to obtain spatial information, to establish erroneous inferences and to the inadequate development of previous knowledge, which does not allow them to properly evaluate the variational behavior of the functions.

KEYWORDS

Errors, Functions, Variational Behavior

1. INTRODUCTION

Within the development of advanced mathematical thinking, the traditional teaching model has not been effective and focuses its actions on the understanding of algorithms for mechanical resolution of certain type exercises, generating difficulties in the adequate understanding of concepts and methods of thinking that are the center of this mathematic field (Artigue, 1995). Students can calculate, limite, derive or integrate without being able to assign a broader meaning to the notions involved in their understanding. (Cantoral, 2013).

Our experience working with university students, reflect the previous statements. Students prefer to act mechanically, restricting their work to the application of known formulas to find immediate results and to the algorithmic management of the variables that are part of a mathematical model, without questioning the type of dependence that exists between them and without really analyze the behavior of these variables. For the analysis of the variational behavior of the variables, the concept of function plays an important role, so the mistakes that are made in the study of this concept constitute an important input to propose teaching strategies that guarantee their adequate learning within a context of variation and change.

However, the learning of this object was limited as a result of the various forms of presentation it has and the way it is approached within the classroom. This multiplicity of representations, as well as the different conceptions that this concept has, make it one of the most difficult to understand, which is strengthened when

algorithmization and analytical methods are prioritized in the classroom, rather than the development of mathematician thinking skills (Farfan, 1992). Due to their own nature and their definition, functions are characterized because they serve to generate models to explain phenomena of reality, which are susceptible to change in different ways, consequently, understanding their behavior implies understanding how they change and how they are quantified these changes, which forces to change the discourse within the classroom and focus its teaching on procedures that give priority to variation and change. Therefore, within the Calculation courses, the analysis of the variation should be considered as the guiding axis of its development so that the mathematical objects that are addressed there serve to quantify, describe and predict the speed of the variation in phenomena of nature (Dolores, 2007). In this sense, the management of various graphic and algebraic resources that involve the concept of function, represent important indicators to evaluate their variation and the behavior of this variation.

Consequently, the development of skills related to variational thinking requires conceptual ruptures and changes in previous knowledge that the student possesses, which will generate the presence of obstacles and errors as a result of cognitive conflicts that will occur in reading and interpretation. of the behavior of the functions in their different representations (Dolores, 2004).

The error is considered today, as an indisputable component and present in the learning process. Therefore, it is necessary to carry out diagnoses in order to treat and discuss students' misconceptions and thus create learning spaces that allow them to readjust their ideas (Del Puerto, Minnaard and Seminara, 2006). Students' errors determine their learning from other related content, so that their identification and analysis generates important information about the way mathematical knowledge is constructed; constituting in this way an alternative so that students become aware of the need to overcome them and thus achieve true learning and the planning of activities where they can explain and make sense of their mistakes (Carrión, 2007; Engler, Gregorini, Müller, Vrancken and Hecklein, 2004).

Based on the aforementioned, the present study aimed to determine the mistakes that engineering students make when they have to analyze the variational behavior of functions, since this constitutes an important element in the understanding of the change of real-life phenomena and his understanding is essential axis in the mathematical formation of university students.

2. THEORETICAL BASES

2.1 The Theory of Semiotic Records

Various theoretical approaches describe the role of representation systems in the learning of mathematics, considering as hypotheses that the transformations between the systems of representation of mathematical objects can facilitate the emergence of such objects in students (Contreras and Font, 2002).

Duval (1998) considers that the semiotic representations of an object are absolutely necessary to be able to represent an idea or a mathematical object. They play an essential role in the development of mental representations, in the fulfillment of different cognitive functions and in the production of knowledge, increasing the subject's ability to think about that object and therefore his knowledge of it. This author means representation registration to a set of signs used to represent an idea or a mathematical object (Duval, 1998). In order for a semiotic system to be considered a representation register, it must have three fundamental characteristics: to be identifiable, to allow treatment, and finally, to enable conversion.

Mathematical activity is always based on some sequence of successive changes from one representation to another. The use of different representations for the same object increases the subject's ability to think about that object and therefore his knowledge of it. That is why it is important to keep in mind that there are always many possible representations of the same object. Each representation provides a different content according to the system used for its production, but always the object represented remains invariant (Duval, 2004).

The learning of mathematics is determined by the progressive coordination that can be made between different semiotic systems of representation, which requires discrimination and coordination of semiotic systems of representation to become able to transform any representation. (Duval, 2004)

Seeing concepts in multiple registers and from multiple perspectives allows students to better organize their knowledge. This is considered a cognitive condition necessary for learning (González, 2006).

2.2 Obstacles and Errors in Learning Mathematics

The generation of knowledge is a process with interruptions, which arises from ruptures, imbalances and reconstructions of previous knowledge. These ruptures can be foreseen by studying the situations and behavior of the students (Brousseau, 1986).

Bachelard (1988) raised the notion of epistemological obstacle to explain the appearance of errors. It does not refer to difficulties that arise in a disorganized manner or that derive from the absence of knowledge, but rather to difficulties directly linked to the ways of considering knowledge or knowledge itself. An obstacle is expressed through errors that are not due to chance, but are linked between them by a common source, a way of knowing, a characteristic, coherent and even correct conception that has been successful in a whole domain of actions (Brousseau, 1986).

Recognizing that errors can be due to epistemological and didactic causes and not only cognitive type is a first step to find possible solutions. The most frequent errors are precisely the first two in such a way that they are frequently manifested at the time of manipulating a representation within the same system of representation, which is usually the algebraic one. Another error that usually occurs is the inappropriate choice of a semiotic system to solve a certain problem. (González, 2006).

Duval (2004) expresses that many of the students' difficulties can be described and explained as a lack of coordination of different representation records. Cognitive difficulties for conversion, determined by two main factors. The first is the non-congruence between two representation contents of the same object. The second is the non-reversibility of the conversion.

This work used as a frame of reference the classification of errors proposed by Abrate et al. (2006), which are set out below:

- a) Errors due to mathematical language
- b) Error is due to difficulties in obtaining spatial information
- c) Errors due to incorrect inferences or associations
- d) Errors due to the recovery of a previous scheme
- e) Errors due to incorrect or accidental calculations
- f) Possible errors due to deficiencies in the construction of prior knowledge
- g) Errors due to lack of prior knowledge

2.3 Variational Thinking

Variational thinking can be described roughly as a dynamic way of thinking, which attempts to mentally produce systems that relate their internal form variables in such a way that they vary together in similar patterns to quantities of the same or different magnitudes in the trimmed threads of reality. (Vasco, 2006).

Cantoral (2013) states that this type of thinking includes the mathematics of change on the one hand and thought processes on the other; it implies the integration of the numerical domains, from the natural to the complex, concepts of variable, function, derivative and integral, as well as their symbolic representations, their properties and the domain of the elementary modeling of the phenomena of change.

The study of the concepts, procedures and methods that involve variation are integrated into different systems of graphic representation, tabular, verbal expressions, diagrams, symbolic expressions, particular and general examples, to allow, through them, the understanding of Mathematical concepts. In this way, the situations that depend on the systematic study of the variation become significant, since it is obliged not only to express attitudes of observation and registration, but also to processes of treatment, coordination and conversion.

3. METHOD

The study carried out has a quantitative-qualitative research approach, as well as explanatory and descriptive. The population was made up of the entrants to the engineering careers of the three universities of the Province of Abancay in Perú. We worked with a non-probabilistic sample of an intentional type made up of 100 incoming students (66% male and 34% female) to the civil engineering career distributed as follows: 48 from the Universidad Nacional Micaela Bastidas de Apurímac (UNAMBA) of the of which 67% were male and

33% female, 29 from the Universidad Tecnológica de los Andes (UTEA) of which 59% were male and 41 were female and 23 from the Universidad Alas Peruanas (UAP) of which the 74% were male and 26% were female.

A questionnaire composed of 3 problematic situations constructed in the representation records was designed and validated: graphic, algebraic, verbal. The questions that made up these situations revolved around the variational behavior of the functions, whose indicators were the following: identification of regions of variability for both "x" and "y"; regions of growth, decrease, stabilization, extreme values as well as analysis and description of the behavior of the function.

Variance analysis of a factor was performed to identify differences between the means obtained by the groups. On the other hand, the analysis of the answers and the determination of the students' mistakes were carried out from a qualitative perspective, through a case study, in their exploratory and descriptive form.

4. RESULTS

The results obtained from the application of the research instrument to the sample of students chosen are presented below.

Table 1. Mean obtained by the groups

Groups	M	DE
UNAMBA	7.4375	4.1071
UAP	5.3043	0.8757
UTEA	5.3276	1.2121

Within a scale of vigesimal evaluation, in Table 1 it was found that in all the study groups, the average performance achieved by the students is poor in relation to the study of the variational behavior of the functions. In general, this poor performance is a characteristic in the students of the 2 private universities where less dispersion is reflected. However, at the state university (UNAMBA), the greater dispersion of the results reflects the existence of better grades in some students.

Table 2. Comparison of means between study groups

Groups	F	P
UNAMBA UAP	21.9	0.000*
UNAMBA UTEA	11.4	0.000*
UAP UTEA	0.52	0.061

In table 2, statistically significant differences were found in the average obtained by the students of the state university (UNAMBA) in comparison to the means obtained by the students of the other 2 universities ($p < 0.05$). On the other hand, the performance obtained by the students of the two private universities does not differ significantly ($p > 0.05$). In students of private universities, poor performance is common in relation to the variational behavior of functions, while in the state university, although the performance is still poor, it is better than in the other 2 universities.

Table 3. Percentage of correct answers on determining regions of growth and positivity

Group	CP	CN	DP	DN	P	N
	Graphic Registry (RG)			Algebraic Registry (RA)		
UNAMBA	50.00%	37.50%	50.00%	50.00%	35.40%	27.10%
UAP	60.90%	52.20%	60.90%	65.20%	0.00%	0.00%
UTEA	48.30%	41.40%	48.30%	65.50%	3.45%	0.00%

Note: CP = Growth and positivity, CN = Growth and negativity; DP = Decrease and positivity; DN = Decrease and negativity; P = Positivity; N = Negativity

Table 3 shows that, in the three study groups, work within the graphic register proved to be more effective in terms of determining the regions of growth, decrease, positivity and negativity of a function. This reflects that a large part of the students correctly read the proposed graph and make a correct coordination between the graph and the proposed algebraic symbology as an alternative response.

Table 4. Percentage of correct answers on indicators of variational behavior

Grupo	IPE	IVV		CF	VE
		RG	RA		
UNAMBA	31.30%	66.70%	29.20%	9.38%	50.00%
UAP	60.90%	58.00%	0.00%	10.90%	6.52%
UTEA	62.10%	43.70%	0.00%	15.50%	6.90%

Note: IPE = Intervals or stability points; IVV = Variation intervals of variables; CF = Function behavior; VE = Extreme Values

Table 4 shows the evaluation of the behavior of the function, as well as the determination of extreme values constituted the variational tasks that presented the most difficulties to the students. Both tasks were raised within the graphic register, which indicates that students are not accustomed to obtaining graphical information of a variational type and that they do not perform an adequate reading of the presented graph. Similarly, the determination of intervals of variation of the variables within the algebraic register presented many difficulties that are reflected in the low percentages of correct answers, a different situation in the graphic register.

Table 5 shows the main errors found in the students' responses to the situations raised in the evaluation questionnaire.

Table 5. Some Errors found

Problematic situation	Procedure description
<p>PROBLEMA N° 01 El siguiente gráfico corresponde a una función definida por: $y = f(x)$.</p> <p>4. La función es decreciente y negativa si: A) $x \in (-3, -1)$ B) $x \in [-4, -1] \cup [1, 2]$ C) $x \in [-4, 0] \cup (1, 2)$</p>	<p>As for the Decrease and Negativity (DN) of the function, the mostly chosen incorrect alternative was B, which reflects the negativity of the function but also its growth, not correctly discriminating that when "x" varies from -4 to -3, the function decreases but is positive, and when "x" varies from 1 to 2, the function is negative but grows.</p> <p>The difficulty in obtaining spatial information of the variational type and the mathematical language used generates this type of error.</p>
<p>PROBLEMA N° 01 El siguiente gráfico corresponde a una función definida por: $y = f(x)$.</p> <p>1. La función es creciente y positiva si: A) $x \in [-4, -3] \cup (2, 4]$ B) $x \in (0, 1] \cup [1, 4]$ C) $x \in (2, 4]$</p>	<p>In the analysis of the Growth and positivity (CP) of the function, the most chosen alternative was B, which reflects that the conception whose function grows must be positive or vice versa, it is not properly discriminated that when "x" varies from 0 to 1, the function is positive but stable, and when "x" varies from 1 to 2, the function is negative even though it is growing. That is, an adequate reflection on the variation of the variable under study is not carried out.</p> <p>We found here an error related to the difficulty of obtaining spatial information and due to mathematical language</p>

Figure 1. Student response 3

Figure 2. Student response 27

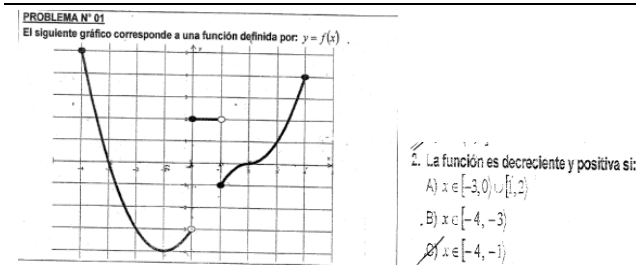


Figure 3. Student response 38

In the analysis of the Decrease and positivity (DP) of the function, a large part of the students chose alternative C, where the function is decreasing but part of it is negative, demonstrating difficulties in correctly discriminating the location of the function within the Cartesian plane, it is not discriminated that when "x" varies between -3 and -1, the function is negative. We also find here an error related to the difficulty of obtaining spatial information, not having an adequate reading of the graph from a variational perspective.

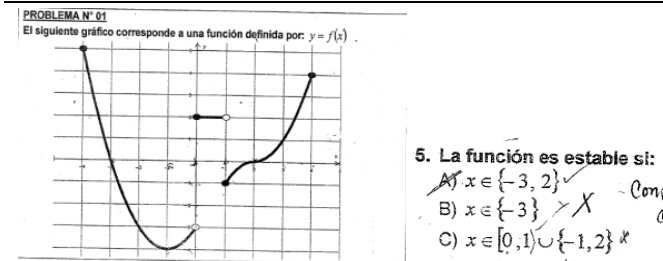


Figure 4. Student response 42

The difficulties encountered in this task refer to the confusion in students to interpret the stability of the function. Some students confuse stability of the function with nullity of the function, which led them to choose as an alternative answer the A, where the function is canceled, but does not seem to associate stability with lack of growth or decrease.

The error related to the difficulty of obtaining spatial information as well as to incorrect associations and to the erroneous construction of previous knowledge is verified

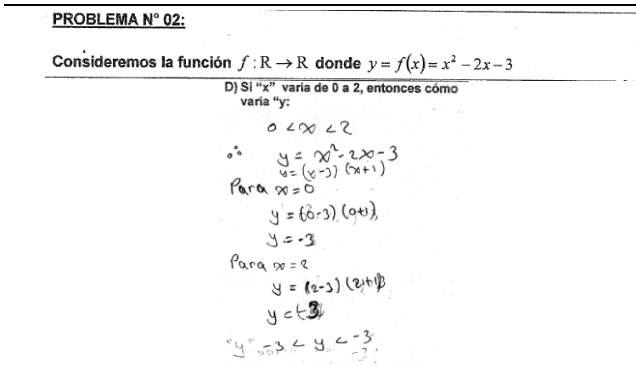


Figure 5. Student response 49

As for the work in the algebraic register, the students resorted to the tabulation strategy rather than to propose a graphic or algebraic strategy that reflects the real variation of the variable. This tabulation was performed directly without considering the form of the function that affects the variation of the requested variable, it is preferred to work the function in a timely manner and make a direct reading of the results without analyzing the form of the expression and how it determines the variation of the variable "y".

