mccsis

multi conference on computer science and information systems

2015

Las Palmas de Gran Canaria, SPAIN

21-24 July

Proceedings of the International Conference

e-Learning 2015

Edited by:

Miguel Baptista Nunes

Maggie Mcpherson

iadis

international association for development of the information society

INTERNATIONAL CONFERENCE

E-LEARNING 2015

part of the

MULTI CONFERENCE ON COMPUTER SCIENCE AND

INFORMATION SYSTEMS 2015

PROCEEDINGS OF THE
INTERNATIONAL CONFERENCE

E-LEARNING 2015

Las Palmas de Gran Canaria, Spain

JULY 21 - 24, 2015

Organised by
IADIS
International Association for Development of the Information Society

Co-organised by

UNIVERSIDAD DE LAS PALMAS
DE GRAN CANARIA

TABLE OF CONTENTS

FULL PAPERS

SHORT PAPERS

REFLECTION PAPERS

POSTERS

FOREWORD

These proceedings contain the papers of the International Conference e-Learning 2015, which was organised by the International Association for Development of the Information and Society and co-organized by Universidad de Las Palmas de Gran Canaria, Spain, 21 – 24 July, 2015. This conference is part of the Multi Conference on Computer Science and Information Systems, 21 - 24 July 2015, which had a total of 652 submissions.

The e-Learning 2015 conference aims to address the main issues of concern within e-Learning. This conference covers both technical as well as the non-technical aspects of e-Learning.

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

The above referred main submission areas are detailed:

Organisational Strategy and Management Issues

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

Technological Issues

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

e-Learning Curriculum Development Issues

- Philosophies and Epistemologies for e-learning
- Learning Theories and Approaches for e-learning
- e-Learning Models
- Conceptual Representations
- Pedagogical Models
- e-Learning Pedagogical Strategies
- e-Learning Tactics
- Developing e-Learning for Specific Subject Domains

Instructional Design Issues

- Designing e-Learning Settings
- Developing e-Learning Pilots and Prototypes
- Creating e-Learning Courses
    - Collaborative learning
    - Problem-based learning
    - Inquiry-based learning
    - Blended learning
    - Distance learning
- Designing e-Learning Tasks
    - E-learning activities
    - Online Groupwork
    - Experiential learning
    - Simulations and Modelling
    - Gaming and edutainment
    - Creativity and design activities
    - Exploratory programming

e-Learning Delivery Issues

- e-Delivery in different contexts
    - Higher and Further Education
    - Primary and Secondary Schools
    - Workplace Learning
    - Vocational Training
    - Distance Learning
- Online Assessment
- Innovations in e-Assessment
- e-Moderating
- e-Tutoring
- e-Facilitating
- Leadership in e-Learning Delivery
- Networked Information and Communication Literacy Skills
- Participation and Motivation in e-Learning

e-Learning Research Methods and Approaches

- Action Research
- Design Research
- Course and Programme Evaluations
- Systematic Literature Reviews
- Historical Analysis

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

e-Skills and Information Literacy for Learning

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

The e-Learning 2015 conference received 102 submissions from more than 24 countries. Each submission has been anonymously reviewed by an average of four independent reviewers, to ensure that accepted submissions were of a high standard. Consequently only 16 full papers were approved which meant an acceptance rate of 16 %. A few more papers were accepted as short papers, reflection papers and posters. An extended version of the best papers will be selected for publishing as extended versions in the Interactive Technology and Smart Education (ITSE) journal (ISSN:1741-5659) and also in the IADIS International Journal on WWW/Internet (ISSN: 1645-7641). Other outlets may also receive extended versions of the best papers, including journals from Inderscience.

Besides the presentation of full papers, short papers, reflection papers and posters, the conference also included two keynote presentations from internationally distinguished researchers. We would therefore like to express our gratitude to Steven Duggan, Director, Worldwide Education Strategy, Microsoft, USA and Dr. Jacques Bulchand-Gidumal, Professor of Digital Enterprises and Entrepreneurship, Universidad de Las Palmas de Gran Canaria, Spain as the e-Learning 2015 keynote speakers.

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

Last but not the least, we hope that everybody will have a good time in Las Palmas de Gran Canaria, and we invite all participants for the next edition.

Miguel Baptista Nunes, University of Sheffield, United Kingdom
Maggie McPherson, University of Leeds, United Kingdom
e-Learning 2015 Conference Program Co-Chairs

Piet Kommers, University of Twente, The Netherlands
Pedro Isaías, Universidade Aberta (Portuguese Open University), Portugal
Heredina Fernandez Betancort, Universidad de Las Palmas de Gran Canaria, Spain
MCCSIS 2015 General Conference Co-Chairs

Las Palmas de Gran Canaria, Spain
July 2015

PROGRAM COMMITTEE

E-LEARNING CONFERENCE PROGRAM CO-CHAIRS

Miguel Baptista Nunes, University of Sheffield, United Kingdom

Maggie McPherson, University of Leeds, United Kingdom

MCCSIS GENERAL CONFERENCE CO-CHAIRS

Piet Kommers, University of Twente, The Netherlands

Pedro Isaías, Universidade Aberta (Portuguese Open University), Portugal

Heredina Fernandez Betancort, Universidad de Las Palmas de Gran Canaria, Spain

E-LEARNING CONFERENCE COMMITTEE MEMBERS

Adamantios Koumpis, Universität Passau Fakultät für Informatik und Mat, Germany
Airina Volungeviciene, Vytautas Magnus University, Lithuania
Alex Voychenko, International Research and Training Center for ITs, Ukraine
Alexis Barlow, Glasgow Caledonian University, United Kingdom
Ali Fawaz Shareef, Villa College, Maldives
Amali Weerasinghe, University of Adelaide, Australia
Andreas Bollin, Klagenfurt University, Austria
Andreas Papasalouros, University of the Aegean, Greece
Andreia Inamorato dos Santos, European Commission, Spain
Andreja Pucihar, University of Maribor, Slovenia
Angélica De Antonio, Universidad Politecnica de Madrid, Spain
Anja Lorenz, Lübeck University of Applied Sciences, Germany
Annette Payne, Brunel University, United Kingdom
Antoanela Naaji, Vasile Goldis West University of Arad, Romania
Antonio Hervás-Jorge, Universidad Politécnica de Valencia, Spain
Antonio Navarro, Universidad Complutense de Madrid, Spain
Antonio Panaggio, Italian Ministry of Education, Italy
Apostolos Gkamas, University Ecclesiastical Academy of Vella of Ioan, Greece
Avgoustos Tsinakos, Department of Computing and Informatics Engineering, Greece
Benedict du Boulay, University of Sussex, United Kingdom
Benno Volk, ETH Zurich – Swiss Federal Institute of Technology, Switzerland
Branislav Smitek, University of Maribor, Slovenia
Cengiz Hakan Aydin, Anadolu University, Turkey
Charalampos Karagiannidis, University of Thessaly, Greece
Christina Gloerfeld, Fernuniversität in Hagen, Germany
Christos Bouras, University of Patras, Greece
Claudia De Witt, Fernuniversität in Hagen, Germany
Claudia Steinberger, Klagenfurt University, Austria
David Guralnick, Kaleidoscope Learning, United States

KEYNOTE LECTURES

"FAIL FAST AND FAIL FORWARD – EMBRACING FAILURE AS A NECESSARY PRECURSOR OF SUCCESS IN THE DELIVERY OF ELEARNING SERVICES"

Steven Duggan,
Director, Worldwide Education Strategy, Microsoft, USA

ABSTRACT

How cloud services, low-cost mobile devices and real-time data can enable system design and course correction in national deployments.

With reference to eLearning partnerships with organizations including UNESCO, World Vision and British Council, Steven Duggan, Microsoft Director of Worldwide Education Strategy, will outline how a shift in the culture and approach to Public Private Partnerships is required to achieve outcomes which can successfully be replicated at scale.

With a focus on the global challenge of illiteracy, Duggan will explain why an openness to recognize and value failure proved essential to the building of new solutions which could address access, equity and quality in the delivery of eLearning services.

A DIFFERENT PERSPECTIVE ON THE SINGULARITY POINT. HOW IT IS SUBSTITUTING JOBS IN THE SERVICE SECTOR

Dr. Jacques Bulchand-Gidumal,
Professor of Digital Enterprises and Entrepreneurship,
Universidad de Las Palmas de Gran Canaria, Spain

ABSTRACT

While the Singularity Point is announced to take place around 2030, before it happens humans will have to face several challenges. Among them, a more than probable substitution of a large amount of jobs by IT. While for some time computers and robots seemed to be especially well oriented to substituting industrial jobs, latest developments have contributed to picture an situation in which many service sector jobs are also being replaced. We posit that this maybe one of the causes behind the global crisis that is taking place right now and of why it is hitting so much in service-based economies. Some future realistic scenarios are explored.

Full Papers

PLAYING MUSIC, PLAYING WITH MUSIC
A PROPOSAL FOR MUSIC CODING IN PRIMARY SCHOOL

Adriano Baratè[1], Luca Andrea Ludovico[1], Giuseppina Rita Mangione[2] and Alessia Rosa[3]

[1]LIM - Laboratorio di Informatica Musicale, Dipartimento di Informatica, Università degli Studi di Milano
Via Comelico, 39/41 – 20135 Milano (MI) – ITALY
[2]INDIRE - Istituto Nazionale di Documentazione, Innovazione e Ricerca Educativa, Sede territoriale Sud
Via G. Melisurgo, 4 - 80133 Napoli
[3]INDIRE - Istituto Nazionale di Documentazione, Innovazione e Ricerca Educativa, Sede territoriale Nord
Corso Vittorio Emanuele II, 70 - 10121 Torino

ABSTRACT

In this work we will introduce the concept of *music coding*, namely a new discipline that employs basic music activities and simplified languages to teach the computational way of thinking to musically-untrained children who attend the primary school. In this context, music represents both a mean and a goal: in fact, from one side coding activities are based on music processes that are able to unveil algorithmic thinking; from the other side, such processes may stimulate creativity and collaborative learning, and their audio feedback is immediately perceivable. Consequently, music can represent a valid learning tool as well as an addictive reinforcement technique to approach coding. After describing a new formalism to graphically encode music operators, a Web prototype specifically designed for music coding will be presented and discussed.

KEYWORDS

Music, coding, web, application, primary school.

1. INTRODUCTION

Media and technology are nowadays characterized by a network system widely structured which encourages the development of phenomena with important consequences both in social and educational fields. Among them a prominent role is played by so-called *digital convergence*, i.e. the process by which different media are redefined in their peculiarities thanks to digital coding. This cannot be merely seen as a technical or technological development, as this process has changed irreversibly media industry and the way media products are enjoyed.

Within a convergent culture, meanings – even music meanings – circulate according unexpected routes, contaminate each other, undergo discontinuous processes of certification, finding only temporary consolidation and being subjected to constant revisions (Ardizzone et al., 2008). In these complex and heterogeneous universes, sound and music take a new and stronger value as languages integrated into broader and diversified contexts, each leading to a hyper-fruition of aural stimuli.

It is worth underlining another key aspect, represented by the new technological opportunities of interaction, with the overcoming of the idea of *audience* proper of the Gutenberg model and the development prosumers increasingly active (McLuhan & Nevitt, 1974). Through digital technologies and the great impulse of Web the sharp dichotomy between producers and consumers disappears, similarly to what happened to communication processes in the 90' (Ceri & Gallino, 1994).

Due to the deep and rapid changes in the world around us, occurring also through media and technologies, the concept of literacy has to be rethought by encompassing a multiplicity of languages. Some researchers state that, in order to achieve socio-educational integration, it is not possible to conceive models of educational relationship other than inclusion, multi-literacy and promotion of excellence (Napodano & Iandoli, 2008). This is a set of educational actions that enhance workshop activities, foster the ability to use

language, orality and heterogeneous systems for analog and digital encoding, and promote the variability of cognitive styles and communication registers according to Gardner's idea of *forma mentis*.

New challenges emerge in modern school, traditionally considered as the depository of literacy processes: guaranteeing the growth of students, each one with his/her own peculiarities, and giving equal dignity to the languages they interact with in everyday life. As regards music language, the problem is not how to employ media technologies during traditional hours of music education, but completely rethink their value in order to train individuals along different axes: searching in sound and timbre collections, analyzing their role and meaning inside a complex media message or a soundscape, understanding the value of music and audio authorship, and much more.

For an actual acquisition of competence, intended here as the ability to act in – or react to – a given situation within a given context in order to achieve a performance (Le Boterf, 1994), it is necessary to develop education proposals able to integrate music analysis with music production. In this sense, coding can prove to be an effective proposal since it implies writing, namely making explicit, juxtaposing and processing concepts in a critical, aware and creative way.

The paper is organized as follows: Section 2 discusses the pedagogical aspects of coding in primary school curricula, Section 3 illustrates the relationship between music and coding starting both from the music and from the technological points of view, Section 4 presents a Web interface that implements music coding, and finally Section 5 proposes a number of case studies.

2. FROM CODING TO MUSIC CODING

In Computer Science, the term *coding* refers to the implementation of a program, namely a sequence of instructions that make a computer run a given set of actions. It is well known that computer programming is a base skill required to understand information technology processes. More surprisingly, in recent times coding has been proposed also as a tool to foster learning processes in young students. By facing coding problems, students activate many cognitive functions that go beyond the acquisition of technical expertise in a strict sense. Coding tasks should be independent from a specific programming language or software environment. Rather, the target is developing a digital competence through playful learning (Resnick, 2004).

The theoretical bases go back to the pedagogical approach of *constructivism* (Piaget et al., 2014). As regards the introduction of coding and computational thinking in primary school, it is worth citing the ideas of Papert: while each discipline claims to push students to think, computer science achieves this result in an operative and concrete way. Papert considers coding as a useful tool to learn how to think, not as a way to obtain improved reasoning skills. In fact, the intrinsic goal is not making children good programmers, but providing the knowledge to create contexts where they can explore advanced ideas (Papert, 1980). For example, young learners can approach differential geometry through the metaphor of a turtle or they can understand the concept of feedback thanks to LEGO robots. Papert adopts LOGO as the reference programming language for children's coding activities. An implementation of Papert's ideas requires a deep change in teaching, transforming the mere transmission of knowledge and skills into laboratory activities and structured projects aimed at encouraging collaboration and discussion.

Music education and training for children require ad hoc techniques and methods as well as a specific review of school curricula. Recent scientific works (Young, 2003) show that an integration of multi-modal experiences based on activities such as moving, creating, playing, reflecting support the development of a "symbolically fluent child" (Gromko, 1995). The learning environment should be able to represent activity-oriented musical experiences, where students – properly sustained by scaffold elements – are involved in a process of music construction/deconstruction. For example, scaffolding children's early musical experiences, investigations and engagement in the world of sound helps them establish strong, confident, vibrant, and creative identities in learning, communication, and performance (Tomlinson, 2013).

Currently a new music pedagogy based on an integrated approach is emerging. Recalling the fundamental concepts of pedagogical activism (Dewey, 2005), the goal is enhancing that educational cross-component able to influence key aspects of the growth such as expressiveness, autonomy and sociality.

Music is able to influence the construction of the child's personality because it promotes the integration of perceptual, motor, affective, social and cognitive dimensions (Willems, 2011) by relating basic aspects of

human life (e.g. physiological, emotional and mental spheres) with the basic elements of music (e.g. rhythm, melody and harmony).

The abilities of listening, exploration and analysis are fundamental for the development of general meta-cognitive skills of the child, such as attention, concentration, control. In this sense, music is both an opportunity and a crucial educational strategy. For example, through music young students can develop the aspects of analysis and synthesis, problematization, argumentation, evaluation and application of rules. In addition, as regards the ability to read and understand, children have the possibility to train their transcoding skills, moving from the musical domain to the verbal language in order to describe what they heard (Branca, 2012).

In the digital era, new technologies and computer-based approaches can influence music learning and teaching processes. A recent and comprehensive review of this subject can be found in (Finney & Burnard, 2010), a work that discusses a range of innovative practices in order to highlight the changing nature of schooling and the transformation of music education. Many researchers, experts and music teachers feel a pressing need to provide new ways of thinking about the application of music and technology in schools. It is necessary to explore teaching strategies and approaches able to stimulate different forms of musical experience, meaningful engagement, creativity, teacher-learner interactions, and so on.

The idea of the this work is applying the most recent pedagogical theories about coding and music teaching in primary school through a playful approach to music composition, conceived for musically untrained children and designed to encourage the computational way of thinking.

3. MUSIC OPERATORS AND COMPUTER PROGRAMMING

In this section we want to explore the historical, cultural, and theoretical relationships between two domains apparently far apart, i.e. music and computer programming. We will follow two approaches somehow complementary, highlighting how some concepts of music can find a counterpart in the constructs of programming languages, and how some concepts typical of algorithmic way of thinking can be intuitively represented through music operators.

3.1 From Music to Coding

In 1985 composer and music theorist Fred Lerdahl and linguist Ray Jackendoff conceived a *generative theory of tonal music* (Lerdahl & Jackendoff, 1985). They provided a "formal description of the musical intuitions of a listener who is experienced in a musical idiom" based on the unique human capacity for musical understanding. The purpose was uncovering a musical grammar that could explain the human musical mind in a scientific manner comparable to Noam Chomsky's transformational or generative grammar dating back to 1975 (Chomsky, 2002). The novelty of their approach was the investigation of the mental procedures under which the structure of individual compositions can be built and understood.

Even if the approach of the mentioned authors was original, many theorists, musicologists and composers in the past formalized or merely used algorithmic processes to conceive music. Examples range from late-Baroque complex counterpoint processes (see e.g. the fugues by Johann Sebastian Bach) to twelve-tone serialism (see e.g. the works by the Second Viennese School, composed by Alban Berg, Anton Webern, Hanns Eisler and Arnold Schoenberg). As regards theoretical works, it is worth citing (Hofstadter, 1980), where the concepts of self-reference and formal rules are applied to the domain of mathematics, art, and music, and (Bizzi, 1982), which unveils the way many historical canons have been composed through mathematical rules and tables.

The mentioned works demonstrate that a formal and algorithmic approach to music composition and analysis is possible. Consequently, we introduce a number of *music operators* that can be seen as single steps of a generative algorithm. Due to the goals of this initiative, the application domain is simplified:

- A score is composed by a number of melodies, one per staff, presenting no chords. Harmony-related aspects come from the coexistence of notes belonging to different instruments and staves;
- Every note is quantized according to the smallest rhythmical value allowed. Longer values can be obtained by tying quanta together. This approach is valid for children's songs and simple tunes, where a coarse quantization is sufficient, but it would fail with tuplets and more complex rhythmic layouts;

- Supported operators are simple to be used and understood. The goal is not covering all possible music-composition processes, but provide untrained children with an intuitive tool set to build basic music performances.

3.1.1 Melodic Operators

The first class of music operators is the one of Melodic Operators (MOs), namely the operators that work on note pitch. The proposed framework includes:

- *Play n* – This operator starts playing a *n*-pitched note. The execution is stopped at the end of the current quantum, unless a Continue operator (see Rhythmic Operators below) is invoked at the next quantum;
- *Clear* – This operator unsets the pitch of the current quantum. In a quantized environment, each note naturally takes a single quantum, nevertheless a quantum cannot be empty. In this sense, *Clear* is the default operator, and it corresponds to the music concept of rest. This behavior implies that *Clear* belongs both to Melodic Operators (since it unsets pitches) and to Rhythmic Operators (since it is a placeholder for a rest);
- *Transpose up/down (and play)* – This operator modifies the previous pitch according to a number of ascending or descending grades. In our implementation, we decided to deal with scale grades (referring to a diatonic scale) rather than halftones (referring to a chromatic scale) because most pitched instruments for children are mainly diatonic, such as toy xylophones and whistles.

3.1.2 Rhythmic Operators

Rhythmic Operators (ROs) work on rhythm-related aspects of notes. In this case, the framework includes:

- *Tie* – This operator extends the last note (or rest) for the duration of the current quantum;
- *Clear* – As mentioned above, this operator means absence of sound. So, even if a note is naturally stopped by the end of its quantum, *Clear* has rhythmic implications too.

3.1.3 Other Operators

In order to foster computational thinking, other operators which do not belong to the mentioned classes have been implemented. A first case is *Repeat*, which allows to choose a number of previous steps to be repeated for a given number of times. In music notation there are symbols that recall this function (e.g., n-bar repeat signs, repeat barlines and text indications such as "Da capo"). However, for the sake of clarity the implemented *Repeat* operator has a less flexible applicability.

On the contrary, conditional expressions and constructs do not have a music definition, but they have been introduced to foster algorithmic thinking (see Section 3.2). In the proposed framework, comparison operators such as *lower than*, *higher than*, *lower or equal to*, *higher or equal to*, *equal to*, and *different from* can be invoked on pitches.

3.2 From Coding to Music

In Section 3.1 we have listed a number of music operators that are implicitly or explicitly used by composers when they create a music piece (Schoenberg & Stein, 1970). We have shown how these operators can be converted into atomic steps of an algorithm. On the contrary, in this section we start from some key concepts typical of computer programming and try to map them onto the music case study.

In our approach, programming constructs intentionally are not presented in an explicit way to children. In other words, the proposed framework hides their presence, but makes the underlying concepts emerge.

First, let us consider the standard *structure of a program*. Most programs have the following pattern: i) statements to mark the start of the program, ii) variable declaration, and iii) program statements. This basic schema can be mapped on: i) choice of the basic parameters (tempo, score length) and creation of instruments, ii) choice of the instruments to play, and iii) for each instrument, selection of a set of actions to be performed. Code lines are usually written and read from top to bottom, whereas music code – in accordance with score notation – should be interpreted from left to right.

In computer programming, *data typing* implies a classification identifying one of various types of data (e.g. integer, real, boolean, etc.) and defines allowed values and available operations on such values. In our proposal numeric, character and boolean values can be selected to perform specific operations, such as setting pitches or testing conditions. However, the novel approach is mapping the concept of data type onto

6

the choice of an instrument type to play. If instruments can be seen as instances of variables, then instrument types correspond to data types. For the sake of clarity, we will present the case of a xylophone vs a drum, which are two of the available instruments supported by the interface described in the following. Please note that they are both percussion instruments, but the former is pitched whereas the latter unpitched. The xylophone allows to define the exact note to be played. This implies the availability of operators such as *Transpose up* or *Compare pitches*. Besides, in accordance with computer programming where values are limited to a range (e.g. in C integer values have to fall in the [−32768,+32767] range, being 16 bits in size), pitch values present limits that depend on the chosen instrument. Needless to say, for an unpitched percussion instrument such as a drum the concept of pitch has no meaning, consequently only rhythmic operators are supported.