The presence of errors related to incorrect associations and to the deficiency in the construction of previous knowledge that lead to erroneous calculations is evidenced

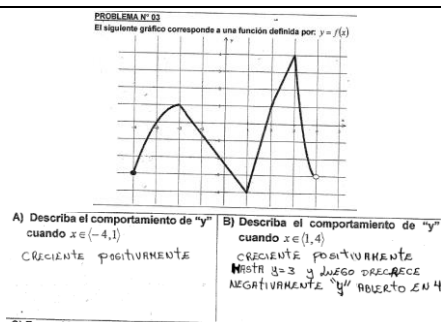


Figure 6. Student response 82

The low percentages in all groups reflect the difficulties that students have in reading the graph and outlining a correct description of the behavior of the function. The greatest difficulties arose when the students had to analyze and describe graphically how the variation of the function occurs. The foregoing highlights the problems students have in coordinating verbal registration and the graph from a variational perspective.

Errors related to mathematical language and to obtaining spatial information that generate incorrect associations are evidenced.

5. CONCLUSION

The analysis of the results obtained after the application of the questionnaire reflects the existence of difficulties in students when they have to determine and describe the variational behavior of the functions represented either graphically or in algebraic or analytical form.

The students' performance turned out to be deficient in the tasks of evaluation of the variational behavior of the functions, there being no significant differences in the study groups, which reflects difficulties of didactic type as a result of the few spaces that are provided to the students within the classroom to perform tasks of variational type. The analysis of the data reported in Table 3 and Table 4, show that students prefer to work the functions in a timely manner, being able to read points or plot them, however, they do not show a real reflection on the variational behavior in intervals of the variables or globally (Bell and Janvier, 1981).

The analysis of the results reported in Table 4, reflects that students have difficulty discriminating between stationary points of a function and the zeros of the function, which indicates confusion between the behavior and the location of the function. This confusion also occurs at the moment that students have to discriminate between the growth and decrease of the function with their positivity and negativity (Dolores, 2004).

The errors that were mostly found in the procedures or responses of the students are related to mathematical language, the limitations to obtain spatial information, to establish erroneous inferences and the inadequate development of previous knowledge, which does not allow them to properly assess the variational behavior of the functions.

On the other hand, the errors found by the students are largely based on the inadequate coordination between representation records of a function, in our case, graphic, algebraic and verbal records. These cognitive difficulties do not allow for an adequate conversion from one register to the other as a result of the lack of congruence between the significant units that make up the representation records, which is consistent with that indicated by Duval (2004) and coincides with that indicated by Dolores, Chi, Canul, Cantú and Pastor (2009), who found it difficult for students to establish relationships between verbal descriptions and graphic representations.

The above also reflects that students are not accustomed to working problem situations that have variation and change as their central axis. In general, algebraic work is limited to the evaluation of a function in certain values of the variables, or to identify domains and ranges. The table of values is only used as a support resource to sketch the graph of a function, and as for the work in the graphic register, this is limited to the construction of the graph. In none of the three cases, the student is questioned about the variational behavior of the function, with which the student sees his work and reflection limited to tasks that involve algorithmic resolution strategies, losing valuable time for the discussion of variational situations, which require of the student the management and development of variational strategies. This reality, which occurs within the classroom, represents a didactic type of difficulty faced by students, and that should serve as a reflection on the part of teachers. From this, it is recommended that the design of pedagogical alternatives that seek the development of variational thinking should be developed based on the analysis of the mistakes that students make.

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AN META-ANALYSIS ON THE EFFECT OF ADAPTIVE HYPERMEDIA LEARNING SYSTEM USING LEARNING STYLE ADAPTOR

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ABSTRACT

The usefulness and limitation of Adaptive Hypermedia Learning System (AHLS) using Learning Style as an adaptor has been long discussed, and many empirical studies show the system can help students increase their academic performance comparing with the traditional classroom learning, but these studies were based on different subjects and participators, thus hard to demonstrate the general effect of this system. This study summarized 13 studies to see whether there is a positive effect of AHLS comparing with the traditional learning in general contexts, and then see whether two factors, Learning Style Theory Choosing and Additional Adaptors, would moderate this effect. The result found that AHLS has a positive effect on student's academic performance, but the moderating effect of two covariate was non-significant. Based on this, the study further gave some suggestions of application AHLS in classroom.

KEYWORDS

Adaptive Hypermedia Learning System, Learning Style, Meta-Analysis

1. INTRODUCTION

Learning is a complex process, especially in the context of e-learning. Technology power makes it possible to integrate multiple learning materials and tutoring strategies into one single system, giving learners more choices as well as confusions (Linn, 2003). How to organize these materials and strategies arises to be a primary question for all e-learning systems. Adaptivity can provide a evidential grounds for this. The main differences between an adaptive system and a non-adaptive one is the User Model (UM) (Kahraman, et al., 2010). It is a model to track each learners' interactions with the system, evaluate these information, and then obtain the learner's attributes like their personalities and knowledge levels.

The UM makes the adaptive learning system more personalized according to each learner's traits, but only those traits that influenced students' learning outcome should be included into UM. Among these traits learning style is evidenced to be an important one (Nelson, Dunn, Griggs & Primavera., 1993). Students prefer to follow the teaching strategies that matched with their learning styles, and students who received a matched learning materials perform better on knowledge retention and academic achievement (Klašnja-Milićević, Vesin, Ivanović & Budimac, 2011).

Another problem of learning materials organization in an educational system is the order of numerous materials. A reasonable solution for this is the hypermedia. This is a collection of multimedia with non-linear order, so users can skip from one material to another (Tolhurst, 1995). The combination of hypermedia and adaptive algorithm is the basement of adaptive hypermedia learning system (AHLS). Hypermedia provide the content, and adaptive algorithm, which is based on learning style in this study, decides the arrangement of content.

There are a lot of studies find hypermedia learning system with adaption of learning styles works well (Chen& Macredie, 2002) (Carver, Howard& Lane, 1999). However, these study were conducted under different situations, based on different learning theories, and some even using more than one adaptors including learning style, thus make it hard to see the efficacy of AHLS using learning style in general. This study conduct a meta-analysis over 13 studies, to find the general effect of AHLS using learning style across several contexts, and then see whether two possible important moderators, learning style theory and additional adaptor, could influence this effect.

2. LITERATURE REVIEW

2.1 Learning Style Theory

Learning style was a conception first appeared on 1970s and then get varied due to multiple contexts (Kazu, 2009), but among which there were still some points in common. First, most researchers agreed that learning style is a mental traits, like personality, that varied across individuals. Second, learning style works during the whole process of learning, leading to various learning behaviors and performances. Appendix Table 2 compared 8 main kinds of learning theory.

Table 1 gives a summary for popular learning style theories, comparing their definitions and methods of classification. In general, the main differences across these theories is the classification of learning styles. Some researchers regarded learning as a step-by-step activities, and a student's behaves could vary in each step, leading to a set of combinations. Other researchers regarded learning as a whole process, thinking that a learner would show a typical learning preferences during the whole learning activity. Another kind of classification of learning styles was to ascribe the differences to different subjects.

Based on learning style theories and their measures, empirical researches showed a positive effect for a match between learning styles and teaching approaches (Peacock, 2001), indicating a possible application in pedagogical practices. However, early attempts on operationalizing learning style were problematic, due to a high rate failure for learning style identification (Curry& Adams, 1991)). Some learning style models, like ATI and VAK, were proved to have a high matching effectiveness (Sen& Yilmaz, 2012) but failed in another scenario (Riener& Willingham, 2010). Researchers have to check the validity of Learning Style measures even with previous validation work, constructing a barriers in the model specification. Choosing the right model in the application is still a challenge in the field.

Table 1. Comparison of Main Learning Style Theories

Author, Year	Definition	Dimension
Pask, 1976	If learning is controlled with in a caste or intuition systems, the students still have preference for different learning strategies.	Serialist Holist
Dunn & Price, 1980	Learning styles are distinct differences in the ways students responded to instructional materials.	Environmental Emotional Sociological Physiological Psychological
Keefe, 1987	Learning style is the composite of characteristic cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment.	Three processes, each has elements: Cognitive variables Affective variables Physiological variables
Felder & Silverman, 1988, Felder & Soloman , 1996	Learning style is the difference in the preference in all five process of learning.	Perception: sensory/intuitive Input: visual/auditory Organization: inductive/deductive Processing: active/reflective Understanding: sequential/global
Honey & Mumfords, 1989	A description of the attitudes and behavior which determine an individual's preferred way of learning	Activist Pragmatist Reflector Theorist
Vermunt, 1996	Learning styles are conceived here as relatively stable, but not unchangeable, ways in which students learn.	Undirected Reproduction directed Meaning directed Application directed
Jackson, 2002	There is a common biological basis to positive and negative outcomes within the workplace, education and the general community.	Sensation seeker Goal oriented achiever Conscientious achiever Emotionally intelligent achiever Deep learning achiever
Fleming , 2011	A learning style is a description of the process and preference for an individual's study.	Visual Aural Read/write Kinesthetic

2.2 Adaptive Hypermedia Learning System

The conception of hypermedia was first introduced on 1965 by Ted Nelson (McAleese & Green, 1990). This type of media includes a set of multisensory nonlinear information, including media (graphs, audio, video, text, etc.) and hyperlinks. Most of the early hypermedia were static, providing same information in a same sequence for all audiences, and hyperlink only provided the function of catalogues. With the development of technology and popularity among users, researchers turned to find some media system more adaptive to create a better usage experience. Due to the trait of nonlinear, hypermedia can provide information in a same theme with difference sequences for different audiences, and became a new direction for hypermedia design since 1990s (Yusob, Haron, Ahmad & Halim, 1999).

Nearly at the same time came early exploration of using adaptive hypermedia in the area of education. Beumont and Bruilovsky first designed an adaptive hypermedia tutoring system using conditional presentation technique, which categorized audiences into two previous knowledge level, beginner and advanced. This system was just a conceptual model with no empirical users' feedback, but it began the era of introducing adaptive hypermedia system into education context. From then on, adaptive hypermedia learning systems were designed with different adaptors, including individual-related variables like personality (Yusob, Haron, Ahmad & Halim, 1999) and gender (Caglayan, et al., 1997), and learning-related variables like user's motivation (Specht & Oppermann, 1998) and education level (da Silva, Van Durm, Duval & Olivie, 1998). With the introducing of different new adaptors, an increasing numbers of researchers used experimental design to assess whether these adaptors effective or not, and many studies found AHSL had a positive effect on students' academic performance (Truong, 2016) (Brusilovsky & Millán, 2007).

2.3 Learning Style Theory and Adaptive Hypermedia Learning System

The early attempt to adapted students' learning styles in AHLS was in 1990s. In 1996, Carver et al. designed a hypermedia system adaptive to student's learning styles, which is considered to be an early attempt of hypermedia learning system adapting to learning styles (Carver, Howard & Lavelle, 1996). In this research, Carver used the Felder-Silverman Index of Learning Style to categorize learners into different learning styles, and then provided them with some prepared learning materials according to their learning styles. Studies focused on AHLS using learning styles mostly used a similar pattern in the following year, first matching students with typical learning styles and then giving them different teaching instructions and materials. Most studies used more than one adaptors, to serve as a supplement for Learning Style adaptors (e.g. prior knowledge, learning motivations), since some researchers claimed that specific learning style adaption itself had no significant impact on the learners performance partly because of the personalization of AHLS needed more information (Mulwa, et al., 2010). However, as a contrary, those studies who only used learning styles as an indicators also showed a significant positive AHLS, comparing with the traditional classroom learning (Truong, 2016). The effectiveness of learning style adaptors is worth to further explore, both for single adaptor systems as well as those with multiple ones.

3. RESEARCH QUESTION

Although there are already many educational experiments assessed the effect of AHLS, considering the different environment and measurement of each study, a general effect size is still worth to compute. Plus, there might also be other potential factors that could affect the efficacy of AHLS. Learning style theory selection was considered to be an essential step in AHLS construction (Akbulut & Cardak, 2012), and the additional adaptor was widely accepted to be a method to improve the performance of AHLS (Mulwa, 2010), which were also addressed above.

Thus, the research question of this study are listed below:

- 1) In general situation, to what extent that AHLS could help student increase its academic performance?
- 2) Would the two potential factor, Learning Style Theory choosing and Additional Adaptor, influence the effect of AHLS or not? If yes, influence by how much degree?

4. METHOD

4.1 Studies Searching and Selection

Adaptive learning system researches first started in 1990s, but only got widely used and researched after 2000, partly due to the popularity of personal computers and smart phones (Mulwa, et al., 2011). Thus, 2000 was set as the start of studies collection, which is similar to many recent literature review in the field of educational technology. Articles published between 2000 January 1 to 2019 June 3 were included.

The data searching strategy used in this research was set according to Cooper & Hedges' study on research synthesis (Cooper, Hedges & Valentine, 2009). According to their view, studies searching for the purpose of research synthesis should be held in a broad range, but stressed more on precision rather than a high recall rate, using multiple databases related to the topic area, thus need more key words to form keyword combinations either or both restricted context, object, method etc.. For this study, the searching databases included: Emerald, JSTOR, SpringerLink, ScienceDirect, Wiley Online Library, Taylor& Francis Online, EBSCOhost and ProQuest. First keyword set comes from the context, to restrict the topic into the educational technology topic, including "e-learning", "educational hypermedia", "leaning/tutoring system", "computer/web/mobile assisted/based learning"; second keyword set comes from the aim of adaptation of the system, including "adaptive", "adaptable", "adaptivity", "adaptability", "adaptation", "personalized"; the third keyword to limited the way of adaptation into learning style, including "learning/cognitive style"; the fourth keyword set was used to filtrate those studies who conducted experimental design to evaluate the efficiency of the system, rather than just simply created a system, including "evaluation", "measurement", "experiment(al)" "control group". Articles only included peer reviewed journal paper, conference proceedings for full paper, and dissertation for master or PhD. Degrees.

The primary attempt gave 178 recalls. Then selection focused on four detailed points: 1) this is an adaptive hypermedia learning system, using hypermedia as learning materials and adapted by learner's traits; 2) at least one of the adaptor is learning style; 3) the research conduct a control experiment to compare the mean difference of learning effectiveness for experimental and control groups; 4) the study give the mean, standard deviation and sample size for both control group and experimental group. After the third round selection, 16 studies were selected for further analysis, 10 were peer-reviewed journal papers, 2 were conference proceeding full papers, 1 were doctoral dissertation. All the studies included 731 students in total.

4.2 Data Extraction and Effect Size

Information was extracted from these 13 papers under three steps. First was background information, including 1) the year of publication and the name of author, which was used to identify each paper; and 2) learning content, which was used to see the subjects that AHLS had been conducted in. These two variables were not necessary in the meta-analysis conducting, but still useful to see the overall trend of AHLS empirical researches in recent years.

The second part is about the sample information, including 1) sample size in each studies, 2) participants' information. The sample size was varied among studies, but the participants mostly were university students. The reason for this might be the available of participants, and AHLS were also mostly used on the higher education in actual application (Akbulut& Cardak, 2012).