The concept of data typing can be further detailed. In computer programming, there is a dichotomy about *strong vs weak typing*. In our proposal, this aspect can be found in the independent use of instruments against the interdependence of notes across different instruments.

As regards operations on variables, *assignment* can be employed at different stages. For example, deciding which actions should take place at a given time is a form of assignment. Besides, some of the supported operators allow to set additional values, such as the pitch to be played or the number of repetitions to be performed. A complete list of operators for this proposal will be provided in the following.

As regards basic *control flow*, most programming languages support unconditional branch (e.g. goto, break, return, etc.), conditional branch (e.g. if-then-else, switch, etc.) and loops (e.g. while-do, do-while, for, etc.). In order to apply conditional statements to the music case, we introduce comparison operators to check for conditions and consequently choose between two alternative execution paths. For example: "If the current note of *Instrument A* is lower than the current note of *Instrument B*, then follow the upper path, otherwise choose the lower one. In order to keep things simple, braches always present the else clause and have the same length.

Loops and iterative constructs are exemplified through the repetition of the last n steps for k times. Please note that these statements introduce a number of implementation issues that in standard coding activities do not arise. The last n steps to be repeated do not have to generate ambiguous or illegal situations, pointing for example to a step where different branches are present (at the moment of coding, the system is not aware of conditional choices which may depend on run-time decisions). Similarly, a standard while-do loop would be difficult to introduce since the exit condition – and consequently the loop duration - cannot be predicted.

Some non-trivial programming features are supported too. First, data types are not limited to simple ones. The concept of *array* can be intuitively represented by a particular set of instruments (an array of mixed variables). If we define the array K by grouping a subset of instruments, operators can refer to single-element as well as aggregated values. For example, in conditional statements we can check conditions such as: "If the current note is higher than all current notes in K..." or "If current note of *Instrument K_1* is higher than the one played by K_3...". In this way, children can get familiar with the access to array elements by index (e.g. *K[1]*) or by key (e.g. *K["drum"]*).

Finally, the specific implementation of some operators recalls advanced concepts such as *overloading*, namely a type of polymorphism where different functions with the same name are invoked based on the data types or the parameters passed. For instance, the operator *Play* can be invoked with no parameters – i.e. *Play()*, which repeats the last pitch if present, and performs the default one otherwise – or with one parameter – i.e. *Play(n)*, which explicitly sets the pitch to be performed. Similarly, *Repeat()* means "play the last music symbol once again", *Repeat(x)* means "play last *x* music symbols once again", and *Repeat(x,y)* means "play last *x* music symbols *y* times". These are simple but effective examples of polymorphism.

4. WEB PROTOTYPE

In order to make music coding appealing, amusing and accessible to children, we have implemented an experimental Web interface adopting a gamification approach. The use of standard Web technologies and languages such as HTML5 and Javascript, developed and promulgated by W3C,[1] let us release a cross-platform multimedia environment, available on all browser-equipped and network-attached devices. The interface is shown in Figure 1.

---

[1] World Wide Web Consortium
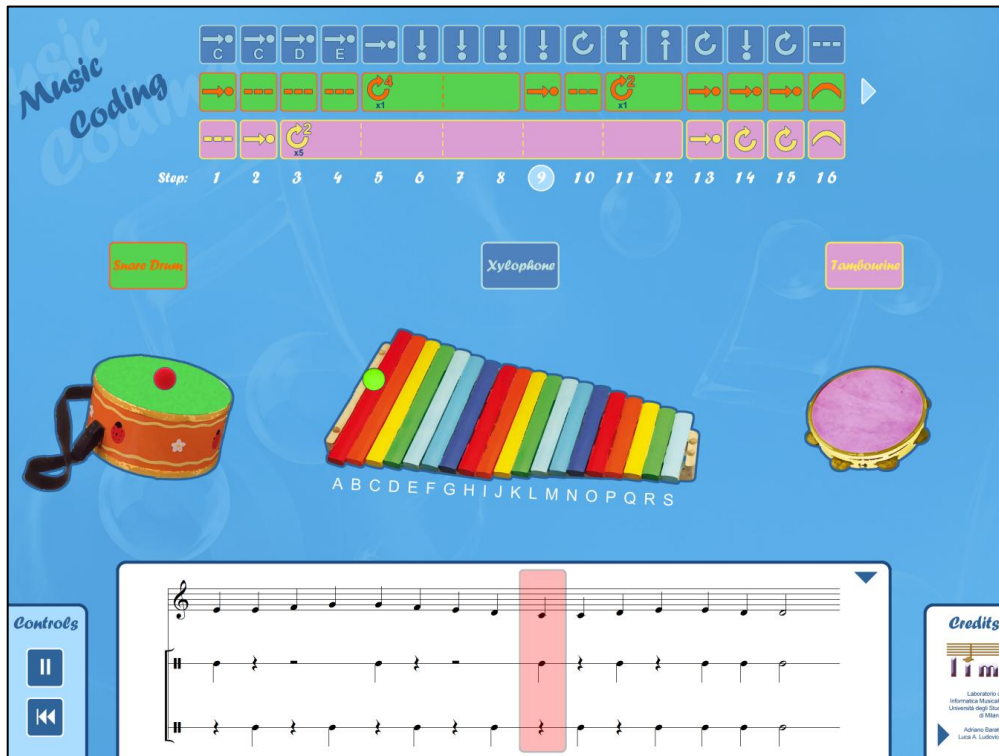
Figure 1. The Web interface designed for music coding.

4.1 The Gameplay

The educational activity is composed by two different steps, named *score coding* and *interactive listening* respectively.

During the first phase, a score is produced by disposing a number of cards (corresponding to music operators) on the game board. Available operators are chosen by clicking the instrument name, which opens a contextual toolset, since different instruments may present different sets of operators. The score length is not fixed, on the contrary it is set on-the-fly while dragging cards. The available space in the interface can be extended thanks to horizontal scrolling. As explained below, during this process the corresponding "traditional" music score is produced as well. The coding process can be performed collaboratively by many children together, for instance by assigning to each student either an instrument or a step, like in turn-based games.

The interactive listening phase starts when the Play button is pushed causing playback to occur. When score steps are parsed, colored balls begin to jump over the instrument interfaces. Graphical and audio materials are fully synchronized, thus allowing a multi-layer score-following experience. For children it is possible to look at the ball moves, follow music over the graphical as well as the traditional score, and listen to the corresponding sounds. This process somehow resembles *debugging*, since actions are parsed one by one to see if the desired result is being achieved. Music performance can be paused, stopped, and rewound.

The second phase has been defined interactive for a number of reasons. First, music performance can be influenced by adjusting and rearranging music operators: at any moment users can modify the score, thus going back to phase 1. Second, children can passively enjoy the results of coding but they can also interact by playing their own instruments.

4.2 The Interface

As regards the interface, the main area of the screen contains a number of pitched and unpitched music instruments. The available orchestra can be configured during the game setup. For music playback, the underlying metaphor is a jumping ball that strikes the sensitive areas of each instrument to make it play. Needless to say, jumps are controlled by the score.

The upper panel represents the game board, namely the area where cards corresponding to music operators are placed. Rounded squares constitute the quantized timeline, and their colors refer to a given music instrument. Icons like those shown in Figure 2 are employed to confer an intuitive graphical representation to music operators.

Figure 2. The icons for Play, Transpose down, Transpose up, Tie, Repeat and Clear music operators.

The bottom panel contains a score transcription following Common Western Notation (CWN) rules. Music contents are automatically generated over the staff system while cards are being placed on top of the game board. This "traditional" score representation has not been conceived for children, nevertheless, its presence can be important for a number of reasons:

- It can be checked by musically-trained students and teachers to validate the use of music operators;
- It can be directly read by young musician to create a live performance or an accompaniment;
- Thanks to full synchronization among all graphical and audio contents (*score following*), it can be an intuitive way to learn the rudiments of music notation.

An inverse exercise based on score notation is trying to reconstruct a simple tune whose score is known through the operators provided by the game. In this case, coding is involved as a problem-solving technique, similarly to standard computer programming: given a goal, find the self-contained step-by-step set of operations to be performed in order to achieve it.

5. EXAMPLES

Now let us refer again to the screenshot shown in Figure 1. This time we will focus on cards over the game board and the corresponding music contents.

The upper staff refers to a pitched instrument, consequently all music operators are available. From the point of view of rhythm, no steps but the last one have been extended through ad hoc operators. The first 4 steps are explicit assignments indicating the pitch to be performed. The 5th step is an overloaded version of the assignment operator, presenting no indication about the pitch: in this case, the last pitch is repeated. Other in use operators are simple transpositions (1 grade up or down) and simple repetitions, i.e. single repetitions of the last step. Clearly the same result could be achieved through different combinations of operators: for instance, the 3rd and the 4th step could be obtained through transpositions. This is another aspect of music coding close to computer programming, where different algorithms can be employed to achieve the same result.

The second and third staves encode parts to be played by unpitched instruments. For an untrained child, starting from a simplified set of operators can be more intuitive. Besides, a rhythmic feedback is easier to recognize.

In this example, we have used a number of Repeat operators, thus originating aggregations of steps different in length and number of repetitions. The notation at the 3rd step of the bottom staff is particularly efficient in representing a huge area of the score. In computer terminology, we would call it *compression*.

6. CONCLUSION

The concept of music coding presented in this work constitutes a novel approach to the computational way of thinking. Actually, playing music is a stimulating and amusing activity for children, which fosters not only technical and theoretical abilities, but also creativity, adaptivity, socialization and cooperation with others.

The interface and the underlying language presented above address primary school children without a specific music background. They have been designed to allow easy interaction with music contents as well as intuitive manipulation through ad hoc operators. Nevertheless, young musicians and music teachers can be involved in these activities as well. From a passive perspective, they can enjoy an alternative and formal representation of music language, quite far from common notation but close to the composer's way of thinking. From an active perspective, musically-trained users can join the playback phase, acting the role of additional instrumentalists and arrangers.

It is worth underlining that the provided framework can be seen as a tool both for *music synthesis* ("choose cards, set parameters and listen to the music produced") and for *music analysis* ("analyze an already available tune and try to reconstruct it through a suitable combination of cards and parameters").

At the moment of writing, the software application has been implemented and is publicly available over the Web, but it has not been extensively tested. As regards future work, a relevant goal is to conduct a test phase in Italian primary schools, in order to understand user acceptance rates and to validate the pedagogical approach. For instance, we are planning assessment activities in order to test if a music-based approach to problem solving can be more effective than a traditional one, by proposing the same algorithmic problem in different forms. An example is reaching a target point by walking in an open space versus composing a simple tune, two clearly different activities that could be described through the same sequence of algorithmic steps. Another kind of exercise is recognizing algorithmic structures in a given music piece.

A number of open problems must be faced before the final release of an effective learning system. These problems suggest a variety of research directions in the fields of pedagogy, technology-aided teaching and learning, computer science, music, and musicology.

REFERENCES

Ardizzone, P., Vandenplas-Holber, C., & Rivoltella, P. C. (2008). *Media e tecnologia per la didattica*. Vita e pensiero.

Bizzi, G. (1982). *Specchi invisibili dei suoni. La costruzione dei canoni: risposta a un enigma*. Centro internazionale di studi per la divulgazione della musica italiana, Roma.

Branca, D. (2012). L'importanza dell'educazione musicale: risvolti pedagogici del fare bene musica insieme. *Studi sulla formazione, 15*(1), 85-102.

Ceri, P., & Gallino, L. (1994). *Manuale di sociologia*. UTET libreria.

Chomsky, N. (2002). *Syntactic structures*. Walter de Gruyter.

Dewey, J. (2005). *Art as experience*. Penguin.

Finney, J., & Burnard, P. (Eds.). (2010). *Music education with digital technology*. Bloomsbury Publishing.

Gromko, J. E. (1994). Children's invented notations as measures of musical understanding. *Psychology of Music, 22*(2), 136-147.

Hofstadter, D. H. (1980). *Gödel, Escher, Bach: An Eternal Golden Braid*. Penguin Books.

Le Boterf, G. (1994). *De la compétence*. Paris: Les éditions d'organisation.

Lerdahl, F., & Jackendoff, R. (1985). *A generative theory of tonal music*. MIT press.

McLuhan, M., & Nevitt, B. (1974). Medium Meaning Message. *Communication*.

Napodano, M., & Iandoli, M. N. (2008). *Socrate in classe* (Vol. 7). Morlacchi Editore.

Papert, S (1980). *Mindstorms: Children, Computers, and Powerful Ideas*. Basic Books, Inc.

Piaget, J., Beth, E. W., & Brousseau, G. (2014). Learning: Creation or re-creation? From Constructivism to the Theory of Didactical Situations. *A Critique of Creativity and Complexity: Deconstructing Clichés*, 25, 19.

Resnick, M. (2004). Edutainment? No thanks. I prefer playful learning. *Associazione Civita Report on Edutainment*, 14.

Schoenberg, A., & Stein, L. (1970). *Fundamentals of musical composition*. G. Strang (Ed.). Faber & Faber.

Tomlinson, M. M. (2013). Literacy and Music in Early Childhood Multimodal Learning and Design. *SAGE Open, 3*(3).

Willems, E. (2011). *Las bases psicológicas de la educación musical*. Editorial Paidós.

Young, S. (2003). Time–space structuring in spontaneous play on educational percussion instruments among three-and four-year-olds. *British Journal of Music Education*, 20(1), 45-59.

LEARNING THROUGH TELEPRESENCE WITH IPADS: PLACING SCHOOLS IN LOCAL/GLOBAL COMMUNITIES

Bente Meyer

Associate Professor, Department of Learning and Philosophy, Aalborg University Copenhagen

ABSTRACT

Distributed learning is a growing issue in education following the mainstreaming of technologies such as videoconferencing. However, though distance and distributed learning have been common in adult education and business since the 1990s little is still known about the use of videoconferencing in elementary education. This paper reports from ongoing research in three rural schools in Denmark where the use of videoconferences are used as part of the teaching at lower secondary level. The research focuses on how students learn from videoconferences that are both one-to-many and peer-to-peer. Videoconferencing, conceptualized by the schools in question as telepresence, is performed in a unique combination of desktop interaction through mobile devices (iPads) and studio-based large screen lectures and interaction. Preliminary results of the research suggest that telepresence could be enhanced in schools by seeing it as a broad framework for collaboration between schools, in which different kinds of connections – both synchronous and asynchronous, mediated and face-to-face, large screen and desktop interaction - can support the placement of schools within the community and in the global context of learning.

KEYWORDS

Telepresence, learning through videoconferences, learning with iPads

1. INTRODUCTION

In the spring of 2013 I was asked to research an ongoing school development project in a rural part of the west of Denmark, where three schools had for a year been using videoconferencing for teaching basic subjects such as maths, German, science, history and literature. The purpose of the project, which was initiated by the local municipality, was to explore how the use of videoconferences in schools could support community and curriculum developments through increased collaboration between schools, access to experts and the establishment of links between schools, industry and community. Within these broad aims the municipality sought to respond to a variety of community challenges, for instance the depopulation of specific rural areas and the consequent limited access to resources such as specialized teachers and experts. Following a municipal reform in 2007, the municipality had increased in size and incorporated several rural school districts which necessitated a local strategy for linking schools and reorganizing available resources. As a result, the municipality initiated the project and at the same time schools invested in iPads for all students in lower secondary school (age 13-16).

The research project specifically explored the potential of videoconferences as a supplement to classroom teaching for qualifying lower secondary students' learning, with the three local schools as an empirical case. Research was done as an ethnographic, multi-sited study that included observations in all three schools as well as interviews with students. Both telepresence activities and classroom activities prior to and after the telepresence activities were observed, whenever possible. Research is ongoing and the following reports from the initial phase of the project from the autumn 2013 to 2014. The project ends in the summer of 2015.

2. UNDERSTANDING TELEPRESENCE: INSIGHTS FROM THE LITERATURE

Telepresence is a broad and complex term for a variety of phenomena involving embodied, virtual presence in mediated environments (Friesen 2014, Levinsen et al. 2012). From a phenomenological perspective telepresence can be understood as "the experience of presence in an environment by means of a communication medium" (Steuer 1995 in Dolezal 2009) or conversely as "a technology that allows the projection of a person to a remote environment" (Draper 1998). As a concept, telepresence has historically been linked to the use of robotics and virtual worlds, however, telepresence also interacts significantly with local physical spaces, as will be seen from the examples below.

In this paper I shall focus on videoconferences as a telepresence activity, where telepresence is understood as a way of configuring learning rather than a specific experience of being present. In understanding telepresence through videoconferences as a process of configuration, I am inspired by the idea that telepresence is contingent on local practices of for instance collaboration, subject cultures and modes of instruction (Pink 2011). In this sense telepresence is placed in local practices and entangled within these practices (Dussel 2013, Latour 2005), rather than in individual learners' experience of presence. Researching telepresence therefore involves studying new ways of placing technologies in schools, as well as new ways of placing schools in the community.

According to the literature, videoconferencing can be defined as "synchronous audio and video communication through computer or telephone networks between two or more geographically dispersed sites" (Cole, Ray, & Zanetis, 2004 in Lawson 2010). The potential of synchronous interaction is immediate interaction with others distributed in geographical space, which may extend learners' access to high-quality learning opportunities (Berge & Clark 2005, Barbour & Reeves 2009). As the practice of learning through videoconferences originated in higher education and business contexts (Lawson 2010, Falloon 2012) the role of videoconferences in learning are still relatively unexplored in elementary schooling, though successful experiences have been made in rural schools and with home-schooled children (Barbour & Reeves 2009, Lawson 2010). Barbour and Reeves (2009) suggest that the use of videoconferences for learning may be difficult to translate into elementary school contexts, as successful learner characteristics such as autonomy and intrinsic motivation, which are usually associated with adult learning, are still active in these environments. Introducing videoconferences in lower secondary schooling will therefore require a reconceptualization of traditional pedagogies.

Though videoconferences, according to the literature, have the potential to increase social presence, community and educational opportunities in specific local areas and for specific students, several challenges are nonetheless connected with establishing these new social arenas. Challenges may include collaboration issues such as time-table coordination, booking requirements and technical limitations (Pitcher et al. 2000, Lawson 2010). In addition to this, modes of instruction such as one-to-many lecture formats may disengage young learners who are used to more enquiry based learning. In the telepresence with iPads project schools sought to meet this challenge by constituting telepresence within the unique combination of studio-based lecture-like activities and student-to-student interaction through personalized technologies (iPads). Within this conceptual matrix, telepresence unfolded as specific configurations of videoconference activities that were meant to suit learners in the 7-9th grade.

3. MOVING BETWEEN SITES – METHODOLOGICAL ISSUES

Because of its focus on distributed learning, the telepresence with iPads research project has been inspired by multi-sited ethnography (Marcus 1995, Hannerz 2003). According to Marcus and others, multi-sited ethnography has provided a methodological framework for ethnographically following things, ideas and people in global contexts where phenomena are mobile and transient. Multi-sited ethnography thus moves away from the single-sited practice of conventional ethnography and follows the circulation of objects, practices and identities across sites.

In the telepresence with iPads project multi-sited ethnography has contributed to mapping relationships between schools and studying their collaboration through telepresence. As collaboration between schools is built into the project, multi-sited ethnography has followed telepresence as a phenomenon that emerges

within these collaborations, i.e, the idea is that looking at it from one locality is only seeing it partially. In the project I as the researcher for instance had to map and travel distances between schools in order to understand how distance and other kinds of (dis)connections might act in relationships between local schools. In mapping and travelling distances between schools, I had to decide, in relation to each telepresence activity, where to be physically present and how to incorporate in my observations the experiences and learning of those that were remote. As the research was multi-sited, I would, if possible, try to shift between sites where the teacher or instructor was remote and where she/he was physically co-present with me in the classroom. In addition to this, I would, if possible, visit the collaborating school(s) later the same day or the day after to have informal talks with teachers or do interviews with the students. However, because of the organizational constraints mentioned below, this rhythm of presence was not always possible.

As physical presence in several sites was a prerequisite for understanding telepresence in the project as seen through the multi-sited lens, researching telepresence ethnographically paradoxically entailed travelling the distance that videoconferencing attempted to bridge. Latour argues that "… elements which are close when disconnected may be infinitely remote if their connections are analyzed; conversely, elements which would appear as infinitely distant may be close when their connections are brought back into the picture." (1996, 4). As suggested by Latour, research has to identify the complexities of these connections which are not only geographical, and my research therefore had to map out the multitude of ways in which connections and their distance-closeness effects could affect students' learning. What this entailed was to some extent that telepresence as a phenomenon was created through my trajectories of observation and presence and the connections I was able to make between them.

In connection with this, my role as a researcher was generally affected by the complexities of being an observer between several sites, including those that were connected with my position as a university employee. As an associate professor employed by a state university I was situated in Copenhagen, a 3-4 hours' drive from the local area I was researching. As someone belonging to a different community, my distance from the field often seemed more extended and remote even when I was physically present in the schools. This became increasingly obvious as I struggled to maintain contact with the schools through email and phone calls, in order to be included in telepresence events. The time/space displacement of researcher and field acted through my role as researcher, as telepresence events where often not planned ahead, but incorporated into local practices and time rhythms. As I was conceptualized as a remote actor with no immediate connections to practice I was often excluded, though I generally felt very welcome in the schools.

Finally, distance and proximity acted in through the relationships between schools and their affiliations with the local community. All three schools, though in average 15-20 kilometers distant from each other, were as mentioned above situated in the same municipality, and in many ways shared local histories and socio-economic conditions. However, organizational differences between the schools, such as differences in time tables, teaching styles and practices, often challenged the realization of collaborative telepresence events. In addition to this, teachers and students, though all in one perspective local, were mostly strangers to each other, and had not generally been given time to meet, get acquainted and plan ahead. For many teachers, collaboration is in itself a challenge as they are used to managing classrooms on their own, and opening up the classroom through videoconferencing can be daunting. In this sense local proximity – as argued by the literature - needs additional affiliations to create trust and give access to classrooms (see for instance Friesen 2014). In fact, in one case collaboration between two teachers was only initiated, I was told, because the teacher in school A knew the teacher in school N as a parent, i.e. his son attended school N where the collaborating teacher taught. What seems to be close in terms of local placement may therefore not be sufficient to support the relationships between schools that are necessary for collaboration.