The third part is about the research design and AHLS design, including 1) Learning Style theory, 2) Additional Adaptor. Both were covariate in this study, whose importance have been discussed above. The variable of Learning Style Theory was coded as 1 and 0, which referred to using Felder & Silverman's learning style theory or not. The reason of focusing on this theory is that more than half of all the studies using Felder & Silverman's leaning style theory, without stating a solid reason on learning style theory choosing, ignoring that Felder proclaimed they formed and validated this theory in the engineer education. To assess the rationality of simply using Felder's Theory without Learning Theory screening, two groups, using or not using Felder & Silverman's Theory were thus compared. The variable of Additional Adaptor were coded also as 1 and 0, for adapting or not adapting additional adaptor, to see whether adapting an additional adaptor could benefit to the effect of AHLS.

Since each study used different test and mark system to assess student's academic performance, all the raw mean differences were transferred into standardized effect sizes. A widely accepted standardized effect size for mean difference is hedge's *g*, since it can standardize a raw mean differences across different samples and studies. Comparing another standardized mean difference, cohen's *d*, the hedge's *g* can fix some bias when sample sizes were small, which could be applied in this research as some selected studies had a relative small sample (Borenstein, Hedges, Higgins & Rothstein, 2011).

5. RESULT AND DISCUSSION

5.1 The Overall Effect of Learning Style AHLS

According to the result of meta-analysis, there was a significant differences in the academic performance, which presented by final score in all the studies, between control group and experiment group. There showed an evidence for heterogeneity across all the studies ($I^2 = 54.26\%$; $p = 0.009$), validating a proposal of a random effects model. The funnel plot showed a possibility of publication bias in this study, but the test of publication bias show no evidence on that (Funnel Plot Asymmetry $Z = -0.754$, $p = 0.451$).

The model result showed a significant positive effect of AHLS on students' academic performance (0.606, $p < 0.001$), which is consistent to most of the previous research. All the estimate of this model are showed in the below table as Model 0.

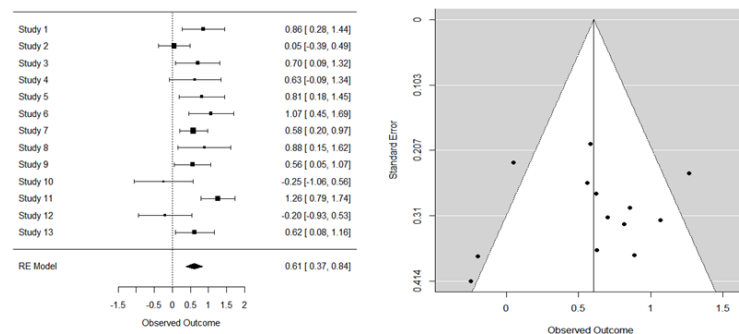


Figure 1. Forest plot and Funnel Plot of Model 0

5.2 The Effect of Meta-Regression

For the research question 2, to assess the effect of Learning Style Theory choosing, three additional meta-analysis model were specified. The first one is Model 1, adding Learning Style Theory as a covariate, named as Model 1. Results showed no evidence of a moderating effect of Learning Style Theory to the AHLS positive effect on students' learning performance, and the increasement of tau-squared seems to not support the decision of including Learning Style Theory into the model ($\tau^2 = 0.100$, $se = 0.080$), with an decrease in I^2 ($I^2 = 53.95\%$). This result showed that the Learning Style choosing has a non-significant negative moderate effect on the AHLS's positive effect (-0.160 , $p = 0.513$).

Model 2 added Additional Adaptor as a covariate comparing to Model 0, showing that Additional Adaptor non-significantly negatively moderated the effect of AHLS (0.127 , $p = 0.633$). The increase in tau-squared, however, inferred that this covariate should be included, with an relatively bigger increase for I^2 ($I^2 = 57.65\%$, $\tau^2 = 0.116$, $se = 0.088$). Even though including the moderator of Learning Style seems to increase between-study variation, the amount accounted for by the random effect model can (relatively) go down, thus showing the moderator still works for the model.

Model 3 add both Learning Style Theory and Additional Adaptor into the model, to see whether the two moderator would influence the model together or not. This model also showed an increasement in tau-squared ($\tau^2 = 0.117$, $se = 0.093$), but a decrease in I^2 comparing with the baseline model ($I^2 = 57.10\%$). These

parameters seems to be not a big different with the model 2, and thus a parsimonious principle should be considered here, indicating the Model 2 should be the most acceptable one. The estimations were showed as Table 3. Figure 2 was the forest plot and funnel plot for the final chosen model, Model 2.

Adding adaptors was considered to be useful way to increase the effectiveness of AHLS in many researchers (Mulwa, et al., 2010), but the evidence of the study showed that it is not as effective as they said. Comparing with the effect brought by the Learning Style AHLS, the additional adaptor’s positive effect was non-significant, making no statistically different on the positive effect of Learning Style AHLS. Considering the desire of less complexity in user model specification and the system construction, it might be better to limit the behavior of adding adaptor, as it not play an essential role for the final effectiveness of AHLS.

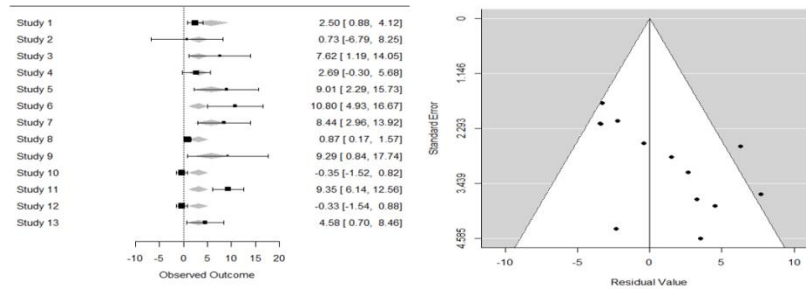


Figure 2. Forest plot and Funnel Plot of Model 3

Table 2. Summary of Model 0, 1, 2, 3

	Model 0	Model 1	Model 2	Model 3
Estimates of model diagnostic				
I ²	54.26%	53.95%	57.65%	57.10%
QE	26.235(<i>p</i> = 0.009)	23.886(<i>p</i> = 0.013)	25.973(<i>p</i> = 0.007)	23.309(<i>p</i> = 0.010)
H ²	2.19	2.17	2.36	2.33
R ²	Not Applicable	0.00%	0.00%	0.00%
Tau ²	0.098(<i>se</i> = 0.076)	0.100 (<i>se</i> = 0.080)	0.116(<i>se</i> = 0.088)	0.117(<i>se</i> = 0.093)
Estimates of variables				
AHLS	0.606(<i>se</i> = 0.120), <i>p</i> < 0.001	0.673(<i>se</i> = 0.159), <i>p</i> < 0.001	0.562(<i>se</i> = 0.155), <i>p</i> < 0.001	0.626(<i>se</i> = 0.182), <i>p</i> = 0.001
LS Theory		-0.160(<i>se</i> = 0.245) <i>p</i> = 0.513		-0.174(<i>se</i> = 0.259), <i>p</i> = 0.570
Additional Adaptor			0.127(<i>se</i> = 0.267), <i>p</i> = 0.633	0.153(<i>se</i> = 0.270), <i>p</i> = 0.501

6. CONCLUSION

This studies used 13 previous studies to see the general effectiveness of AHLS using Learning Style Theory, and then discuss the moderating effect of two factor, Learning Style Theory and Additional Adaptor. AHLS is effective among general subjects, and adding adaptor did not influence a lot on that positive effect. In the application of AHLS under the classroom context, adding more adaptor would not necessarily benefit to the performance of students, and once the adaptivity get applied, the more concern of system design and application should focus on other side instead of simply adding new adaptors.

However, this study still have several limitations. The first could be the number of studies. AHLS has a short history and thus a smaller number of studies comparing with other educational technology tools, and when the adaptor focus on Learning Style the number of studies could decrease more. Second limitation could be other potential covariates, like identification algorithm and student age, might also influence the effectiveness of AHLS, which is not discussed in this study. But with a scanty number of studies it is hard to get enough sample for each covariate. In recent years, more researchers and educators noticed the usefulness of AHLS and the importance of conducting empirical studies to see the effectiveness, and with these new emerging researches it could be possible to discuss these questions.

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DIGITAL TOOL FOR BLENDED LEARNING FOR TEACHING VISUAL EFFECTS

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ABSTRACT

The use of digital and blended digital learning modes is becoming more popular in teaching practice at various levels of instruction. This article reports a case study with a strong experimental approach in which a digital learning object (DLO) was developed to assist in the pedagogical practice in higher education (in the audiovisual area).

The objective of the research was mainly to evaluate the pedagogical contribution of DLO, however, this article is restricted to demonstrate what were the methodological paths taken during the research process for the development and conception of the tool (DLO), using theoretical references from the design area, pedagogy (regarding the construction and validation of digital learning objects), and the methodologies defined for their subsequent evaluation and validation.

This article intends to contribute mainly by pointing out the design strategies adopted for the conception and creation of a Digital Learning Object for Blended Learning. Future works will present the subsequent validation results, pointing out the paths taken and new research paths to be followed to complement and further contribute to research regarding the importance of DLOs in the teaching practice of higher education. Besides, it is believed that the more research and experimentation with the construction of new DLOs and the sharing of the methods used, the better for the development, reflection and definition of better design strategies to more effectively reach the objectives initially proposed for the digital learning tool.

KEYWORDS

Digital Learning Objects, Match Moving, Undergraduate Degree, Visual Effects, Audiovisual Production, Mobile and Virtual Learning

1. INTRODUCTION

The teaching experience in undergraduate courses in the audiovisual area, more specifically in the production of visual effects (VFX) in which occurs integration between real and virtual images (match moving), enabled the said researcher to notice to certain difficulties during the teaching and learning process.

The production of VFX with match moving involves diverse techniques and technologies, besides the most varied concepts and theories of the cinematographic area. Bibliographical references on this stage of production and technologies involved are found in the following works consulted (Prata & Nascimento 2007, Hornung 2010, Jackman 2007, Dobbert 2005, VES 2010). This great variety of knowledge that needs to be combined, integrated in a transdisciplinary way at the time of practical teaching activities, presented a high degree of difficulty in its execution. The step named "data collection" was the most critical when compared to the other stages of production.

During this stage, the students need to note several values referring to the configurations of the most diverse devices and filming environment. Due to this enormous amount of data to be collected (varying in quantity depending on the degree of complexity of the scene shooting), forgetting the collection of certain values may be crucial for not achieving success, failing to execute audiovisual production as an all, or in the best scenario, being necessary to spend more time to be able to execute it, bursting the anticipated budgets.

Starting from this presented difficulty, the present researcher proposed to design a prototype of a digital learning object (DLO) to assist in these practical teaching activities.

2. TOOL DEFINITION / PREVIOUS SEARCH

Starting from the idea of developing a digital learning object (DLO) to aid in the practical learning activities mentioned above, initial research was carried out in search of some existing tool with the functionality close to that desired by the prototype to be created.

For this, the prototype had to be minimally defined in relation to its objectives: a) to assist in the indispensable collection of data for later reconstruction of the real characteristics in the three-dimensional virtual environment (computer graphics software); b) prevent essential and important information from being forgotten; c) create a methodology for collecting the data in order to organize it; d) if possible, automate part of the task of reconstructing the virtual environment from the actual data collected, using programming so that from the data collected, it is possible to generate script for the automation of the creation and configuration of the virtual elements.

After this guiding definition, research was done on computer software (Windows, Linux and Mac operating systems), App's for mobile devices (in App's distribution stores such as Google Play, App Store, Amazon Appstore, Uptodown, Aptoide, APKPure, F -Droid, Uptodown), and online tools (websites) that could offer the same solutions.

No software, App or website was found with the characteristics listed. The closest application that, however, does not specifically meet the listed goals was the "Shot Designer" App available for Mac / PC / iOS / Android. This application allows collecting several data during the filming, besides having several and relevant other functions, however, it is not directly oriented to the production of VFX and Match Moving. In addition, it does not offer the function of automating part of the work of rebuilding the real environment for the computing graphics imaging (CGI) software.

3. RESEARCH PROPOSAL

Considering that the tool to be designed and tested has as one of its objectives its use in an educational environment, the research proposal, after methodological appropriateness (better delineated forward), was defined as follows: a mini-course with a total duration of 4 weeks, with activities 5 days a week, with 3 hours of duration per day, totaling a total workload of 60 hours.

From these four weeks the first two weeks reserved for teaching the theoretical part, technique and realization of the filming to capture the raw images, and the final two weeks devoted to the production of the images in CGI software and composition of the virtual images with the real ones.

In this context, each of the final weeks was dedicated to the production of one of the two practical exercises proposed during the mini-course, in addition students were randomly divided into groups and performed the exercises in different order and with and without the aid of the tool in one or the other exercise, something explained in greater depth in the next sections.

At the end of the mini-course, in addition to providing the practical exercises performed during the mini-course for subsequent blind evaluation of the material by third parties, they respond to three research forms responsible for evaluating the tool (DLO) in three dimensions, which are:

1. Analysis of the concept of the product.
2. Evaluation of the characteristics of the product regarding its relevance.
3. Assessment of the characteristics of the product regarding its adequacy.

The research involving the Portuguese research institution and being carried out in Brazilian territory is classified as international research by Brazilian institutions.

The entities involved are Faculty of Science and Technology (FCT) of the New University of Lisbon (NOVA), Portugal, and the Federal University of Paraíba (UFPB) in the city of João Pessoa, Brazil.

In addition, because it involved human beings (students of undergraduate courses related to audiovisual production), it needed to be submitted to the Research Ethics Committee (CEP) and later to the National Research Ethics Council (CONEP) in Brazil.

The investigation received the CAAE case number: 03763418.6.0000.5188, it was appreciated, and its methodology and ethical aspects approved for its execution, according to the presented planning.

4. RESEARCH METHODOLOGY

Considering that no tool/application with such characteristics was found, and could, therefore, be classified as innovative, we set out to the methodological definition to later design it, evaluate it and validate it.

After a bibliographic review to look for the best methodological strategy to be adopted, the research was classified based on its objectives as exploratory and based on the technical procedures used as bibliographical, research that field and experimental study.

Based on their objectives was framed as an experimental method (Gil 2002, Singh 2006).

Regarding the technical procedures, it was classified as "bibliographic" (Gil 2002) because it will use all the research repertoire already developed and available in articles and books related to digital design methodologies and digital learning objects, to support the whole tool design, evaluation, and validation process. It was also classified as "field study" (Gil 2002) because it will have the application of forms and different methods of analysis for the evaluation and validation of the tool (such as Decis, NPS and MaxDiff scales). In addition, also classified as "experimental" (Gil 2002) because it will seek through the ministration of a mini-course and control of the research environment, conduct a blind analysis of the practical work developed by the students participating in the research/mini-course.

The intention in the experimental stage was to try to infer qualitative improvement in the practical exercises realized with the aid of the tool when compared to the exercises without the aid of her. In this way, we seek to understand if the contribution of the DLO tool is more restricted and visible in the teaching activity, or if it also adds performance contributions in the execution of the works that it assists (due to the possible time gain due to the automation capabilities in the work of transposition of collected data to CGI software).

4.1 Variables Control

For the experimental part of the research, methodological precautions were necessary for its correct execution, such as the manipulation of an independent variable, ways of controlling and observing the effects, random distribution, among others. The forms of control that needed to be observed and adopted were as follows:

1. Random distribution of the research participants into 4 groups.
2. Computer lab, where the practical activities of the mini course were executed, with all the computers (workstations) with the same technical specifications, that is, the same hardware and software configurations, so that possible differences could not interfere in the quality of the practical exercises developed.
3. Subdivision of time into equal sections for the execution of each of the practical activities during the mini course.
4. Same practical exercises with the same levels of difficulty (equivalents) to be performed by all students participating in the mini course because creative freedom would make it impossible to compare qualitatively between the practical works developed.
5. Definition of the independent variable and the control group, where the variable was the use or not of the tool (DLO) in the aid of the data collected during the filming and later transposition of the data to computer graphics software using the script generated by the tool.
6. The use of the same video images shot together by all participants of all groups at the same time (but each group collects data during the shooting in a different way) so that they can perform the integration exercises with the same degree of difficulty.
7. The avoid completely the practical exercise with similar activities before the experiment so as not to incur into the "training effect" and compromise the samples later.

Works that served as the basis for this organization and methodological care for the experimental part for consequent statistical and ethical validity were (Goodwin 2010, Coolican 2009, Hair et al. 2010, Singh 2006).

4.2 Model for Experimental Execution

Due to the number of computers available in the computer lab and in view of the limitation in the number of participants that the available infrastructure would allow, the experimental part of the research was designed to be performed inter-subject and intra-subject, for what even counting a reduced number of participants, it was possible to obtain representative statistical data in the final results.

For this the participants were randomly subdivided by lot into 4 groups with 5 members each, a total of 20 participants to start the mini course. The groups were named from one to four (G1, G2, G3, and G4). In the following table it is possible to understand the order of execution of the practical exercises (which group started the practical activities by exercise A or B) and in which of exercises each group used and did not use the tool to aid the execution of the activity (where w = with the tool wo = without the tool).

Table 1. Subdivision by groups and order of execution of activities

Order AB	Order BA
G1 – A(w) B(wo)	G2 – B(w) A(wo)
G3 – A(wo) B(w)	G4 – B(wo) A(w)

5. PROTOTYPE DEVELOPMENT - CONCEPTUAL RESEARCH

The prototype was developed from two parallel theoretical frameworks based on preliminary bibliographic research: the one related to fundamental components of design, encompassing concepts such as user experience evaluation methods, sketching user experiences, instructional design, user interface, user experience, theoretical referential works as (Vermeeren et al. 2010, Buxton 2007, Wiley 2000, Piskurich 2015, Greenberg et al. 2012, Adão & Jacob 2011); and the one related to the specific pedagogical components for the design of digital learning objects (DLO) through works like. (Dias et al. 2009, Prata & Nascimento 2007, Ghisi 2016, Neto et al. 2017, Nocar 2016, Fuchs, Bruch & Annegarn-Gläß 2016, Pentead, Gluz & Galafassi 2013, Braga 2014, Braga 2015, Tarouco 2003, Tarouco 2014, Smith 2004, Zucherman 2006).

In this way, it was tried to consider both the primordial characteristics for the development of a new tool as digital media, focusing on the identification of the opportunity for innovation and the creation of a new product/functionality; as well as considering the essential characteristics so that this new digital tool can also be useful, recognized and conceptually framed as a DLO.

Considering that the purpose of the research was not restricted only to the creation of the tool itself, but also its validation in its technical and pedagogical criteria, the basic elements for its development were from the beginning related to the posterior form of evaluation and validating of the prototype.

After the in-depth study of several works related to the design, production, and evaluation of DLO, it was realized that there is no definitive methodology on how to conceive and mainly evaluate a Learning Object (LO). A study that exemplifies with propriety is done by Neto et al (2017) where, through a systematic review of the specialized literature, they presented the main methodologies and instruments for evaluating LO found in the SCOPUS database, published between 2005 and 2015.

In this comparative study, 34 different methods of analysis of learning objects were included and among these are:

(...) from evaluations composed of only two criteria (Morgado, Ruiz and Peñalvo, 2007), until evaluations that consider fourteen dimensions (Marzal and Pedrazzi, 2015). Nevertheless, it can be said that in general, the main criteria considered were pedagogical and usability (Neto et al 2017).

Based on this study and its others works with content related to LO evaluation mentioned above, a survey and evaluation of what characteristics each of these methods used in their evaluations were made. The objective was to identify and select the most common characteristics among these already existing and reported assessment methods.

Some of the existing evaluation methods whose characteristics have been studied: Reeves, LORI (Learning Object Review Instrument), MERLOT (Multimedia Educational Resource for Learning and Online Teaching), HEODAR (Herramienta para la Evaluación de Objetos Didácticos de Aprendizaje, Quality Criteria, Elements Determining Quality, BECTA (British Educational Communications Agency), DESIRE (Development of a European Service for Information on Research and Education), LOEM (Learning Object Evaluation Metric), Q4R (Quality for Reuse), CNICE-MED, Open ECBCheck (E-learning for Capacity Building), QEES, LOQVAL (Learning Objects Quality Evaluation), TAM (Technology Acceptance Model), LOAM (Learning Object Attribute Metric Tool), LOAM (Learning Object Acceptance Model), Model CIPP (Context, Input, Process, and Product), among others.

We defined 39 characteristics to be used in the design and consequently in the evaluation of the prototype. Of these, 17 more directly related to fundamental concepts of design and 22 characteristics with concepts of DLO.

The following table shows the list of the 39 final attributes with a classification to indicate the theoretical reference base (Ref. T.) related to each formatted characteristic. These characteristics had to be constituted in attribute format since these characteristics were designed to be used both in the form of relevance and in the form of adequacy to be applied to the participants.

The difference between the forms is that in the relevance form uses all 39 attributes, while the appropriateness form uses only 16 of these attributes, 8 of which are design fundamentals and 8 are related to the DLO design. The reduction for the 16 adequacy attributes was based on the attributes most frequently mentioned in the different methods studied.

Table 2. Main theoretical references selected to guide prototype development and future evaluation and validation

Attributes	Main Ref.
Accessibility - internet dependence; accessible by any browser and operating system.*	DB-UI
Reuse - reusable in different contexts of teaching and audiovisual production, serving as a reference for other teachers.	DB-UI, LO-GA
Pedagogical relevance - appropriate and relevant in the educational context in which it is inserted.	LO-GA
Adaptability - navigation options to fit the needs of the student, making it use intuitively.	DB-UI
Aesthetics - layout, and choice of elements such as texts, links, images, videos. Considering the limitations on forms.*	DB-UI
Comfort - a perception of a comfortable feeling while using the tool.*	DB-UI, DB-Erg
Utility - a perception that the use of the tool is valid.*	DB-UI, DB-Erg, DB-UX
Organization - a perception of organization (way of navigation and subdivision in stages).*	DB-UI, DB-Erg
Supporting documentation - information about the tool. Contained in it and in the site related to the doctoral research and the tool.*	DB-UI, DB-Erg
Technical functionality - if it fulfills its purposes: assistance in data collection and automation in the transfer of these to CGI software.*	DB-UI, DB-UX, DB-Usb
Ease of use - a perception of ease of use of the tool.*	DB-UI, DB-UX, DB-Usb
Self-explanatory - self-explanatory capacity perception during its use.	DB-UI, DB-UX, DB-Usb
Error messages - when they occur clearly identify the error that is occurring and presents a solution to it.	DB-UI, DB-UX, DB-Usb
Efficiency - a perception of being competent, productive, of achieving the best yield with the minimum of errors and/or expenditures.	DB-UI, DB-UX, DB-Usb
Convenience - a perception that it can be used to uncomplicate a routine; which can bring advantages to the person using it.	DB-UX
Economic value (cost) - free.	DB-UX
Satisfaction - contentment, pleasure arising from the accomplishment of what is expected, of what is desired in the use of the tool.	DB-UX
Interactivity - allows the individual to interact by making it possible to choose which data and information the user want to collect or have access to.	DB-UI
Collaborative learning - enables the partnership between students/users to better perform activities.	LO-GA
Pedagogical objectives - identifiable and appropriate to the target audience. Assistance in the practical activities of audiovisual production with real x virtual interaction.*	LO-LA
Language - favors understanding and learning.	LO-LA
Challenging - it brings forth, instigates, provokes a confrontation, puts itself to the test.	LO-LA
Feedback - received by the teacher during the execution of the activities was important for the use of the tool and understanding of the related content.	LO-LA
Autonomy - allows students to carry out activities without teacher intervention, encouraging exploration and involvement.*	LO-LA
Content - addressed in a clear and precise manner, with adequacy and consistency to the target audience. It hasn't omissions or prejudice.	LO-LA, LO-P
Pedagogical appropriateness - presents conformity to the educational context in which it is inserted.*	LO-GA

Active Learning - Leads the student from the passive listener role to an active learner who builds their knowledge (learning to learn).	LO-P
Motivation - a set of processes that give the behavior an intensity, a direction determined during the use of the tool.*	LO-M
Quantity of information - enough and not excessive.	LO-GA
Coherence - logic, meaning between the contents, the objectives, the activities developed, the evaluation and the profile of the student.	LO-SLO
Playfulness - a perception that the use of the tool is pleasant, fun.	LO-P
Instructional structure of orientation to the student - quality and sufficiency of the instructional contents in the website of the tool.	LO-P
Help in learning - provided by the tool as an educational resource (learning object).*	LO-P
Instructional structure of orientation to the teacher - quality and sufficiency of the instructional contents in the website of the tool.	LO-P
Metadata - present on the tool's website in accordance with the standardization of Learning Objects repositories.*	LO-P
Medium level of requirement - the demands necessary for the student to access, interpret and process the instructions of the tool and make use of it.	LO-GA
Content quality - concepts, information, references, images, etc. used in the tool (reinforce key points and significant ideas).*	LO-TA, LO-P
Multimodal text - when integrating text and image or text and video into the necessary moments for a better understanding of the concept to the user.	LO-P
Language - English language, international use, majority use in the CGI and audiovisual software area.*	LO-LA

Table 3. Legend - Main Theoretical References of Attributes of Table 2

DB-UI	Design Basics - User Interface
DB-UX	Design Basics - User Experience
DB-Erg	Design Basics - Ergonomics
DB-Usb	Design Basics - Usability
LO-GA	Learning Object - General Aspects
LO-LA	Learning Object - Learning Assessment
LO-P	Learning Object - Psychopedagogy
LO-M	Learning Object - Motivation
LO-SLO	Learning Object - Adequacy of Learning Objectives
LO-TA	Learning Object - Teaching Assessment
*	Attributes selected for Adequacy Form

The explanation of the attributes used, therefore, serves to define methodologically the design, technical and pedagogical qualities, fundamental for the prototype design process and later to proceed with its evaluation and validation.

5.1 Definition of Tool Features

The main characteristics for the design of the prototype were as follows:

1. Previous tips on measuring instruments.
2. Data collection from cameras (legacy and physical).
3. Data collection of natural light.
4. Data collection of artificial lights (standard and photometric).
5. Data collection of reference objects (reference balls, plans, reference rod).
6. Alert for other important references (color checkers, references for camera trackers, creation of photos or film in 360 degrees for reflections).
7. Data collection for render setup.
8. Capability to utilize the data collected to automate the process of reconstruction of the real elements into virtual ones in the computer graphic image (CGI) software.

5.2 Technical Research

Technical research is conceptualized as being part of the research focused on which technologies to adopt for the practical execution of the prototype.

For this stage, it was based on some assumptions/limitations regarding the technical capacity and training of the researcher: a) the professor and researcher in charge does not have any knowledge of current programming language, already had contact with programming languages such as Turbo Pascal, Clipper and basic programming of batch files, however are obsolete and outdated languages; b) the research does not have a team or any professional in the field of computer science to assist in programming tasks; c) for the implementation of the automation feature it is well known that at least the programming language used by CGI software it is necessary.

5.2.1 Prototyping Platforms

Due to these conditions, preliminary research was done searching for Prototyping Platforms (sketch and mockup), because currently there are several platforms that besides designing App's for mobile phones, it is also possible to program them and design functional products without needing to know programming languages. In addition, it is possible to also test them on various mobile devices and submit them after finalized to distribution stores of Apps like Google Play and App Store.

InVision, Prott, Mockup.io, JustInMind, Mobincube, Appy Pie, OutSystems, AppSheet, GoodBarber, AppMakr, Axure, Instappy, Sketch, among others, were tested (with respect to technical resources, ease of use, difficulties, limitations, price of use).

The great potential of these platforms that present integrated solutions is that they propitiate what comment Tarouco et al.:

Authoring tools are essential resources for teachers to develop digital pedagogical content without the need to know a specific programming language. (Tarouco 2014).

The evolution of authoring tools has contributed to a new scenario in which the production of digital educational material has been less and less restricted to the group of programming and design experts. Tools that provide the addition of interactivity and multimedia resources to digital content, without the need for programming, have provided the teacher with a new panorama, in which he sees himself not only as a user but also as a professional able to prepare their own Learning Objects. (Tarouco 2014).

In addition to these platforms with complete solutions, other large corporations' platforms were also researched for the creation and prototyping such as: Google App Maker (with G Suite for Education – Google Apps), Visual Studio LightSwitch (Microsoft), PowerApps (Microsoft Office 365).

The research was based on finding a way to enable the prototype with the imagined characteristics but through a process not very complex, considering the concept of an DLO as defined by Wiley (2000), Tarouco, Fabre & Tamusiunas (2003) and IEEE (Institute of Electrical and Electronic Engineers) in Braga (2014) there is a concern that it can be used by other teachers (use and reuse/reusability), as well as the possibility to serve as a reference so that other educators can also design their own DLO suited to their needs. In this context, choosing open source technology and good accessibility meets these properties.

After these technical and technological investigations, it was concluded that such platforms could even enable an App that would allow the aid in data collection, meeting almost all the features listed initially. However, the latest and most innovative feature of automating part of the production process would not be possible without having to learn some programming language to interact internally with one of these platforms (noting that not all of them offer this possibility of more specific programming that goes beyond the basic functionalities offered).

In this way, it was decided not to use any of the existing platforms, but rather to use another set of digital tools to achieve the goal completely without needing to learn a new programming language, besides that what it would already be necessary (the CGI software language).

The solution found was to use the technologies available through the Google Forms and Spreadsheets and in an integrated way, to complement and make feasible the programming of the functionalities, the use of two add-ons developed by CloudLab - Part of New Visions for Public Schools, which are the "autoCrat" and "copyDown".

Through several technical tests, it was possible to conclude that with the union and integration of these tools it would be possible to meet all the characteristics of the tool. In addition, the programming part for the generation of the automation function could be developed through basic instructions of calculation and automation through form formulas, not needing to learn new programming language. Thus, it would be a more affordable challenge than learning a programming language like Java, Visual Basic, C, C ++, C #, F #, as well as a database programming language like SQL.

5.2.2 CGI Software and Programming Language

There is currently several professional CGI software for production of animation and three-dimensional graphics computing. Some examples used in the entertainment industry for animations and visual effects are Maya, Houdini, Cinema 4D, Softimage, Lightwave, Pixar RenderMan, 3D Studio Max, Blender.

Many of this software have their own programming language known as Scripts, which allow you to do automation through command lines, even creating plug-ins and add-ons. Some examples of these languages are the Maya Embedded Language (MEL) used in Maya software, HScript used in Houdini software, COFFEE used in Cinema 4D software, LScript used in Lightwave software, MAXScript used in 3DS Max and Python language used in Softimage, Blender and also accepted in Houdini and Maya software.