4.   CASE 1: GEOGRAPHY THROUGH TELEPRESENCE.

School A is a small, rural school in the west of Denmark where the students have been working with telepresence through their iPads as well as large screens situated in the classroom dedicated to telepresence[1]. The students are working on a project in geography with school N, a larger, rural school situated about 16 kilometers away. The students in school A and school N have not met each other physically before the

---

[1] School A has a population of 214 students, School N 294 students, school T 257 students

telepresence session, however, a few of the students know each other from communion class, leisure activities or other contexts.

School A and school N are collaborating on a geography project where Google Earth is used to tag places in different countries. According to the teacher in school A, the point of the project is to raise the students' awareness of local differences in countries like for instance Norway, USA, Belgium and Holland. Through Google Earth, he explains, students will ideally be able to identify infrastructural differences through the visual representations of local spaces in the Google Earth interface. As the project is collaborative between the schools, the tags are swapped in a kind of treasure hunt for national, geographical differences.

In the lesson I am observing, videoconferencing is used to instruct students in both schools in how to place the tags in Google Earth used for the treasure hunt. The teacher in school N is teaching the students in both schools, as the teachers have divided the tasks between them, and he is the only one who knows the functionalities of Google Earth. This means that the students in school A are obliged to address the remote teacher if they need help in understanding the assignment.

The focus of the telepresence session is, as described above, the identification and study of local/global space as a geographical phenomenon. Thus, images of the earth are projected and navigated easily by the remote teacher on the large screens covering the end of the wall that faces the students (see figure 1). In quick successions, students' gaze is invited to travel from a view of the Earth from out of space to a view of their local area in Denmark and then further into European locations. As shown in the photo below, students are meant to follow and replicate the remote teachers' instructions on their own pcs and iPads – which potentially adds a feeling of proximity to what is illustrated as well as draws on a student centered approach to the instruction. However, as I shall argue below, the instruction generally fails to engage the students in school A, who for the most part very quickly become completely disengaged from the activity.

Figure 1. Geography through videoconference: school A and school N

Location and geographical space is thematized by the geography lesson as described, however, as illustrated by figure 1, issues of location are active not only as an aspect of what is taught, but as part of the learning situation itself, i.e. as modes of proximity and remoteness in the telepresence activity act actively in the learning of the students. This echoes the argument made by Richardson & Wilkin (2012), that the supposedly dematerializing effects of cyberspace and telepresence – in this case the projections on the screens - is always unfolded within specific, localized contexts and activities. In the case at hand, schools are localized within a distance of less than 20 kilometers from each other and belong to the same municipality, which in some ways – for instance in terms of community - seem integrated and close. However, distances between the students and teachers in school A and N are nonetheless not easily negotiated in the specific session, as students in school A become increasingly passive during the geography lesson. What acts in the situation and inspires (dis)engagement is, it seems, not geographical proximity or local affinity, but modes of attachment and instruction that keep the students from actively participating in the lesson. Thus, as the students are not familiar with the remote teacher, they fail to address him when they do not follow the

14

instructions on the screen. As a rule, they prefer to ask their local teacher for help, but, because of the division of labor between the teachers, the teacher at school A cannot help them with the task. In addition to this, the mode of instruction and possibly the way in which school N is presented on the screen – displayed from a distance and with no eye contact with school A – disengages students from both the partner school and the subject at hand. What seems to be near in terms of geographical proximity and local identity therefore presents itself as infinitely remote in the specific context of the geography lesson observed. In fact, as the screens simultaneously show an out of space perspective on the earth and a view of the remote teacher standing at the front of his class in school N, these spaces seem to be at the same level and at a similar distance. This is in spite of the intruding soundscape that all through the session penetrates the relative quiet of the classroom in school A with the shrill voices of students of school N. In this way the community may be brought into the classroom but not engaged with in significant ways.

5. CASE 2: LEARNING GERMAN THROUGH TELEPRESENCE

Case 2 consists of two separate scenarios where I observed how German was taught through telepresence in the same class in two different school years in school T, in collaboration with respectively school A and school N. In the first scenario German was taught peer-to-peer, i.e. through iPads, with FaceTime interaction between students in school T and school A. The students, who were at that time beginners in German as a foreign language, were asked to take turns with presenting themselves in German to the students in the collaborating school. This was done with the support of a piece of paper with notes that they had prepared before the lesson. In the second scenario students in school T and N were taught German adverbs one-to-many by a teacher at school N, who taught the basic grammatical principles of adverbs through a PowerPoint in a videoconference on the large screen. After the presentation, students at school T and N were asked to translate sentences from Danish into German that included different kinds of adverbs. In both cases the German teachers were present in the respective schools. In the first scenario students did the task from their usual classroom, in the second scenario, both classes had moved to the telepresence room(s). In the second scenario only a smaller group of the students participated, as the teachers had chosen to divide the class into two groups of which only one was taught German.

5.1 Student to Student Interaction through Telepresence

Communicating with authentic others through telepresence can support learners' communicative approach to the language and engage learners in the target language. According to Arnold, Cayley and Griffith (2002) and others, enhanced language learning is one of the significant impacts of videoconferencing. Thus, language learning and intercultural understanding is mentioned frequently in the literature as an aspect of schooling that videoconferencing may enhance. However, in language learning specifically, the anxiety of communicating with native speakers or strangers in the novel environment may intervene with the students' ability to profit from the synchronous event (Kinginger 1999). In this way, the specific practices and contexts of language learning will affect how videoconferencing becomes part of the learning.

In the first scenario FaceTime interaction was, as mentioned above, chosen as a framework for the task, as new learners of a foreign language often are reluctant to speak up in a plenary session where strangers are present. One of the principles underlying the use of interaction through the tablet screen was therefore to create a feeling of equity and proximity between the students. This was done both through the choice of subject – a presentation (in German) of the students' families and near relations – and through the pedagogical set-up which was student-to-student interaction through the small screen of the iPad. The iPad is arguably a more intimate platform for videoconferencing, as the iPad is a personal device and supports a close up view of communication partners.

In school T students were placed in groups of two and given the necessary contact information to call up the students at school A. In school A the teacher had asked the students to work individually with the task to avoid distractions, which meant that the interaction at the outset was a situation that was organized differently by the two teachers.

Figure 2. iPad interaction in school T and A

Though the videoconference setting itself – as can be seen in figure 2 – is a more intimate scenario than the geography lesson described above, issues of remoteness and proximity still affected the interaction of students in the learning process. As students in the two schools did not as a rule know each other and were not used to collaborating, interaction never became natural or fluent, and students generally clung to their pre-prepared manuscripts, transforming the situation into a shared reading event rather than a conversation. As interaction was generally based on transmission of information, a number of the students increasingly became unfocused and dissociated from the task in the course of the lesson. In addition to this the unfamiliarity of students with this way of learning the language affected their behavior in the situation, which according to the teachers was to a large extent disruptive and lacked (n)etiquette.

5.2 Teacher to Student Instruction through Telepresence

In the second scenario teaching German grammar one-to-many became a practice of language learning that contributed to shaping the experience of videoconferencing as a learning event. Contrary to the practice of speaking a foreign language, learning German grammar was configured as a big screen one-to-many learning event, where students in both schools were moved to an auditorium-like classroom and situated in rows. In this session the teacher from school N taught the principles of adverbial connections through a PowerPoint presentation on the screen. The teacher at school T was present as an assistant teacher to her own class.

Figure 3. The telepresence auditorium at school T

Figure 4. The remote teacher at school N

The lesson was, I was told by the teacher, a relatively classic enactment of a grammar session, where an aspect of the lesson was to try to experiment with the relationship between students in school T and their relationship to the teachers in respectively school T and N. The question was whether students would feel confident with addressing the remote teacher in German in the course of the lesson.

As remote participants in the grammar lesson, students were at the outset placed as spectators to the presentation given by the remote teacher. However, after her presentation students in school T were invited to participate in the discussion of translations of Danish sentences into German. In this context the students were extremely reluctant to address the remote teacher and to speak out in the plenary in German. As a rule, students addressed their local teacher, and spoke out to her, though she was purposely seated at the row behind them. In the evaluation after the session, students generally said that they had enjoyed the lesson as a break from classroom based teaching, and that they felt the remote teacher had presented the grammatical issues clearly. However, they all felt uncomfortable with speaking out in the plenary, as students in school N were strangers to them and they were afraid of making mistakes in the plenary. In this sense they were primarily placed in the telepresence event as spectators, and chose to act within their local configuration of teacher-student relationships.

6. DISCUSSION AND SOME CONCLUSIONS

The scenarios above illustrate some of the challenges, issues and potentials involved in connecting schools through telepresence understood as different kinds of mediated practices in everyday schooling. Whereas videoconferencing – according to the literature – has extensive potential for redistributing learning resources in rural communities and enriching learning - actually making the connection(s) is, as the examples show, still affected by both logistics and issues of proximity and distance. In terms of logistics, the schools in question must – as shown above – aim to adapt their organizational and cultural specificities to the community of schools with regard to for instance timetables and teaching styles. When this adaptation is successful, three school organizations may to some extent become one and can act as one in the synchronous learning environment. What works against this, however, are not only organizational structures in the individual schools, but also the lack of familiarity and feeling of community between students and teachers who are in many senses effectively strangers inhabiting the same local municipality. Therefore, connections between students and teachers in the schools must in future be supported and enhanced in order to establish engaging learning forms in the mediated environment that can create this feeling of community.

Another issue that acts in the telepresence with iPads activities is the co-presence of several teachers and learners in restricted synchronous learning environments. As argued by the literature, synchronous interaction can be an extremely challenging framework for learning in terms of both logistics and effectively making the connections that support interactive learning practices (see for instance Anderson & Rourke 2005). This is an aspect of videoconferencing that schools should address and take seriously in their development of telepresence activities. In the schools in question, one of the challenges identified by the research is exactly these brief and fragile synchronous learning spaces that to a large extent fail to connect distributed students

and teachers. Therefore, the synchronous activities in these schools might be enhanced by extending and supporting them through asynchronous and face-to-face activities that could establish a more solid and meaningful basis for collaboration by bringing real connectivity back into the picture. This will entail looking at collaboration – and telepresence - as a broad framework for learning between the schools, in which different kinds of connections – both synchronous and asynchronous, mediated and face-to-face, large screen and desktop interaction, can support the placement of schools within the community and in the global context of learning. One of the exciting aspects of telepresence is thus the ways in which the potential of mediation changes the directions of learning – i.e. brings them out of the brick and mortar environment and into communities that are both global and local and in which collaboration is directed at real world communities. One of the interesting issues to be taken up by the research described in this paper will therefore be a further study of the consequences of these new directions and connections of learning, i.e. how a deeper study of these connections between schools and communities can bring more learning potentials into the picture.

REFERENCES

Anderson, T., & Rourke, L. (2005). *Videoconferencing in Kindergarten-to-Grade 12 Settings: A Review of the Literature*. Edmonton: Alberta Education

Arnold, T., Cayley, S., & Griffith, M. (2002). *Video conferencing in the classroom: Communications technology across the curriculum.* Exeter: Devon County Council.