In this context, in order to be able to execute the said automation characteristic by the prototype, it was necessary to choose one of this software and its respective programming language. In this process of choice, although the Python language is interesting because it is accepted by several CGI software, the previous experience and greater professional baggage of the teacher and researcher in the use of the software 3DS Max, has made that it was preferred, together with the MAXScript language. This choice led to the need to deepen the learning about the language, its commands and the understanding of its possibilities and limitations.

After these studies, several tests were carried out to find out the viability of the implementation of the proposal and it was discovered that practically all the necessary characteristics could be programmed through the language MAXScript, except those used to rebuild the natural lighting system. Clarifying better, the creation of the natural light system could be performed by Script, but it is not possible to transpose the variables (data) referring to the system.

To remedy this deficiency, a satisfactory solution was found at the end of the execution of the Script to create the natural light system, leave the screen open with all the properties and fields for insertion of the data and display at the same time on another screen through an pop-up all data collected to be copied and transposed to the software's natural lighting system, facilitating this process.

It is important to note that in addition to creating a script for automation in the use of the chosen software, all the data collected by the tool is also made available to the user of the tool so that they can be used in any other CGI software manually.

5.2.3 Definition of the Variables to be used

After defining the technologies to be used to produce the prototype, a study was carried out of which variables could be interesting to be used in the tool.

As an example it is possible to mention: the standard lights, of 47 possible attributes for its creation and configuration, were selected 11 for use in the tool, besides the positioning and name data, reaching 15 attributes; or the Physical Camera, that of a total of 77 possible attributes (18 commons with other camera types added to other 59 specific attributes) were chosen 21 of these attributes, plus name, position, and angle of inclination, reaching 28 attributes.

Thus, as in these elements, it was necessary to select as to which attributes were the most important and relevant to be included in the tool, all other elements of the prototype passed through the same bottleneck of attributes.

For this selection was prioritized in the first moment the essential attributes for the correct configuration of the element, so that it could present the same characteristics of the real element used in the set of filming. In second filtering, certain internal configurations of the CGI software were selected that could also facilitate the representation of certain physical (real) characteristics of the elements. Were left out the attributes related to more specialized and finer (detailing) configurations whose function is more relevant within the software itself during its use and rendering tests (generation of the final image).

5.2.4 Definition of the Number of Elements that the Prototype will Support

The tool will have the following characteristics and technical capabilities in data collection: a) shot location information; b) visual effects information; c) camera data collection (limit of 3 cameras at the same time in a scene, choices between legacy or physical type); d) lighting data collection natural and/or artificial (limit of 1 natural light in a scene and 8 artificial lights, limited of 4 lights that each type - standard or photometric); e) data relating to reference objects (reference balls for incidence light angle and color of light; reference plane to the place that will receive shadows and reflections from virtual 3d object or character; reference rod for size proportions and shadows); f) reminders about other important types of reference instruments and images/film to be produced for specific situations (color checkers, chroma-key references for camera trackers and the creation of photos or film in 360° for reflections); g) data collection for render setup; h) presets for 3DS Max File.

At the end of the production of the prototype, after the effective tests, were used between fields necessary to meet the attributes of all possible entries of all possible elements, plus the necessary fields for navigability and tool programming, a total of 319 fields of data.

5.3 Prototype Construction

To assist in the implementation of the prototype items such as navigability, freedoms and technical limitations, elements of support, language, license, website and repositories of learning objects were thought, discussed and used.

5.3.1 Navigability

In order to contribute to the project execution, programming, navigability and interface, some UML Structures (Unified Modeling Language) Diagrams were created.

The most used was the Use Case Diagram, focused on the presentation of features and characteristics of a system and the Activity Diagram, which contemplates the various tasks performed in the execution of an activity.

Such supports were essential for better organization of the navigability, ordering of the screens and options of routes for the task of data collection, as well as support in the tests and definition for the final layout. Because they are large diagrams it was not possible to make them available in this article.

5.3.2 Technical Design Freedoms and Limitations

The technical choice of the digital tools for tool development presented, like any other possible option, positive and negative points.

Some of the good points were: a) the tools are all freely accessible, thus highlighting the possibility of developing DLO through affordable and zero cost technologies, encouraging other teachers to create their own tools to aid in their teaching and learning activities; b) the programming language can be considered as open source, since the researcher gives full permission to the visualization of the formulas used to program the prototype so that other teachers can adapt the solution found to other needs; c) the solution does not use any programming language advanced beyond the MAXScript of the software 3DS Max, because, for the transposition of the collected data and its automation for the creation of Script, only spreadsheet formulas were used; d) the technology chosen for designing the prototype allows it to be used in any device and operating system, in both computers and mobile devices, making it very accessible and adaptable.

Some negatives: a) design limitations because the use of Google Forms for data collection implied technical limitations in the possibilities of layout configurations, navigability, among others. However, since it has been on the market a long time, and it is used by millions of people around the world, it already has undergone continuous improvements and corrections, adding design solutions (UI, UX, ergonomics, usability), already tested, corrected and improved; b) technological dependence of companies that provide the technologies, because despite the "property" through login and Google account, the company can change some feature or discontinue some function without prior notice and compromise the resources already implemented; c) despite the practicality and adaptability of being an online tool that can be used in any web browser of computers and mobile devices of any operating system, it is needed the device to have an internet connection to work. That is, you cannot use the device offline, compromising its utility in remote locations and without a data connection.

Layout limitations caused certain design tests (layout, ergonomics, usability) to be suppressed because the creation did not have the aesthetic and functional freedom of an application created from scratch without the aid of a third-party tool.

5.3.3 Elements of Support

In order to meet several of the attributes and complement the tool's functionalities, some animations and static images were produced to aid in the understanding of some concepts within the tool. With the same intentionality, it is also used images found on the web (all credited sources).

In this context of support, references were used through hyperlinks to some specific websites, which have more detailed technical explanations and online tools to assist with specific calculations in the audiovisual area. As examples we can mention tools for conversion among units of measurement of light intensity (lux, lumens, candela, watts); online tool "color wheel" to find the RGB code of a certain color; as well as a tool for calculating the Field of View (FOV) of the camera used for filming (more specifically the angle of view in horizontal direction degrees).

In addition to the use of static images, animations and hyperlinks, the tool itself contains some explanations to avoid that the student or inexperienced user provides wrong data, trying to minimize possible errors of understanding technical terms.

5.3.4 Idiom

Field research was designed for execution at a Brazilian university, mainly due to the following factors: a) technical availability for the execution of the activities (infrastructure with filming equipment, audio capture, computers for editing and composition of the material, audio studio and video, classrooms), with the necessary control of the variables (laboratory with equipment with the same configuration in hardware and software and time available to render the images outside the class hours); b) the university consists of three undergraduate courses related to audiovisual production (Cinema and Audiovisual course, Radio and TV course and Digital Media Communication course), thus increasing the possibility of a sufficient number of participants in the mini-course / activity of research.

In addition, the choice to develop the field research in Brazil instead of Portugal also happened because the proponent, despite being linked to the doctorate in the Portuguese university, is a professor at the Brazilian university, having, therefore, access and knowledge about the infrastructure besides the support of the institution.

In this context, although the students who participated in the experiment were native speakers of Portuguese, most of the audiovisual and CGI production software is already used in the English language, as well as the manuals of the video and lighting equipment used in the productions during the teaching activities.

Due to this common use that students of audiovisual courses established with the English language, and understanding that it is the most used language internationally, it was preferred for adoption in the prototype because it would allow its dissemination and use by teachers in an international context, and not in only countries adopting the Portuguese language.

5.3.5 License

The prototype was licensed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License. It allows others to download and share the work if they assign the credit but cannot change or use it for commercial purposes.

5.3.6 Website

For the tool to meet some important characteristics to be classified conceptually as a digital learning object as advocated by authors such as Tarouco et al. (2014) and Braga (2015), it was necessary to create a website to house the tool and complement it, with informative items such as its metadata and instructional structure (information about the general and pedagogical goal of the tool, usage guidelines and instructions for teachers and students).

In this way, the website was created which, in addition to housing the tool and such instructional and metadata content, also presents complementary information about this doctoral research. It can be accessed at <https://sites.google.com/campus.fct.unl.pt/digital-media-phd-website-avm>.

5.3.7 Learning Object Repositories

Another important feature in the definition and conceptualization of a digital learning object according to several researchers in the area (Prata & Nascimento 2007, Pentead, Gluz & Galafassi 2013, Braga 2014, Braga 2015, Tarouco 2014, Tarouco, Fabre & Tamusiunas 2003) (Prata & Nascimento 2007, Pentead, Gluz & Galafassi 2013, Braga 2014, Braga 2015, Tarouco 2014, Tarouco, Fabre & Tamusiunas 2003) is the possibility of their sharing in repositories so that they can be accessed and used by other teachers.

In this way, in order to contemplate this conceptual and relevant element for the distribution and dissemination of the tool, after having passed several tests and finalizing its first version, it was submitted to appreciation in two international DLO repositories, Merlot Repository (Brinthead, Pilati & King 2008, pp. 240-245) and Open Educational Resources Commons (2008, p. 1).

After the evaluation of the tool by these repositories and approval and release for publication, it has been made available for access and is already cataloged in the respective search services and available for viewing, access, and sharing.

6. CONCLUSION

The theoretical and practical research carried out in references of the Design area and the most varied methods of evaluation and conception of Digital Learning Objects, evidenced the great amount and diversity of different methods and techniques for the design of a DLO. Moreover, it has been found that due to the wide diversity of types of DLOs that can be created for a wide range of purposes and areas of knowledge, it has not been possible to come up with a single, standardized method that can be recommended for design and development of any DLO.

That is, the research was based on the evaluation and understanding of the most diverse existing methods, to extract which attributes were the most common among the different methods already reported in theoretical references that address the conception of DLOs. Thus, the research sought not only to indicate the most relevant and essential attributes to aid in the design of a DLO but also to explain the method used, which was based on a meeting of these best qualities of various methods, which can serve as a reference. It is a departure for other teachers and enthusiasts looking to design their own DLOs to assist in their teaching activities, whether the tool is for blended-use or autonomous use.

Thus, it is believed that the research was useful in its survey, selection, and improvement of the most relevant attributes and repeatedly used by the best known and widespread methods in the area. Therefore, the research was positive in its intention to contribute to the reflections about the design techniques necessary for the development of a DLO, allowing to guide new investigations and creations of DLOs.

Besides, future publications may further expose the results of the DLO implementation designed in this research to contribute to other research fronts regarding the validation of DLO's.

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Short Papers

MAKING TECHNOLOGY HUMAN: REAL TIME INTERACTIONS IN ONLINE LEARNING

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ABSTRACT

As online education becomes more and more ubiquitous in higher education, instructors are constantly seeking new ways to improve online teaching. Much has been done to increase the effective use of Learning Management Systems and to use student digital footprints to predict learning outcomes, however, prominent teaching strategies such as interpersonal interactions and immediate feedbacks that are common in brick and mortar classrooms are minimized in online learning or replaced by email communications and message board postings. Online education is gradually becoming technology-centered rather than human centered and lack of instructor intervention is still the number one disadvantage of online education. This paper proposes a virtual classroom approach that brings human interactions into online learning. It maximizes the opportunity students can interact with instructor and their peers, and effectively integrates traditional classroom teaching techniques with digital materials. The paper explains how traditional techniques can be adjusted to suit online teaching, and how to help students gain a sense of community, a strong human bond and a rich classroom experience in a virtual learning environment. Course evaluation result shows that student satisfaction rate from the trial class increased significantly over the average of previous semesters.

KEYWORDS

Higher Education, Distant Learning, Real-Time Interaction

1. PROBLEM STATEMENT

Online learning has been an integral part of high education across the world. According to BABSON Survey Research Group, distance education student enrollments have increased for the fourteenth straight year in 2016 and 31.6 percent of all students now take at least one distance education course (Seaman J. et al, 2017). More and more brick and mortar universities are increasing their online only degree offerings. Many institutions have adopted an online learning management systems (LMS) such as Blackboard, Angel or WebCT. The purpose of these systems are usually two folds, 1) to effectively distribute and manage learning materials and activities 2) to track participation and progress. With proper instructional design, an LMS can create a learning environment that enables students to take a class 100% online.

Two most obvious advantages of distance education are flexibility and convenience. The disadvantages of distance education are also clear, such as lack of face to face interaction with the instructor and the huge demand of student self-discipline. The rich array of tools provided by LMS help instructors to gain summary report on student activities, assignment completions and participation records. Because of this, there is a tendency that instructors rely greatly on technology to increase the quality of online education. Many instructors focus on developing better quality teaching materials such as slides or pre-recorded videos, tightly managed discussion items or forums. While all these are highly applauded and should indeed play a great role in online teaching, instructors tend to leave the course running on its own, and limit communication with students to emails or online postings. Online education is starting to lose human touch; however, this human touch is at the heart of the traditional classroom teaching; it is the time when teacher and students laugh together; it is what makes learning interactive and fun. As a matter of fact, many students prefer face-to-face classes than online classes due to “more engagement” and “immediate feedback” (Kemp N. & Grieve R., 2014). This paper introduces a virtual classroom approach that incorporates human touch into online learning so as to give students a similar experience to the traditional classroom learning while still maintain all the other online learning advantages such as flexibility, low cost and convenience.

2. LITERATURE REVIEW

Researchers have recognized the importance of human interactions in online learning. Moore (1989) identified three types of interactions, i.e. learner-instructor interaction, learner-content interaction and learner-learner interaction. Shackelford and Maxwell (2012) defined seven types of learner-instructor interactions, including providing timely feedback and instructor participating in discussions. A lot of research has been conducted on learner-content interactions, such as which learner-content activities are most effective (Kumtepe, A.T. et al, 2018), the relationship between learner-content interaction and course success (Zimmerman, 2012). For learner-learner interactions, researchers recommend using a variety of groupings, such as whole class and small group discussions, partner assignments, and individual responses (Mayes et al., 2011). Discussions among students, either synchronously or asynchronously, can create a strong sense of community, and can be led either by instructors or students. These three types of interactions can be easily facilitated and integrated in traditional classroom teaching, however, in distance education, much focus lies on promoting each type of interaction rather than the integration of them all. Adding a human touch through digital contents allow an instructor's passion and personality to shine through the online environment, and these practices do have a positive effect on student learning (Conaway T. and Schiefelbein J. 2011), however, much has been done to instill personality into digital materials such as videos, images and email announcements, and these cannot replace the instructor's real time presence in a virtual classroom that mimics the atmosphere of a traditional classroom setting.

3. APPROACH

In the proposed approach, instructor meets with students via video conferencing at a fixed time of the week. The video conferencing room serves as the virtual classroom where instructor can conduct a variety of in-class activities such as lecturing, demonstration, facilitating discussions, helping with assignments etc. The software tool selected for this purpose must support audio/video real time group conversations, computer screen sharing, remote desktop control, video recording, private and public chat rooms, small group breakout rooms. These features give instructor different options in designing classroom activities that can best promote interpersonal integrations as well as learner-content integrations. Popular video conferencing software that supports the above features include Web Meeting, Global Meeting Collaboration, Skype and Zoom. The author experimented the virtual classroom approach using Zoom, with a class of 56 students in Fall 2018. Below is a summary of key practices used.

3.1 Exquisitely Managed Virtual Classroom Sessions

The class would meet every Monday evening for two hours online. Using Zoom, instructor can create a recurring meeting at the beginning of a semester, and the link for all meetings is the same. Students just need to click on the link to enter the classroom. Clicking on the same link gives the students a feeling of entering the same classroom. Zoom will allow all participants see each other if the student's video camera is on and the participants can talk to one another freely. Once the students are in the virtual classroom, the instructor will orchestrate the class so that this virtual classroom truly functions like a real classroom.