Barbour, M.K. & Reeves, T.C. (2009) The reality of virtual schools: a review of the literature. *Computers & Education 52, 402-16*

Berge, Z. L., & Clark, T. (2005). *Virtual schools: Planning for success*. New York, NY: Teachers College Press.

Cole, C., Ray, K., & Zanetis, J. (2004). *Videoconferencing for K12 classrooms: A program development guide.* Eugene, OR: International Society for Technology in Education

Dolezal, L. (2009) The phenomenology of Telepresence and Re-embodiment. *HumanTechnology* 5, 2. 208-226

Draper, J.V., Kaper, D.B. & Usher, J.M. (1998) Telepresence. *Human Factors* 40. 354-75

Dussel, I. (2013) The assembling of schooling: discussing concepts and models for understanding the historical production of modern schooling. *European Educational Research Journal* 12, 2. 176-89

Falloon, G. (2012). Using videoconferencing in a school-scientist partnership: students' perceptions and scientists' challenges. *Research in Learning Technologies* 20(1) 1-18.

Friesen (2014) Telepresence and Tele-absence: A Phenomenology of the (In)visible Alien Online. *Phenomenology & Practice* 8, 1. 17-23

Hannerz, U. (2003) Being there…and there…and there!: reflections on multi-site ethnography. *Ethnography* 4:2, 201-16

Kinginger, C. (1998). Videoconferencing as access to spoken French. *Modern Language Journal, 82*(4), 502–513.

Latour, B. (1996) On actor-network theory. A few clarifications plus more than a few complications. *Soziale Welt* 47. 47-64

Latour, B. (2005) Reassembling the social: An introduction to actor-network theory. Oxford: Oxford University Press

Lawson, T. & Comber, C., (2010) Videoconferencing in English schools: one technology, many pedagogies? *Technology, Pedagogy and Education.* 19(3), 315–326.

Lawson, T., Comber, C., Gage, J., & Cullum-Hanshaw, A. (2010). Images of the future for education? Videoconferencing: a literature review. *Technology, Pedagogy and Education* 19(3), 295–314.

Levinsen, K.T., Ørngreen, R. & Buhl, M. (2012) Telepresence as Educational Practice in the Third Teaching Room – a study in Advanced Music Education. *Proceedings, European Conference on Elearning*

Marcus, G.E. (1995) Ethnography in/of the world system: the emergence of multi-sited ethnography. *Annual Review of Anthropology* 24, 95-117

Pink, S. (2011) From embodiment to emplacement: rethinking competing bodies, senses and spatialities. Sport, Education and Society 16, 3. 343-355

Pitcher, N., Davidson, K., & Goldfinch, J. (2000). Videoconferencing in higher education. Innovations in Education and Training International, 37(3), 199–209.

Richardson, I. and Wilken, R. (2012) *Parerga of the third screen: Mobile media, place, presence.* In: Wilken, R. and Goggin, G., (eds.) *Mobile technology and place.* Routledge, New York, U.S.A.

Steuer, J. (1995) Defining virtual reality: Dimensions determining telepresence. In Biocca, F. & Levy, M.R. (eds.) *Communication in the age of virtual reality* Hillsdal NJ: Lawrence Erlbaum Associates

STRATEGIC DECISION MAKING CYCLE IN HIGHER EDUCATION: CASE STUDY OF E-LEARNING

Blaženka Divjak and Nina Begičević Ređep
University of Zagreb, Faculty of Organization and Informatics
Pavlinska 2, 42 000 Varaždin

ABSTRACT

This paper presents the methodology for strategic decision making in higher education (HE). The methodology is structured as a cycle of strategic decision making with four phases, and it is focused on institutional and national perspective, i.e. on decision making that takes place at institutions of HE and relevant national authorities, in case HEIs are public. Case study of e-learning implementation in HE is presented. E-learning refers to technology enhanced learning, blended learning, open and distance learning as well as massive online courses (MOOCs) delivered by HEIs.

KEYWORDS

Strategic Decision Making, Multi-criteria Decision Making, Diffusion of Innovation, E-learning, Open and Distance Learning, High Education

1. INTRODUCTION

Higher education's (HE) key mission is to develop human potential with beneficial effects for social and economic development. Higher education institutions (HEIs) have been evaluated through the performance in triple mission: teaching, research, serving to society (outreach). Until the end of the 19th century, universities were mostly focused on teaching along with conservation and dissemination of knowledge. At the end of the 19th century, universities directed their mission to teaching and research. Adding the so-called third mission, which refers to the contribution to the society, economy as well as personal development, happened at the end of the 20th century. Since then it has had a remarkable influence on the development of the universities and HE in general. The way in which HEI meets its mission is becoming a first-class research problem (Cortés-Aldana et al. 2009). HE as a system, along with HEIs, must be innovative and strategically managed to be able to fulfil its mission. Therefore, the decision making (DM) accompanied by evaluation of its implementation in higher education is an issue of the highest priority.

This paper presents the methodology for strategic decision making in HE. The methodology is focused on institutional and national perspective, i.e. on decision making that takes place on institutions of HE and relevant national authorities, in case HEIs are public. Application and adjustment of the proposed methodology of strategic decision making in HE is given on the example of implementation of e-learning.

Many different terms have been used in the literature to describe learning supported by information and communication technology (ICT). Here, we use the term e-learning in a broader sense to cover a variety of forms; starting from using ICT in classrooms, blended learning, open and distant learning, online learning as well use of MOOCs, e-portfolios, social media technologies, open badges, etc.

The methodology is structured as a cycle of strategic decision making with four phases:

(1) Identification and research of the problem - problem identification and research of the problem, adjustment and implementation of methodologies such as readiness assessment and diffusion of innovation

(2) Design of decision making methodology - improvement of multi-criteria decision analysis enabling better strategic decision making in HE

(3) Implementation and monitoring of strategic decision – individual/group decision making supported by multi-criteria decision making methods, implementation of decision, identification of key factors that determine effectiveness of strategic decision, their correlation and design of the measuring model for maturity and effectiveness of strategic decision implementation in HE

(4) Evaluation of the strategic decision effects - evaluation by standard methods such as stakeholder evaluation, alignment with strategic goals but also by application of structural causal models for identification of strategic decision effects (Pearl, 2000).

These four phases will be explained in the paper, and a case study of e-learning implementation will be presented. The case study's complex nature, while technology is an obvious component of e-learning and educational pedagogy, must also focus on participation (Tucker, Gentry, 2009). There are also specifics of HE environment that have to be taken into account when analyzing strategic decision making. Most HEIs have a certain level of institutional autonomy, but also the academic freedom of researchers and professors to research and teach due to their best knowledge and according to their own discipline values and personal academic integrity. Besides that, HE can be seen as private or public good, and this introduces different stakeholders into the process of decision making (Marginson, 2011). However, the decision making process at HEIs can be very complex and essentially different from decision making in other private or public organizations. The public good, the historic purpose such as universities and colleges, is replaced in many HE systems by the demands of private interests and economy in many HE systems. However, it still has considerable influence on governing the HEIs. In this paper we are going to refer mostly to HEIs that have a certain level of autonomy from state, but are seen as a public good where staff and students participate in the process of strategic decision making.

2.   STATE OF THE ART

There are different approaches to strategic planning and strategic decision making that are applied within HE. Lerner (Lerner, 1999) gives a review of access to the strategic planning process in HE and presents process model of strategic planning and decision making in HE. Related to the methods of the strategic planning and decision making, GAP analysis, SWOT analysis, method five competitive forces, methods of strategic programming and some other methods are applied. Further, Clayton (Clayton, 1997) proposed Delphi method as the method for making strategic decisions in education. In the paper, Jani method (Jani, 2013) based on the theory of inventive problem solving (TRIZ) is modified to become suitable for problem solving in HE.

In the book (Saaty, Cillo, 2008) analytical network process (ANP) was used for decision making in the field of education, but mainly for individual decision making. For example: to make personal decisions about the choice of direction for further education and for ranking of HE institutions. Possibilities of improving AHP and ANP methods for multi-criteria group decision making, with applications within HE, are explored in the paper (Begičević, Divjak, 2006). The methodological framework for strategic planning and decision making of e-learning has been developed and published in the paper (Begičević et al., 2007). However, this methodology has been developed for a narrower application than the methodology presented in this paper.

According to Okumus (2001), there are 10 key factors that affect the implementation of the strategy: its formulation, uncertain environment, organizational structure, organizational culture, operational planning, resource allocation, individuals, controls and outcomes. Key factors that influence strategic changes at universities are leadership, decision-making procedures, communication and evaluation (Stensakers et al., 2014). Application of DEA method (Data Development Analysis) in the evaluation of the effectiveness of education is presented by (Jablonsky, 2011). We can emphasize several models for estimation of some aspects of e-learning effects: Anderson's conversational e-learning model (Anderson, 2007), decision making model on introduction of e-learning in HE (Begičević et al., 2007), EVEDIN model for evaluation of effects of learning and teaching in e-learning systems (Grubišić et al., 2007). None of these offer a complete framework for estimating the effects of strategic decisions in e-learning. According to Mahsood and Chenicheri (Mahsood, Chenicheri, 2013), literature on development and implementation of strategies in universities is limited. In that respect this paper contributes to the research in the field of strategic decision making in HE.

3. STRATEGIC DECISION MAKING CYCLE IN HIGH EDUCATION

Initial pattern in developing methodology for strategic decision in HE is a methodological framework called Deming cycle (PDCA circle) and Dyer's model (Dyer, 1991) of decision making and implementation.

According to Dyer, there are four phases of decision making and implementation process: Intelligence phase, Design phase, Choice phase and Implementation phase. The tools that can be used in these phases are: data acquisition, storage and retrieval, data base management systems, interactive query, data bases, data analysis and decision analysis (Dyer, 1991).

Deming cycle implies constant improvement of the system's ability, which is the aim of the quality management. This cycle recognizes four phases: P (plan) – determination of the mission, vision and strategy, planning and establishing of objectives; D (do) – applying the processes, performing; C (check) – supervising and measuring of the process and their results considering objectives and indicators; A (act) – improvement of the process. The argument for choosing this methodological pattern is that Deming cycle is widely used in different areas, in its original or modified form. Besides being an effective process improvement guide it offers a systematic improvement method. The Deming cycle informs future improvement by providing feedback and maintains order during strategic planning, decision making and problem solving. It is useful for daily routine management, problem-solving process, project management, continuous development, vendor development, human resources development, new product development and process trials, etc.