In a physical classroom, the instructor presence ties the class together. Instructor's outlook, mood and personality depict the tone of a class or even an entire course. Same can be said for a virtual classroom. Professional attire, friendly and encouraging voices, carefully selected camera backdrops etc. all contribute to the atmosphere of the classroom. Although the backdrop design should not divert students' attention, changing the backdrop to reflect the current events, holiday or seasonal changes will bring a great deal of human touch to the online class. Props and other objects relevant to teaching materials can be brought into the classroom. Spending some time at the beginning of a semester introducing each other, and later throughout the semester, a minute or two exchanging personal or holiday greetings help to create a strong sense of community and a bond among instructor and students. This course then becomes live to students, and is no longer just some materials to study, videos to watch and assignments to submit. When feeling more connected with each other and with the instructor, students will be more willing to ask questions and seek

timely help, thus the human touch not only draws student attention to the class but also increases academic performance.

Other learner-centered interactive activities help creating a richer classroom experience as well. Examples include seeking student feedback periodically, asking students to complete a small assignment after watching instructor live demonstrations, and group discussions. Small breakout rooms on Zoom allow students to be separated into different groups, and group activities can be carried out as if they are in a physical classroom. Later, group leaders can report activity outcome to the entire class. Students who feel engaged and connected are more likely to feel satisfied in the learning environment.

In a traditional classroom, the three types of interactions as defined by Moore can be easily integrated. Learner-Instructor and Learner-Learner interaction can be achieved through direct and interpersonal communications inside the classroom. Learner-Content interaction can be done through carefully designed active learning strategies such as Affective Response and Clarification Pauses (Paulson, D. & Faust J., 2019). Because a virtual classroom can function just like a brick and mortar classroom, instructor can design a class that includes a Q&A session (Learner-Instructor Interaction), Active Learning activities (Learner-Content Interaction) and student Group Discussions (Learner-Learner Interaction). As a result, instructor intervention and timely feedback which are normally known as common drawbacks in online learning can be fully implemented in a virtual classroom.

3.2 Adjusted Teaching Strategies to Suit Online Learning

Due to the nature of online learning, some adjustments must be done in teaching strategies. Instead of using a white board or projector as in a physical classroom, instructor would use his/her own computer screen and share computer screen with students. Lots of video conferencing tools provide this screen sharing capability. As different types of digital materials can be played on a computer, this method is more powerful than using a white board. What's more, each student is looking at instructor's computer screen and hearing instructor's voice at a close distance, as if the instructor is sitting right next to his/her. This makes learner-instructor relationship very personal. Students can also share their screen with each other or with the class, thus makes learner-learner interaction personal.

One of the biggest advantages of online education is the flexibility, which allows students to learn materials at their own pace, or fit school in around their work and family responsibilities. Because of this, attendance to classes should not be required. For those who cannot attend a class, the entire virtual classroom session will be recorded, and the recording will be made available to students within 24 hours. Recording capability is also a standard feature for many video conferencing tools. In the class, instructor can pause and resume recording at any time. Timely release of class recordings is very important so that all students, whether they attend a virtual class or not, are on the same page.

Although attendance is not required, attendance should be taken to encourage student presence in the virtual classroom. In the trial class, the author gave extra credits for students who attend over 90% of the classes. Another challenge is classroom participation. Students login into the classroom not necessarily mean they are actively listening, thus techniques such as pop-up questions, on-the-fly discussions, and small assignments after demonstrations can be used, and participation records should be kept on track.

Virtual classrooms can be used for instructor or teaching assistant help sessions. All techniques used in the class applies, except that in help sessions, the relationship becomes a one-to-one relationship, rather than a one-to-many relationship. Zoom allows a student to release mouse control to the helper, so that the helper can operate student's computer when necessary. It makes coaching extremely personal and efficient.

3.3 Well Organized Supporting Materials

In online education, it is common that abundant digital learning materials are posted in the LMS for self-study. Such materials often include power point slides, text files, and videos. Although virtual classroom sessions play a key role in the class, supplementary learning materials may be posted on LMS as additional resources. The virtual classroom recordings should be logically organized and well mixed with other materials. The role of the virtual classroom should be made clear to students, whether it is the starting point or summary of a topic. Virtual classroom can be the core of the course, or supplementary to other materials, but should not be designed to be the only resource of learning.

4. CONCLUSION AND FUTURE WORK

In the university where author teaches, all students are expected to complete an anonymous end-of-semester online course evaluation. Using the same questionnaire, student satisfaction rate from the trial class showed a significant increase over previous semesters, in the same course taught by the same author. See Figure 1.

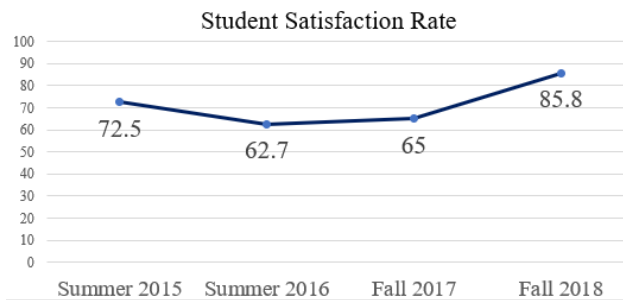


Figure 1. Student satisfaction rate in trial semester (Fall 2018) compared with previous semesters

It is worth a note that national student satisfaction rate in academic year 2014 through 2016 for four-year public institutions was 55% (Ruffalo Noel Levitz, 2017). While the experiment has gained initial success, there are a few more questions to be answered, such as 1) Will the satisfaction rate remain consistently high in the same class and in other classes? 2) How to handle classes with large enrollments? 3) Should a class be capped under certain enrollment for the virtual classroom approach to be effective? If so, what is that magic number? At the time when this paper is written, the author is conducting a second experiment with a different course and will continue to seek answers for other questions.

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USING ELEARNING AND INTERNATIONAL COLLABORATION AMONG UNIVERSITIES TO PREPARE TEACHERS OF CHINESE AS A FOREIGN LANGUAGE

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ABSTRACT

With the growth and international expansion of the Internet has come a corresponding growth in eLearning. Colleges and universities throughout the globe have incorporated eLearning as an increasingly important part of their activities, and a predictable consequence has been increased interest in international collaboration among colleges and universities to solve common problems in higher education. This paper describes the successful international collaboration by building activities of one United States public university, working with partners in China and Taiwan to address needs for enrollment, expanded course offerings, and new degree programs to meet an identified demand for teachers of Chinese as a foreign language in multiple settings.

KEYWORDS

eLearning, Collaboration, International, Mandarin Chinese, Foreign Language Instruction

1. INTRODUCTION

The rise of the Internet as a global platform for eLearning in the 21st century has had a profound effect on higher education. Teaching and learning activities have become available to anyone with an Internet connection, anytime, and anywhere (Cifuentes & Shih, 2001). eLearning has become a standard component in the offerings of higher education institutions (Ellis, Ginns, & Piggott, 2009; Arkorful & Abaidoo, 2014; Clover, 2017). This has helped colleges and universities provide for a more diverse student body, both in terms of geography and in terms of age (O'Neill, Singh, & O'Donoghue, 2004). In the process these institutions have expanded their global reach in search of new students and international reputations (Singh, O'Donoghue, & Worton, 2005). To do so has required international collaboration, which is complicated at best (Wang & Beasley, 2014) but has the potential to enhance activities that are fundamental to the existence of colleges and universities (McLoughlin, Wang, & Beasley, 2008). Successful international collaboration via eLearning has supported the maintenance (and sometimes increase) of needed student enrollment, expansion of course offerings, and even the development of entire new degree programs.

The purpose of this paper is to share some eLearning examples implemented in the author's working university in the Midwestern United States. Please note that the model for using eLearning in the author's institution is wholly online (as specified by Arkorful & Abaidoo, 2014, p. 404).

2. CONTEXT

The following is an account of how a public university in the United States developed successful international collaboration using eLearning that benefited students in institutions in higher education among the United States, China, and Taiwan.

About 14 years ago, a public university in the United States came to have a strong interest in collaboration with universities in other countries for three main reasons:

- 1) Enrollment. Every university is interested in boosting enrollment, and international students provided a promising pool of potential applicants.
- 2) Expanded course offerings. No university has faculty and resources to offer every possible course in every field. Partnerships could increase available course offerings, thereby potentially increasing enrollments and revenue.
- 3) Creating something new. Working with international partners could make it possible to accomplish things that neither entity could accomplish alone. (This ultimately became a quest for new degree and certification programs.)

These three items became the primary goals of an ultimately successful project that would span the next 14 years. This is an account of that project – what actions were taken, what obstacles were encountered, and how problems were solved.

It all began in approximately 15 years ago when the author of this proposal received an invitation to deliver several professional presentations in China. She soon invited the Dean of her college and other faculty and administrators from her home institution to China, and began to stimulate interest in various forms of international collaboration – faculty exchange, jointly sponsored conferences, visits, and international collaboration between K-12 institutions. Two years later she was successful in securing a Fulbright Scholarship to Taiwan, and her time spent at a university there allowed her to cultivate additional professional contacts with institutions in both China and Taiwan. That process continued in the ensuing years.

About the same time, the U.S. government had made available three years of funding through the CORE program for training teachers of critical languages – and Mandarin Chinese was one of these languages. Her home university successfully secured funding to offer classes leading to such certification; they recruited native Chinese speakers in their geographic area, trained them in pedagogical techniques, and secured state teaching licensure for the individuals as teachers of Chinese. But the federal funding ended after three years. The experience demonstrated that there was a large demand for such a program, and there was at that time no replacement program to continue meeting the demand.

The author of this paper saw an opportunity. She created a graduate program aimed at native speakers of Chinese which led to a combination of a Master's degree in education with state teaching licensure in the area of Chinese language. It took three years to secure all of the approvals, but the program launched in Spring 2011 and continues to this day. In order to meet all ACTFL standards for teacher education candidates, the degree included a requirement for evidence of appropriate coursework in Chinese culture, literature, and linguistics. The U.S. home university lacked courses or faculty in these areas – but as it turned out, institutions with which connections had been established in both China and Taiwan had existing courses in these areas and were willing to provide them via eLearning. They began doing so in 2011 and continue doing so in the present. The program was an immediate success. Enrollment has been steady since its inception, and nearly every graduate who sought a teaching position has been able to find a job placement teaching Chinese in the U.S.

At this point we should note that those three initial goals were met (in some form) at this stage. Students were enrolling in the local university in the U.S. who might never have done so without this program. The available course offerings had been expanded to include eLearning courses in Chinese culture, literature, and linguistics, with the support of Chinese and Taiwanese partner universities. And the local university in the U.S., working with multiple partners overseas, had created an entire new graduate degree/teaching licensure program.

This was noticed. The author formed a delegation led by the local university President in the U.S. to visit with institutional partners in China. At the encouragement of the author, the possibility was raised of “upping the ante” – creating a program that would not only prepare teachers of Chinese as a foreign language, but would instead prepare individuals to prepare teachers of Chinese as a foreign language. That is, a doctoral program, that could graduate individuals capable of creating and maintaining their own programs for preparing teachers of Chinese as a foreign language. At about the same time, the students graduating from the earliest cohorts in

the local Master's degree/licensure program were voicing an interest in being able to continue their studies. This also pointed toward a doctoral program. The author began the process of formally proposing and securing approval for such a doctoral program.

Fast forward (since securing approval for doctoral level programs is exponentially more complicated than doing so for Master's level programs) to 2017. Final approval was secured for a Ph.D. program in Urban Education, with a specialization in "Teaching Chinese as a Foreign Language". The required coursework includes four graduate courses supported by two partner universities in China. In Fall 2018, the program admitted its first student.

We can now step back and say that the three initial goals have been met a second time, at a higher level. Doctoral students are now enrolling at the local institution in the U.S. who would have been unlikely to do so prior to the establishment of this doctoral degree specialization program. Course offerings have been further expanded, to include four at the doctoral level offered via eLearning by Chinese partner institutions. And the collaboration has again produced something new, this time at an even higher level – a doctoral program specialization engaged in turning out future leaders in the field of teaching Chinese as a foreign language.

3. CONCLUSION

In summary, this account has described the process through which a Midwestern public university in the United States was able to make use of eLearning and international collaboration to address concerns common to all universities everywhere: enrollment, course offerings, and the ongoing drive to create and nurture new scholarly endeavors.

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Reflection Papers

GLOBAL LEARNING AND ITS IMPLEMENTATION

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ABSTRACT

Global learning is concerned with intercultural and international aspects of education as well as specific content areas. Technological advances support students from different countries, backgrounds, and cultures to study and learn together, and enhance their pedagogical and life experiences. Global learning is critical for educators as well as students in order to embrace world cultures and events and develop as citizens of the world. This paper provides a background into global learning. The generic goals of global learning and the technology that can implement, facilitate, and sometimes impede them are discussed.

KEYWORDS

Global Learning, Benefits, Education, Technology

1. INTRODUCTION

Global learning is the collaboration for the attainment of knowledge that surpasses national boundaries. It is international, and both multicultural and intercultural. It supports tolerance and diversity. It provides varied perspectives on politics, religion, ethnicity, and race. Connections between subject matter and future careers and society are formed. The world today is complex and greater understanding among different countries and their populations is necessary. Students need to recognize interdependencies and promotion of social justice in a worldwide context. Global education is a stepping-stone for universal acceptance and peace. It promotes progress toward the unity of man as well as the enhancement of content learning (Education Transforms Lives, 2019).

The goals of global learning include the generating of new knowledge about global studies, the encouraging of greater civic engagement and social responsibility, the cultivation of intercultural skills and the necessary technical skill expansion and training. This includes greater knowledge of the historical, political, cultural and socioeconomic connections among the world, identification of the processes by which civilizations are defined now and in the past, and investigation of the dynamics of global transactions of various types (Kahn & Agnew, 2015).

We need to inculcate our students with civic awareness and respect so they may become citizens of the world. Global education promotes a heightened sense of international connections and interdependencies, a heightened sense of the power of individual intervention in a global situation, identification of ethical and moral questions from an international perspective, identifications of international as well as national obligations. The future requires the ability to traverse cultural borders with greater skill, the ability to view issues from different perspectives, the capability to work effectively with people from different backgrounds and beliefs, and greater tolerance for differences (Global Dimensions, 2019; Kahn & Agnew, 2015).

As global educators, we need to support our students analyzing situations across different areas of information. We need to guide our students in applying their knowledge to new local and global environments and to discern the similarities and differences between the two. We need to support their analysis of the ethical and moral issues, including those pertaining to technology. Furthermore, we need to share pedagogical strategies that work for all students. Different learning styles that need to be addressed are not local in nature, but rather worldwide (Education Transforms Lives, 2015; Global Dimensions, 2019).

2. BODY OF PAPER

2.1 The Implementation

Many innovations in today's educational environment incorporate technology to an extensive degree. Indeed, technology supports a global learning community. Technology has facilitated greater collaboration and dialogue among participants who are interested in advancing global learning and learning in general. We are able to share research, pedagogy, and learning with colleagues and students both geographically close and remote. Technology has bridged temporal and geographic disparities.