In our methodology, the Deming cycle was modified as shown in Figure 1. The methodological cycle for strategic decision making in HE was upgraded with the application and adjustment of the methodology on case study of e-learning implementation in HE. It consists of two wider goals as two concentric cycles; the inner cycle representing different phases of general methodological approach described below, and the outer cycle representing case study of e-learning implementation in HE described in the following sections. Further iterations may add additional cycles representing new use-cases of given methodological framework (technology transfer, human resources development, inclusive curriculum development etc.). They can provide validity checks, as well as motivation for methodology upgrade.
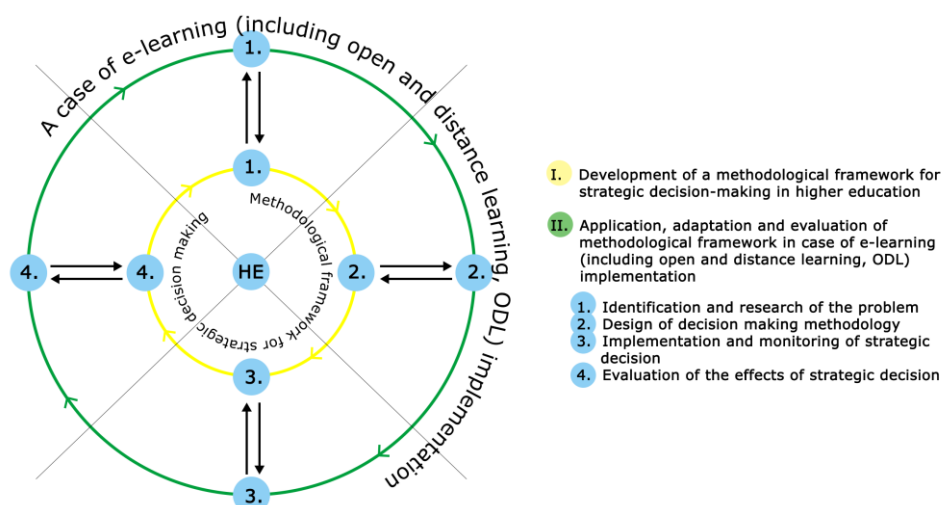
Figure 1. Double cycle of strategic decision making – case study of e-learning (including ODL)

The cycle of strategic decision making, in our case it is the one in HE, consists of four phases: (1) Identification and research of the problem, (2) Development of the methodology of strategic DM, (3) Implementation and monitoring of strategic decision and (4) Evaluation of the effects of strategic decision.

In the first phase called Identification and research of the problem, the problem is going to be identified and the research of the problem, using situation analysis, conducted. In this phase the methodology for institution readiness assessment can be applied. Further, an additional modelling - the diffusion of innovation (DOI) developed by Rogers (Rogers, 2003), is valuable in this phase. According to the theory of DOI, diffusion is a process for transfer of innovations through certain channels, over time and among the members of a social system. Thereby, innovation implies every "idea, practice, or project that is perceived as

new by an individual or other unit of adoption" (Rogers, 2003). In this phase key factors for assessment of organization's readiness for a decision about adoption of innovation and key performance indicators for the measurement of diffusion of innovations performance in a specific implementation case can be defined.

In the second phase called Design of decision making methodology, based on the improvement of multi-criteria decision analysis enabling, better strategic decision making must be done. The methods used in this phase are multi-criteria decision making methods (MCDM) such as the AHP (Analytic Hierarchy Process) and the ANP (Analytic Network Process) (Saaty, 2001). Other methods can be also used, for example PROMETHEE and ELECTRE, or some of the ideal point-based multi-criteria decision methods (Estrella et al. 2014). In our experience and research it is convenient to use the AHP and ANP BOCR (Benefits, Opportunities, Costs, Risks) models for group decision making (Begičević et al., 2007). The results can be analyzed by using sensitivity analysis. According to the purpose and aims of decision making, the multi-criteria variant of cost-benefit and risk analysis can be used.

In the third phase called Implementation and monitoring of strategic decision, decision making supported by developed decision making methodology is conducted. This methodology helps decision makers to prioritise objectives and alternatives. The objectives and alternatives are presented in a hierarchical (AHP), network BOCR (ANP) structure or in a decision making table (PROMETHEE or ELECTRE). Decision makers are able to drill down to their level of expertise, and apply judgments to the objectives and alternatives considered important for achieving the goals as well as prioritize alternatives.

In the process of group DM, the alternatives are prioritized and decision is made and implemented based on the obtained results. Parallel with the implementation, it is crucial to have a monitoring of the implementation of decision. To ensure monitoring, it is important to identify factors that determine effectiveness of implementation, their correlation and design of measuring the model for maturity and effectiveness of the decision implementation (KPI – Key Performance Indicators). In order to build a model for the assessment of the organization's maturity to implement and monitor the decisions, BSC Balanced Scorecard, Enterprise Architecture for BPM or CMMI (Capability Maturity Model Integration) can be used.

Monitoring the process of implementation of the strategic decision is based on milestones and other measurable indicators. Monitoring and evaluation are strongly linked and must be both based on reliable, accurate and updated data. Therefore, the purpose of monitoring is to collect relevant data to demonstrate the results of strategic decision implementation. The purpose of the evaluation is a rigorous and systematic assessment of the strategic decision implementation's success.

In the fourth phase called Evaluation of the effects of strategic decision, several standard qualitative (econometric analysis, cost-benefit analysis, multi-criteria analysis, regression analysis etc.) and quantitative (stakeholder perspective, document analysis, internal consistency of the strategy and external effectiveness, benchmarking, in-depth case study, Delphi panel, etc.) methods can be implemented, but some innovative approaches such as Pearl's structural causal models for the identification of the effects of strategic decision. Evaluation phase also encompasses feedback that informs policy makers and is used as an input for starting a new cycle of strategic planning. For the evaluation to be meaningful, the strategic goals must be SMART, meaning that the objectives are: Specific, Measurable Achievable, Relevant and Time Bound.

In the following sections the main stages of the outer cycle with emphasis on the e-learning implementation in HE are described.

3.1 Identification and Research of the Problem – e-Learning in HE

In general, the identification and research of the problem phase consists of three parts: (1) Analysis of supply and demand using situation analysis, (2) Determination of diffusion indicators and success, (3) Determination of readiness for innovations.

Situation analysis includes the analysis of present state, research of the problem and analysis of potential solutions. The methods which can be applied at this stage are: recording of the current situation, case study research and different types of qualitative analysis. These methods enable identification of key factors related to the identified strategic problems in HE and define the responsibility for solving those problems.

When modelling the diffusion of innovation, structural equation modelling (SEM) and social network analysis (SNA) can be used to identify: 1) key factors for assessment of organization's readiness for a decision on the adoption of innovation in a particular social environment, and 2) key performance indicators for the measurement of diffusion of innovations' performance in a specific example on e-learning

implementation. We emphasize here the theory of diffusion of innovations according to Rogers (Rogers, 2003), which is almost completely ignored within the existing research.

In this phase, the methodology for readiness assessment, for the purpose of strategic decision making, used to be applied. In the context of our case study of e-learning implementation in HE, the starting point is a methodology for e-readiness assessment based on CID methodology. CID methodology was developed by the Center for International Development at Harvard University (CID, 2006). It is a diagnostic instrument for the assessment of society's readiness to use ICT, and it was originally based on indicators in five categories: access, education, society, economy and policy. Upgrade of CID methodology is necessary in order to accommodate the problem's needs and to cover, at least, the following areas: Access to technology; Digital literacy and willingness to change of staff and students; Expectations from society and economy; Educational goals, policy and their funding. The co-authors of this paper conducted an extensive research on e-readiness and adapted the methodology in Kosovo from 2010 to 2011, and accordingly developed the strategy of e-learning for pre-tertiary education within the EU IT Pilot Project in the Field of Education in pre-tertiary education in Kosovo (Divjak, Begičević Ređep, 2012).

Methodology for e-readiness assessment can be complemented by the use of qualitative analysis, in-depth interview with stakeholders, focus groups or panel discussion. This is very important for HEIs due to institutional autonomy and participation of staff and students in strategic DM. Therefore, raising awareness of new challenges and potential benefits is at the very core of strategic DM in HE. A HEI finishes the first phase with understanding the objectives or reasons why an organization wishes to establish e-learning education, and the support garners from the various institution stakeholders (Tucker, Gentry, 2009).

3.2 Design of Decision Making Methodology – e-Learning in HE

The development of methodology for strategic DM in HE covers three basic stages: 1) Choosing the most appropriate multi-criteria decision making methods (MCDM) related to the problem characteristics, 2) Improving methods for MCDM, and 3) Building models for decision making using MDCM.

The main hypothesis at this phase is that by adjusting and implementing the methodology of multi-criteria decision making analysis (MCDM), it is possible to improve the quality of strategic decisions in HE.

Decision making in HE has several perspectives and dimensions. The main perspectives are personal, institutional and public. Key factors that make decision making in HE more difficult are: complexity; weak structure and interdependence and decision making at multiple levels in the hierarchy (national, university, faculty/institute, department/division, personal level). The criteria by which it is possible to describe alternatives for making strategic decisions in HE have both qualitative and quantitative characteristics.

Considering the characteristics we described, it is desirable that the methods for the analysis of decisions in HE have the following features: support for multiple criteria decision making, support for structuring of decision problems, support for modelling dependencies between the elements of decision making, the intensities of the criteria have to be expressed in qualitative and quantitative scales, support for group decision making, performing sensitivity analysis and risk analysis, as well as cost-benefit analysis. Existing methods for multi-criteria decision making only partially meet these requirements. Therefore, it was necessary to improve the methods for decision analysis in order to fit strategic decision making in HE. The starting points were methods for multi-criteria decision making: AHP and (Saaty, 2001). AHP provides a hierarchical structuring of decision making problems, and ANP models provide interdependencies of the problem via network. The AHP and ANP can be used to create a BOCR (Benefits, Opportunities, Costs, Risks) decision making models for group decision making on problems in HE. Other methods available are PROMETHEE, ELECTRE, and the ideal point-based multi-criteria decision methods and they can be used if they are more appropriate for solving a specific problem in HE. Due to the importance of cost-benefit analysis for decisions making in HE, the multi-criteria variant of cost-benefit analysis can be useful. If risks are identified in making strategic decisions in HE, it is important to have a risk management strategy. Activities in risk management can be prioritized by hybrid methodology. Monte Carlo simulation can be used for the analysis of financial risks. Risks associated with prioritization can be analysed by sensitivity analysis.

In the stage of building a model for decision making using MCDM, models that incorporate methods from previous stage are built. In stages 2) and 3), the qualitative analysis, survey, factor analysis and clustering (to determine participants in the process of group decision making) can be applied.

3.3 Implementation and Monitoring of Strategic Decision – e-Learning in HE

In the phase of implementing a strategic decision, individual or group decision making must be conducted and the made decision implemented. We propose the decision making methodology designed for strategic decision making in HE is based on the MCDM methods. In that context we have already mentioned AHP and ANP BOCR methods as the methods used for building the decision making models. However, other MCDM methods can be used according to the analysis in the previous phase.

The AHP/ANP BOCR models helps groups to structure decision into objectives and alternatives, prioritise objectives and alternatives, and justify decisions using sensitivity analysis. It is important to choose the participants in group decision making with specific knowledge; this makes them competent to assess and give judgments in the process of group decision making on some strategic issues. Results of group decision making are the objective's relative significance and priorities of the alternatives, gained by judgment synthesis of participants included in decision making process. Sensitivity Analysis offers a stable solution, but it also enables the change of input figures as well as observing consequences on priorities of the alternatives. Sensitivity Analysis is used to investigate the sensitivity of the alternatives to changes in the priorities of the objectives. In the process of group decision making based on the developed models, the alternatives are prioritized and the best alternative is implemented. Parallel to the implementation, it is crucial to have monitoring of strategic decision.