2.2 Technological Perspectives

For the most part, technology promotes and enhances global learning. The Internet and the World Wide Web are the underlying platforms for global learning channels and environments. The cost to promote global learning is relatively low over the computer networks, and yet, the audience it can reach is massive. Courseware, like Blackboard or Moodle, is the vehicle driving global learning (Blackboard, 2019; Moodle, 2019). Courseware provides secure login, discussion templates, internal emails, homework postings and submissions, exam monitoring, student activity logs, and many other assessment functions (Blackboard, 2019; Moodle, 2019). Technology creates courseware as a virtual classroom with all the tools needed and without the physical walls and doors. Digital learning tools, e.g. Cengage's MindTap or Pearson's MyLab, assist teachers to plan lessons, utilize test banks, monitor student progress, and perform tasks usually done with pencils and papers without technology (Cengage, 2019; Pearson, 2019). Blogs, webcasts, social media, invitation-only video and audio meeting software, like Zoom or Skype, are not subject to geographical boundaries; they facilitate seamless communications, protect academic freedom, and make the global learning experience truly multi-media focused and cost-effective (Zoom, 2019; Skype 2019). On the other hand, technology can be implemented by governments or certain organizations to impede global learning. Some governments employ technology to censor dissident scholars, monitor opponents' daily activities, and even shut down the entire Internet services in their perspective nations. In recent years, technology has become a double-edged sword for global learning. Many innovations in today's educational environment incorporate technology to an extensive degree. Indeed, technology supports a global learning community. Technology has facilitated greater collaboration and dialogue among participants who are interested in advancing global learning and learning in general. We are able to share research, pedagogy, and learning with colleagues and students both geographically close and remote. Technology has bridged temporal and geographic disparities.

2.3 Ethical Perspectives

The growth of global learning communities and the incorporation of technology into the learning environment require appropriate ethical behavior when using and taking advantage of these educational boons. People need to be familiar with different concerns and issues, including, just to name a few, the following: the liability of publishing false or private information on the Internet, the format of Internet citations, fair use and copyright, computer-use guidelines, and the evaluation of Web information. Plagiarism as a concept needs to be addressed from different perspectives, including that of sociological background. Part of understanding and accepting differences in populations is to be ready to lay a foundation that one might have taken for granted in a homogeneous environment.

2.4 Pedagogical Perspectives

From a global perspective, educators are seeking to enhance the education of our students. There are different types of learners and different cultures at different institutions. Global learning fosters networking for academic improvement and builds upon these differences.

The culture of an institution with regard to the scholarship of pedagogy and learning needs to be strong. This is important from a local perspective but even more so from a global perspective because of all the additional considerations. If the faculty does not believe in its importance, given the possible consequences, the culture of the institution needs to be changed. The fundamental way of accomplishing this is by establishing expectations, providing support, and then assessing and rewarding the faculty (Global Dimensions, 2019).

3. CONCLUSION

We are now part of a global knowledge community. When one speaks of global learning, it is for students and instructors as well. We are living in a remarkable time for education and the enhancement of pedagogy. Ideas, thoughts and knowledge can be readily shared. We need to take advantage of the opportunities offered to us. We are citizens of the world.

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ACCOUNTANCY HIGHER EDUCATION: EVOLUTION IN DIGITAL TECHNOLOGIES ADOPTION

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ABSTRACT

The digital technologies are increasingly present in the daily life as we can notice through the dissemination of smartphones with countless apps that brought innovation in the manner people interact, access information and learn. The educational environment is not aloof from this digital evolution and there are several initiatives to apply technologies in the education on several subjects, being this paper focused on Accountancy undergraduate program. This paper is based on a qualitative research method comprising the review of the literature as well as the participant observation of two semesters of the course Accounting Information Systems at the University of São Paulo. It is possible to observe that the digital technologies increase the dynamics in the teaching-learning process, however it is necessary to be mindful that the technology is not the end, instead it is the mean. The digital technology use has a broader impact than a mere tool, because the current technologies have potential to interact with people and allow them to reorganize their thinking process. For scholars, several possibilities unfold to fulfill the learning objectives, going far beyond blackboard and books. For professors, there is the challenge of being trained, adapt and incorporate the technologies in the classroom.

KEYWORDS

Digital Technologies, Education, Accounting

1. INTRODUCTION

The human history encompasses the evolution in the way assets, liabilities, equities, production costs, profits and several other items are valued and booked since the times of Luca Pacioli. Nowadays, with the information technology present in the enterprise information systems known as ERPs, several automatic postings are included in its accounting processes that in essence refer to the gist of the double-entry bookkeeping.

The accountancy education is not dissociated from this evolution, once the traditional lectures that were mostly expository already can count on digital technologies to change the teaching-learning scenario. In a broader sense, it is noticed the importance of avoiding that the students stay aloof from the new technologies that surround the business environments that are beyond the academia.

This reflection paper analyzes how the theoretical reference approaches the digital technologies in the accountancy education. Will it perceive it as an additional tool? Will it be a replacement for the expository lecture? Will it have an approach towards programming logic or data modeling? Or, even further, will it be an ally in the human-computer interaction resulting in new ways of thinking, learning and teaching?

In order to accomplish its objectives, this research adopts a methodology that consists of literature review, a reflection based on the researched authors and an observant participation example of digital technology applied in the accountancy undergraduate course in the University of Sao Paulo.

2. EVOLUTION IN DIGITAL TECHNOLOGIES ADOPTION

First, a brief definition of technology in education according to Barros (2017): the education technology comprises all resources and tools used in the process of teaching and learning. In this definition, it is necessary to highlight that the core is the education and that the technologies are the means not the end, thus the human aspects of education and interactions between the individuals are maintained.

This research presents an analogy of the digital technologies phases in the mathematics education according to Borba, Scucuglia and Gadanidis (2015) and the phases in the Accountancy education. The transition between each phase has distinguished scenarios, since the use of a new educational technology resource added originality to the thinking process with technology. The Table 1 summarizes several breakthroughs that can be seen between the transitions of phases such as evolution in computer processing, high speed internet improvements and scalability with more people accessing digital technologies.

Table 1. Evolution of digital technologies usage in Education

Phase	Technologies	Events
Phase I - 80's	Computers Calculators	Calculator HP 12C launched in 1981
Phase II - beginning 90's	Popularization of computers	Spreadsheets (Microsoft Excel®)
Phase III - End of 90's	Computers, laptops and internet	Teleduc, e-mail, chat, forum, google
Phase IV - After year 2004	Computers Laptops Tablets Smartphones Faster Internet Speed	Youtube Virtual Learning Environment Wikipedia Apps

In each phase there were challenges and opportunities disrupting traditional approaches. According to Barros (2015), it is possible to distinguish technophiles and technophobes, being the first with a positive perception of technology adoption while the technophobe sees negative aspects and resistance that might be linked to a trend to stay in the comfort zone. The ideal is that education professionals have critical thinking to evaluate both positive and negative aspects of technology in the teaching-learning process.

The use of calculators and spreadsheet applications, for instance, could be seen by technophiles as a way to optimize the resolution of more complex calculations resulting in more time to think about the logic and problem resolution instead of repetition of mechanical calculations. On the other hand, technophobes can argue that calculations should be done manually in order to avoid the students' dependency on technology and a scenario in which they are not able to perform the calculations without a calculator or a spreadsheet application. Concerning internet in the education, it can be used as a tool to expand knowledge as well as a distraction, being necessary a good dosage of its use to avoid that students are overwhelmed with a lot of information contrasting with little assimilation.

An approach to be considered is that education technology is not a mere tool to replace or an accessory to help the execution of tasks, it can have a broader usage in enabling the reorganization of the thinking process, since there is the constant interaction between individuals and technologies in a sequence of inputs and outputs (Tikhomirov, 1981 as cited in Borba and Penteadó 2016).

In the book *The One World Schoolhouse*, Samal Khan, the creator of the Khan Academy, among other considerations, observes how digital technologies can enable the flipped classroom approach in which the videos of explanatory classes can be seen as homework while in the classroom the activities are focused on discussion, problems' resolutions and interaction between students and teachers. By watching the explanations in the videos, students can pause and repeat the video as many times as necessary and make their notes in a pace that does not affect the pace of other students learning and besides allowing the students to expand horizons if their curiosity leads them to make more research on the theme (KHAN, 2013).

2.1 Example of Digital Technology in Accountancy Higher Education

Several digital technology options are available nowadays to be used in the teaching-learning process. Some of these were specifically designed for educational purposes such as Khan Academy, others can be incorporated in the classes for educational purposes. In this paper, we will see an example of digital technology usage in an Accounting Information Systems course in an occasion that the author of this paper participated as tutor in the classes. The tutor role of the author was performed as part of the Teaching Improvement Program in the University of Sao Paulo known as PAE (*Programa de Aperfeiçoamento de Ensino*).

This Accounting Information Systems course had its program and some materials such as power-point presentations available in the course portal. In addition to that, the class had activities on an actual ERP system in order to familiarize students with the way the companies maintain information and transactions in such system.

The use of the ERP in class was possible thanks to a partnership between the course professor and the professionals from an ERP company. The students received an individual remote desktop access to a laboratory ERP system. With this remote desktop access, they were able to connect to the system from home anytime as well as during the class from their own laptops or from the computer lab in the university. A list of activities was provided to the students and they had assignments to maintain master data, create chart of accounts, make some accounting postings and display their results on the system.

All the students' tasks were captured in the system log allowing the professor and the tutor to monitor which students completed the activities and which ones needed more guidance. The students had additional support through an e-mail communication to clarify questions or solve issues. In this learning process, the students were constantly facing the cycle of inserting inputs in the system, executing, receiving warnings when some input was wrong or receiving the confirmation that the outputs were the expected ones. This was an ongoing process rather than a final exam date when everything is evaluated in a single event.

3. CONCLUSION

The role of digital technologies is becoming more comprehensive than a tool because of its interactivity characteristics that are promoting a new reorganization of the thinking process to teach and learn. Specifically, in the example presented of the Accounting Information Systems course, it was noticed the transition between the theoretical concepts about chart of accounts, accounting postings and ledger to a translation in terms of the modelling of information systems, which for some students represented their first contact to the practice using a system designed to be used by companies. The usage of the logs from the system provided a new evaluation method because the students knew the system was tracking what they were doing without the need that they present or deliver a written task.

Future researches on this theme can count on case studies about technologies applied in the business courses, the flipped classroom approach and also there are opportunities of multi-disciplinary studies with neuroscience related to the reorganization of thought in the learning process with digital technologies. It will be interesting also to perform interviews with professors about the challenges they face to keep up with the innovations in the digital technologies in education. Besides that, learn from the professors which adaptations they have done in their teaching methodologies that differ from the way they were taught at the time they were students.

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VIRTUAL REALITY IN SECOND LANGUAGE ACQUISITION RESEARCH: A CASE ON AMAZON SUMERIAN

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ABSTRACT

Virtual reality (VR) has gained increasing academic attention in recent years, and a possible reason for that might be its spread-out applications across different sectors of life. From the advent of the WebVR 1.0 API (application program interface), released in 2016, it has become easier for developers, without extensive knowledge of programming and modeling of 3D objects, to build and host applications that can be accessed anywhere by a minimum setup of devices. The development of WebVR, now continued as WebXR, is, therefore, especially relevant for research on education and teaching since experiments in VR had required not only expertise in the computer science domain but were also dependent on state-of-the-art hardware, which could have been limiting aspects to researchers and teachers. This paper presents the result of a project conducted at CITEC (Cluster of Excellence Cognitive Interaction Technology), Bielefeld University, Germany, which intended to teach English for a specific purpose in a VR environment using Amazon Sumerian, a web-based service. Contributions and limitations of this project are also discussed.

KEYWORDS

Virtual Reality, Second Language Acquisition, Vocabulary, WebXR, Amazon Sumerian

1. INTRODUCTION

By naming an experience VR, we refer at least to a visualization in 360 degrees of digital content displayed, e.g., inside a visor, called **virtual reality headset** or HMD (Head Mounted Display). Such a device fits on the head of its users in a way to block or minimize the interference with the surrounding environment. Moreover, some of these devices allow 6 degrees of freedom (meaning the possibility of moving right and left, up and down, forward and backward, combined with rotation on three perpendicular axes) and the manipulation of objects in the virtual world by adding controllers to the hands of its users.

The gaming industry has been taking the lead on the development of consumer VR technology and applications, but many other markets have shown interest in it as an **ultimate tool**, education included, especially in the field of hard sciences, where some concepts gain a new perspective when they can be perceived in 3D and 360 degrees (Curcio, Dipace & Norlund, 2016). In addition to this trend, which focuses on problem-solving, simulations of scenarios and historical events are also found, where the user receives information in the form of text and/or audio while contemplating the virtual environment. Among the vast possibilities in the field of education, this paper is particularly concerned about WebVR as a means for second language acquisition (SLA). More specifically, how **immersion** can be beneficial for vocabulary learning. By immersion, it is understood here the techniques that enable the user of a system to feel an illusion of non-mediation between them and the virtual world. VR environments are experienced in the first-person perspective, and such a perspective might be worth investigating since it is easier to translate foreign language vocabulary when autobiographic memories take part in its evoking, i.e., when a person is asked to translate a foreign word which has a significant contextual meaning in their lives (Matlin, 2004).

Although the research interest on VR has been noted for some time in the CALL field (Schwienhorst, 2002), only recently it became possible to create web-based life-sized experiences with natural interactivity.

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Moreover, academic projects towards VR in the field of foreign language vocabulary learning are scarce, and a possible reason for that had been the restricted access to the technology in Humanities before WebVR became a suitable tool. As the literature review shows, by the time this research started, there were only a few comparative studies about this topic (Cho, 2018; Vazquez et al., 2018; Gupta, 2016). Meanwhile, VR has been used commercially, in the field of language instruction, mostly as training of ready-made sentences for travellers. Therefore, one could ask if VR is a replacement for classroom role-plays and drills, as well as what would take for the learner to feel immersed conversationally in the virtual space.

The following topics introduce how Amazon Sumerian, an online platform for the development of augmented and virtual reality applications based on WebVR/WebXR, can be of use in the SLA research field, considering the two aspects mentioned above, as well as its limitations within Amazon Web Services.

2. VOCABULARY AND COMMUNICATION IN CONTEXT

During a research visit of Ana Monteiro at CITEC's virtual reality group led by Thies Pfeiffer, now Professor at Emden, a group project was created, entitled **Second language vocabulary learning for health professionals**. This project had the support of the Nursing Faculty at an institution nearby, where other projects had been conducted before to train the Nursing students certain procedures in VR. The main work during the summer semester of 2019 was to build scenes in VR so they could be a context-based scenario for learning English vocabulary related to wound care materials and for the practicing of protocols for good and effective communication between the nurse and the patient. Besides labeling the target-objects with name tags that would appear when the player touches them in VR, a dialogue system (outside AWS) using both text and voice input was built, creating a bi-lingual communication between the user and the guide of the experience (a virtual agent). In this way, the player could ask for translations in either English or German.

2.1 Amazon Sumerian

Amazon Sumerian (hereafter AS) is one of the services offered by AWS. It allows users to create and publish AR and VR scenes via an URL accessible from any compatible browser (the latest versions of Chrome or Firefox), which is made possible via the WebVR standard. AS supports the main VR headsets in the market today, including the now open-sourced Google Cardboard. The HTC Vive headset and controllers were chosen for this project, for its higher quality.

To begin developing with AS, an account on AWS must be created. This account gives access to other services such as Amazon Lex and Amazon Polly, which were also used in our prototype, and it can be free for educational purposes. Programming knowledge is not needed since AS uses an editing system based on a visual representation of coding called **state machines**. However, as the developer's goals become more specific, knowledge of JavaScript allows connecting services outside AWS' scope which can be useful for a system including natural language processing (NLP), as we exemplify below. AS allows the user to import 3D objects, together with their materials and animations, from modeling programs (such as Blender, a free, open-source software) and online assets shops. AS also features the so-called *hosts*, human-like characters that can guide the user through the experience via speech recognition and text input.

2.1.1 Models and animations

Since the 3D objects available in the AS library did not correspond entirely to the needs of the scene in the project, two students were responsible for modeling a few elements in Blender and export them to AS. During this process, we realized there were some limitations on the size of the images regarding texture, as well as a limit of vertices AS can render. Despite that, two scenes were composed with all the objects and respective animations needed for the simulations of a wound care procedure. Relevant to note, however, is that the scene in VR cannot function properly with as many objects and textures as the desktop version of the same scene. Thus, as the model for the host could not be implemented beyond scene 01, we kept only its voice acting as the player's guide.

For acting as a patient (Figure 1), another character had to be made outside AS since hosts cannot have their bodies and vertical position changed. As a solution, the students used two other software products, Fuse, for character building, and Mixamo, for character animation (both from Adobe and free to use in the context of this project).



Figure 1. Patient rigged in Mixamo, which added a ready-made animation for lying down and breathing

2.2 Vocabulary Teaching Methods

As a prototype, this project sought to experiment with both explicit and implicit methods of teaching words and phrases in context. One was by directly showing the player the names of the objects they were manipulating. The other one was via the dialogue component of the scene, meaning the voice interactions the player can have with either the guide or the patient. While talking to the patient, as good practice, the nurse must be able to explain what they are doing and that is where the name labels on the objects become useful. Repetitive exposure to the name of the items, regarded as crucial in vocabulary learning (Koda, 2012), comes in naturally at play since the same objects are manipulated more than once.

2.2.1 The Dialogue

AWS features a chatbot system called **Lex**, which could not be used for the wanted interactions in the project because of its limitations for dialogue flow. For example, it requires intents, sentences that are likely to be said by the player. Since we wanted to build a system that dealt with a degree of unpredictability in the sentences spoken by the player, another option was found outside AWS, on Wit.ai, a free NLP resource for web-developers. Incorporating such a tool to AS is possible, but not through the visual interface and therefore knowledge of JavaScript was needed. We used keywords so the player does not get frustrated if they do not remember or say correctly an entire English sentence. Moreover, Wit.ai made possible the switch between two languages (German and English), which could be accessed by a specific triggering sentence directed to the virtual guide (Maya), such as in **Maya, can you translate that?**

The dialogue was segmented in 10 units concerning different parts of communication skills for the interaction nurse-patient, e.g., explanation of procedures and small-talk. If the player says something that is not expected, the virtual guide interferes in the dialogue to give the player a hint. After each segment is done correctly, two buttons appear in the scene, one to continue, and go to the next section of the dialogue, and another one to redo that dialogue section. The player can also pause the scene at any time.

Finally, to give the characters different English variations, we used Amazon Polly, a text-to-speech application that can be managed directly from the AS console. Polly also allows the customization of these voices in terms of prosody, enabling the characters to sound closer to a human voice.

3. NEXT STEPS

A comparative study will be applied to Nursing students at Universidade Federal de Juiz de Fora, after the ongoing English for specific purposes module being taught by Ana Monteiro in the same institution. This study will expose the participants, divided into two groups (control and experimental), to the desktop and VR conditions for learning the target-words related to wound care. For the experimental group in the VR condition, HTC Vive headsets and controllers will be used.

The quantitative data of the experiment, i.e., the pre and post-vocabulary tests, as well as the qualitative data, obtained from questionnaires, will be analyzed to answer these questions: 1) Does VR contribute for short and long-term recall of English vocabulary as a second language?, and 2) To what extent does the affective component influence English vocabulary learning in VR?

The fact that AS is web-based is something to consider if the results obtained from the experiment are promising for education purposes. That means it will be easier for other researchers and teachers to replicate the methodology of the study, once there is no need for high-end computers and headsets.

4. CONCLUSION

Language and cultural differences can be a barrier to ensure best-as-possible care for patients, as it is the case in German hospitals, where many health professionals are often dealing with foreign language patients. Language learning for specific purposes has in virtual reality a combination of a more realistic environment, task performance training, voice recognition and feedback of virtual agents. For researchers in the SLA realm, the possibilities offered by WebVR resources have the potential to expand experiences such as the one presented here to other fields where language training is combined with specific tasks. For learners, a VR environment can be a practicing field for reducing the anxiety of speaking in the real world. For institutions, a VR language training program can be a low-cost option for professionals' continuing education. In sum, WebVR represents not only an alternative to common traditional practices of second language classes but it can offer, to a certain extent, a real feel of participation in a life-like, less predictable conversation. Acquiring the programming knowledge for that to happen is, perhaps, the biggest limitation imposed on an Applied Linguistics researcher who wishes to build such a system. Nonetheless, since Applied Linguistics has been essentially an interdisciplinary field, the challenge can be overcome by cooperation with other areas of knowledge such as Computer Science, as showcased in the frame of this work.

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Doctoral Consortium

TRAINING THE COMPUTATIONAL THINKING WITH AUGMENTED REALITY

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ABSTRACT

To overcome the difficulties of teaching Computer Programming, felt by teachers and students, an increasingly bigger community of researchers in Computer Science is claiming for the importance of preparing students, since very early (primary school), to acquire Computational Thinking skills; in that way the interpretation and design of algorithms/programs will become much easier. However, the development of Computational Thinking requires the creation and use of appropriate Learning Resources. The pragmatics shows that a person only acquires a new way of thinking or a new way of behaving if he is trained with the appropriate devices. First of all, in the paper, we will discuss how an ontology can be used to specify what is involved in Computer Programming and how these concepts and Computational Thinking concepts are related. We believe that this formal description will guide the choice of convenient Learning Resources. In that context, we intend to investigate the impact of Augmented Reality on them. After the ontological approach, the paper will focus on the process of shaping Computational Thinking through Augmented Reality. We aim at creating AR-based Learning Resource in an attractive way to improve fundamental skills on young students.

KEYWORDS

Computational Thinking, Programming, Learning Resource, Augmented Reality, Teacher support Tools, Ontology

1. INTRODUCTION

Nowadays we need to adopt new strategies that promote in the students the development of fundamental skills like reading, writing, arithmetic, or analytic capabilities. These skills are crucial for many activities that in general require Problem-Solving capabilities as it is the case of Computer-based tasks demanding for Computational Thinking (CT) ability. In that direction, CT shall be included as a fundamental skill in the primary and secondary school curricula. The aim of such a decision is to develop in the student's competencies for problem-solving that will be required to the 21st-century citizens. To train and induce in the student's CT a novel teaching/learning process must be devised using techniques derived from Mathematics, Gaming, and Computer Science. The abilities that characterize CT---like logic reasoning, abstraction, rigor in analysis and specification, strategic planning, etc.---are of uttermost relevance in Programming. Augmented Reality is defined by Azuma (Azuma 1997) as the overlapping of virtual information in the real world through technology. This information can be simple textual images or 3D objects that can perform interactions with such objects. AR provides greater motivation, gains learning, and delights the students who use it. In that context and motivated by the evidence that the main investment to educate people in Computational Thinking is the choice/creation of appropriate resources, we intend to investigate the impact of Augmented Reality (AR) on the education on CT. AR supports pedagogical approaches through constructivism learning by enabling educational experiments that complement the activities of the real classroom. We believe that it is possible to explore AR as a technology that provides constructs to develop skills of uttermost importance for computer programming, not only as a mere technology operator, but also as a computationally literate individual. AR in education can be applied in the training of students' abilities, encouraging learning based on discoveries. Summing up, AR can be used to provide a rich contextual learning environment, adhering to constructivist principles, fostering opportunities for multiple learning styles, engaging learners in ways that are not possible in real-world without real consequences if mistakes are made during the training. These advantages will be used to created Learning Resources that should be available to promote CT in primary and secondary schools. We have as indicators the following questions to research: How can an ontology be used to describe CT;

A formal description helps in choosing the LR; What are the impacts of AR Resources on CT; How to study the Impacts of Learning Resources in the development of Computational Thinking?

Consequently, the main objective of the research project here proposed is to improve motivation in teaching CP. To attain that objective, the following specific objectives must be achieved: Study broadly and deeply the area of AR in Education to characterize and classify the best possible those tools to know the systems that have been proposed and developed, what approaches have been used in their implementation, and so identify clearly what is solved and what deserves further research; Choose/create a generic architecture (among the existing ones or defining a new one) that can always be adopted to build an AR-based LR, Identify what components are stable and those that vary from a specific system to another one, in order to understand which information needs to be specified in each concrete case, aiming at the construction of those artifacts; Use the ontology *OntoCnE—Ontology for Computing-at-School (from the Portuguese Ontologia para Computação na Escola)*, developed to describe CT; Validate with concrete case studies the approach proposed and the generator we intend to developed.

2. THE IMPORTANCE OF TEACHING COMPUTATIONAL THINKING

Computational Thinking is a way of thinking that uses various educational techniques that develop competencies in students required in the 21st century, to organize people's mind in order to efficiently solve problems (Wing 2006); explains that CT is the ability to formulate a problem and express its solution in such a way that the problem will be solved. In this way, CT helps expressing how to solve a problem by approaching the concepts of decomposition, abstraction and algorithmic design (sequence of elementary steps to obtain the solution). Computational Thinking is based on the concepts of Pattern Recognition, Abstraction, Problem Decomposition and Algorithms.

In 2006, (Wing 2006, 2011, 2014) proposed the foundations of Computational Thinking and showed how society is influenced by technology even more in education. According to the author, the most important and high-level thinking process is the process of abstraction, being used in the definition of patterns, generalizing from specific instances and parametrization. With adequate resources, it is possible to work with the identification of common characteristics between the problems and their solutions. We can also identify patterns among the sub-problems that have been abstracted, finding an efficient solution to the problems encountered. It is also possible to work with resources that help breakdown processes in smaller parts for easier resolution. Thus it is possible to prepare the thought so that it arrives at the moment of creation of the Algorithms in the strategy or clear instructions for the solution of the problem. Learning Resources (LR) are hard or soft devices that allow students to train previous knowledge or acquire new knowledge, stimulating their ability to comprehend, organize and synthesize educational content in a specific domain (Bušljeta 2013). As said above, we believe that we need to resort to LRs to train Computational Thinking; so LRs will play a very important role in this process. However, it is crucial to have adequate resources to transmit the different skills involved in Computational Thinking. The richer the resources, the better students will shape their minds, learning the desired competencies. The LRs that we intend to use are of two types: *virtual* (need electronic devices) and *unplugged* (do not need any kind of electronic devices). The ability of way of thinking can be developed by inserting disciplines in the curriculum using technology to promote computational literacy or disciplines that explore the concepts of Computational Thinking through games, robotics or even cross-sectional, all skills are related to better communication and problem-solving in all aspects of life. These artifacts are often available in the school environment in which they help improve the quality of teaching and the innovation of the teaching-learning process. This technology is effective for teaching abstract and complex concepts because students can see the virtual elements immediately. AR also has student learning gains and improves motivation. This technology helps collaboration among students. The low cost is related to the simulations of environments or information in which a specific site would be necessary for teaching, for example, one can teach organic chemistry and observe the connections between the elements without the student's displacement to a laboratory. The information in the AR is appraised in real-time that provides an increase in the attention of the students. Thus the AR can be a powerful allied technology in the development of Computational Thinking in students exploring in different ways the decomposition, pattern recognition, abstraction and algorithm construction. The features present in the use of AR are: possible an education-oriented from the beginning has an educational target; Adaptive, Allows users to create, edit and visualize their

own AR projects, doing it by themselves; and Interactive, Interactions help better concept understanding and gamifying the learning process. It helps students gain a better understanding of abstract concepts, fosters intellectual curiosity, creativity and teamwork. With the popularization of games and applications that use AR, there is also the adaptation for different platforms, including mobile platforms, in which the use of mobile phones to aid in education using AR is possible today.

We use OntoCnE ontology to describe Computational Thinking. This ontology is discussed with more details in the works of Araújo (Araújo et al. 2019). The work proposed by (Azevedo et al. 2019) describes Micas, as a tool that allows to store the resources and classifies them according to the OntoCnE, the tool can be accessed at - "<https://micas.epl.di.uminho.pt/>".

3. AUGMENTED REALITY AND LEARNING RESOURCES

The work of (Klopfenstein et al.) presented an AR system for mobile devices of Low cost, that uses a simple smartphone like an increased sensor to turn a fully unplugged coding set into an AR encoding experiment, use of new and innovative technologies, also reducing the requirements for the use of tools capable of being effective in teaching and learning coding skills. The game that the author developed based on letters, can be printed at home demonstrating simplicity and accessibility.

Already (Chung and Hsiao 2019) proposes a mobile system of incorporation of the AR designed for computational thinking exploring the concepts of debugging and the concept of abstraction of the students. The system allows interaction with the 3d models using hand movement, the research still in progress (2019) shows how it is possible to explore AR in Computational Thinking applying to High School demonstrating engagement among students by showing that the interface attracts attention quickly. The author's conclusions are that: Low-cost unplugged educational activities: simplicity and accessibility; Augmented sensor (mobile device) transforms the unplugged card game in an immersive experience. Compromise between innovative technologies and efforts in reducing requirements for Computational Thinking teaching.

Initially the use of AR in programming can be observed in the works of (Lee et al. 2004), the author presents a new approach for authoring tangible AR applications. This approach allows the user to carry out the authoring tasks within the AR application being built so that the development and testing of the application can be done concurrently throughout the development process. The results have shown that the users generally found it easier and faster to carry out authoring tasks using AR.

But the relationship between the development of Computational Thinking and programming learning with AR can also be seen currently in the works of (Jin et al. 2018; Krpan et al. 2018; Teng et al. 2018).

The work of (Krpan et al. 2018) uses Visual Programming Languages (VPLs), the idea to replace textual language constructs with visual representations or blocks resulted in the development of the visual programming languages (VPLs), but the visual blocks are then replaced with physical objects such as cards or cubes and are referred to as "tangible programming languages" (TPLs). The work of Jin (Jin et al. 2018) also deals with tangible programming with AR affirming that programming is an effective way to promote children Computational Thinking presenting a novel tangible programming tool using AR technology for young children helping children create their programs by arranging programming blocks and debug or execute the code with a mobile device. The students can learn fundamental programming concepts, such as parameters, loop logic, debug, etc; providing help children programming in an interesting and intuitive way. The similar work of (Deng et al. 2019) presents a propose too of a tangible programming tool designed to help children learn Depth First Search (DFS) algorithm with AR technology combining the visual environment presented in AR environment and tangible cards. The results of studies reveal that the huge popularization of AR tools and these tools enable students to have better learning efficiency than the normal system. In addition, the AR system also made students have enhanced perceptions in terms of system usability, flow experience, and user perception, thus observing the great research niche related to AR and Computational Thinking through programming.

4. CONCLUSION

Coding is important, but not enough to learn Computer Programming; it is also necessary to learn how to analyze a problem, to strategically plan how to design a solution schema, test and assess outcomes to optimize solutions. To teach all those fundamental skills to become a Programmer, as argued along the paper, we believe that smart choices must be made to create adequate LRs. In that context, we propose the inclusion of AR technologies to improve such LRs. One of the objectives of the project here reported is the creation of a specialized framework to support the development of new artifacts incorporating AR. The automatization process will be guided by OntoCnE, an ontology for Computational Thinking, to provide a formal representation of the knowledge domain. That generator or framework will leverage the production and availability of the adequate effective resources. To sum up the discussion sustained in the present paper, we defend that it is necessary to develop digital technologies and digital media to build sensitive LR to be applied in the basic education curriculum to train students in the principles of Computational Thinking to allow them to solve correctly problems using the computer.

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