The implementation of strategic decisions, along with strategic goals, requires the adoption of related action plan which includes: activities, responsibilities, deadlines, costs, indicators and prerequisites for implementation. In general, the methodology is based on the following methods and models: 1) BSC Balanced Scorecard: in order to define indicators i.e. KPIs (Key Performance Indicators) to monitor the implementation of strategic decision; 2) Enterprise Architecture for BPM (Business Process Management) for modelling and management of activities; 3) CMMI (Capability Maturity Model Integration) to assess the level, of process capability and maturity of organizations for the implementation of strategic decisions.

In order to build a model for assessment of the maturity of an organization for implementation and monitoring of strategic decisions in HE, CMMI model can be used. Accordingly, the relevant criteria for assessment of capability levels for the process of implementation and monitoring of strategic decision in HE must be defined. Process capability levels are the basis for determining a maturity level of the organization, which is an indicator of its readiness to implement the strategic decision.

Additionally, the success of the implementation and monitoring of strategic decisions in HE can be assessed by using KPIs (related to BSC and BPM) and econometric methods (ROI, productivity, efficiency, profitability, etc.), This must be done with significant adaptation to the environment in order to interpret what notions of productivity, efficiency and specially profitability mean in HE. These indicators are related to three important project-oriented objectives: time, quality and cost.

3.4 Evaluation of the Effects of Strategic Decision – e-Learning in HE

The evaluation of the effects of a strategic decision in HE is very rarely researched or even performed on systematic basis in HEIs. However, the results of such evaluation should have a major impact on the following cycle of strategic planning. Therefore, the methods for strategy evaluation must be carefully selected and applied, and the evaluation results must be announced and used as lessons learned. In the phase of evaluation, different quantitative, qualitative and mixed methods can be used. The quantitative methods that can be used are econometric analysis, cost-benefit analysis, multi-criteria analysis and regression analysis. The qualitative methods that can be used for the evaluation of the effects of strategic decision are stakeholder perspective, document analysis, internal consistency of the strategy and external effectiveness, benchmarking, in-depth case study and Delphi panel. In our methodology we also suggest using some innovative approaches, such as Pearl's structural causal models to identify the effects of strategic decision.

Pearl's structural causal models can be used for the identification of strategic decision effects. J. Pearl's interpretation of causality enables quantitative modelling of causal concepts in dynamic systems. After the groundbreaking work in Bayesian networks and probabilistic reasoning, Pearl has been developing his structural causal models (SCMs) for the last 20 years. Using SCMs, we replace informal causal utterances with probabilistic queries. For example, we can say something about "why the system behaves in certain way" (explanation) or "how would the system behave under external actions" (prediction).

The research on this paper topics continues in the scope of the project "Development of a methodological framework for strategic decision making in higher education – a case of open and distance learning implementation" (HigherDecision) supported by Croatian Science Foundation and planned for the period 2015-2019. Primary goal of HigherDecison project is to develop a complete methodology for strategic DM and the monitoring of its implementation in HE. Two basic components of the project are: 1. Development of methodological framework for strategic DM and monitoring of its implementation; 2.Application, adjustment and evaluation of methodology on the example of decision implementation on e-learning (ODL).

4. CONCLUSION

HEIs today are facing many challenges, but also vast opportunities for change. The core question is how to use the opportunities despite restrictions in funding, international competition and internal resistance to change in order to better fulfil their fundamental mission. One of the biggest opportunities is the implementation of educational technologies that can serve many institutional goals, such as enhancing quality of teaching and learning, strengthening outreach and also raising profits. However, the process of strategic DM is even more complex in HEIs than in other organizations due to the nature of HE system and its role in the development of society, economy as well as in students' personal development. In order to systemize and improve the process we proposed the methodology called strategic decision making cycle that includes four phases. We also proposed the listed methods that can be used in each phase, as well as some specifics of decision making in HE and especially when e-learning is concerned. A summary is given in Table 1.

Table 1. Summary of strategic decision making cycle in HE

Phase of the cycle	Approaches	Specifics of HE and e-learning	Methods
Identification and research of the problem	Needs and situation analysis Readiness assessment Diffusion of innovation	Stakeholders' involvement E-readiness Consciousness raising	Situation analysis Case study research Different types of qualitative analysis Structural Equation Modelling (SEM) Social Network Analysis (SNA) Upgraded CID methodology for e-readiness assessment
Development of methodology for DM	Analysis of potential solutions MCDM Cost-benefit and risk analysis	Benchmarking of HEIs Modelling dependencies and group DM (AHP & ANP with BOCR)	BOCR AHP and ANP, PROMETHEE, ELECTRE Ideal point-based MCDM Multi-criteria variant of cost-benefit analysis Hybrid methodology of risk management – Monte Carlo simulation and Sensitivity analysis Different types of qualitative analysis Factor analysis, Clustering
Implementation and strategic decision monitoring	BSC, KPI, BPM CMMI PPM	Interpretations of econometrics and use of KPIs and PPM	BSC Balanced Scorecard Enterprise Architecture for BPM (Business Process Management) CMMI (Capability Maturity Model Integration) Econometric methods (ROI, productivity, efficiency, profitability)
Evaluation of effects of the strategic decisions	Qualitative, quantitative and mixed methods Structural causal models	Stakeholder perspective analysis In-depth case study to find out causes & effects	Qualitative methods - stakeholder perspective, document analysis, internal consistency of the strategy and external effectiveness, benchmarking, in-depth case study, Delphi Quantitative methods - econometric analysis, cost-benefit analysis, multi-criteria analysis and regression analysis Innovative approaches - Pearl's structural causal models

Finally, many open questions still remain and therefore the need for further research. In the phase of problem definition and exploration different stakeholders must be involved in order to contribute to development of goals and alternative solution. Different stakeholders have diversified goals and expectation of HE. However, if group decision making is facilitated in effective and efficient manner, solution can be reached and implemented. Nevertheless, implementation monitoring and evaluation are neither a common practice in HEI nor a well-researched area. Finally, the proposed research could have a reach beyond HE.

ACKNOWLEDGEMENT

REFERENCES

Anderson, T., 2008.*Theory and practice of e-learning*, Athabasca University Press

Begičević, N. et al., 2007. Comparison between AHP and ANP: Case Study of Strategic Planning of E-Learning Implementation. *International Journal of the AHP*, 1(1), pp.1–10.

Begičević, N. , Divjak, B., 2006. Validation of theoretical model for decision making about e-learning implementation. *Journal of Information and Organizational Sciences*, 30(2), pp.171–184.

Begičević, N. et al. 2007. Prioritization of e-learning form: a multicriteria methodology. *Central European Journal of Operations Research*. 15(4). pp. 405-419.

CID Readiness for the Networked World – A Guide for Developing Countries, 2006. Available at: http://www.readinessgude.com

Clayton, M.J., 1997. Delphi: a technique to harness expert opinion for critical decision-making tasks in education. *Educational Psychology: An International Journal of Experimental Educational Psychology*. 17(4). pp. 373-386.

Cortés-Aldana, F.A. et al., 2009. University objectives and socioeconomic results: A multicriteria measuring of alignment. *European Journal of Operational Research*, 199(3), pp.811–822.

Divjak, B., Begičević Ređep, N., 2012. Methodology for Strategic Planning of e-Learning Implementation in Developing Countries, *Proceedings of the EDEN 2012 (European Distance and E-learning Network)*, Porto, Portugal

Dyer, F. R., Forman E. H.,1991. *An Analytic Approach to Marketing Decisions*. Prentice-Hall International

Estrella, R. et al. 2014. Comparison of Three Ideal Point-Based Multi-Criteria Decision Methods for Afforestation Planning. *Forests*, 5(12), pp.3222–3240.

Grubišić, A. et al. 2007. EVEDIN A system for automatic evaluation of educational influence, *International Journal of WSEAS Transactions on Computers* 6(01), pp. 1109-2750.

Jablonský, J., 2011. Models for efficiency evaluation in education. In: *Proceedings of the 8th International Conference on Efficiency and Responsibility in Education*. Prague, 9th–10th June 2011.

Jani, H.M., 2013. Teaching TRIZ Problem-Solving Methodology in Higher Education: A Review. *International Journal of Science and Research (IJSR)*. 2(9). pp. 98-103.

Lerner, A.L. ,1999. A strategic planning primer for higher education. [Accessed September 4, 2014]. Available at: http://www.des.calstate.edu/strategic.html.

Mahsood, S., Chenicheri, S.N., 2013. *External Quality Audit: Has It Improved Quality Assurance in Universities?* (Chandos Learning and Teaching Series)

Marginson, S., 2011. Higher Education and Public Good. *Higher Education Quarterly*, 65(4), pp.411–433.

Okumus, F.et al. 2010. *Strategic Management in the International Hospitality and Tourism Industry*. Routledge.

Pearl, J., 2000. *Causality: models, reasoning, and inference*. New York, NY: Cambridge University Press.

Rogers, E.M., 2003. *Diffusion of innovations*. Fifth Edition. New York: Free Press.

Saaty, T.L., Cillo, B., 2008. *The Encyclicon: A Dictionary of Complex Decisions Using the Analytic Network Process*. Volume 2. Pittsburgh, PA: RWS Publications.

Saaty, T.L., 2001. *Decision Making for Leaders: The Analytic Hierarchy Process for Decisions in a Complex World*, New Edition 2001 (Analytic Hierarchy Process Series, Vol. 2)

Stensaker, B. et al., 2014. Factors affecting strategic change in higher education. *Journal of Strategy and Management*. 7(2). pp. 193-207.

Stettina, C.J., Hörz, J., 2015. Agile portfolio management: An empirical perspective on the practice in use. *International Journal of Project Management*, 33(1), pp.140–152.

Tucker, J.P., Gentry, G.R., 2009. Developing an e-learning strategy in higher education. *Foresight*, 11(2), pp.43–49.

PERFORMANCE & EMOTION – A STUDY ON ADAPTIVE E-LEARNING BASED ON VISUAL/VERBAL LEARNING STYLES [1]

Jennifer Beckmann[1], Sven Bertel[2] and Steffi Zander[3]

[1]*Fachhochschule Südwestfalen, Department of Electrical Engineering, Lübecker Ring 2, 59494 Soest, Germany*
[2]*Bauhaus-Universität Weimar, Faculty of Media, Usability Research Group, Bauhausstraße 11, 99423 Weimar, Germany*
[3]*Bauhaus-Universität Weimar, Faculty of Art and Design, Chair of Instructional Design, Geschwister-Scholl-Straße 7, 99423 Weimar, Germany*

ABSTRACT

Adaptive eLearning systems are able to adjust to a user's learning needs, usually by user modeling or tracking progress. Such learner-adaptive behavior has rapidly become a hot topic for eLearning, furthered in part by the recent rapid increase in the use of MOOCs (Massive Open Online Courses). A lack of general, individual, and situational data about student populations currently hampers the infusion of effective adaptive behavior into existing eLearning platforms. This contribution presents original research on using differences in individual learning styles. Factors related to performance, motivation, satisfaction, and previous knowledge were targeted and used to assess the effectiveness of the approach. We discuss alternative bases for adaptation (e.g. cognitive styles), style distributions in student populations, and conclude with repercussions for adaptive behavior in HCI in general.

KEYWORDS

Adaptive eLearning, Learning Styles, eLearning, Inter-individual Differences, Learner Satisfaction, Motivation

1. INTRODUCTION

Recently, MOOCs have seen a rapid increase in use, both in the number of courses that are on offer, often for free, as well as in attendance per course, with participant numbers surpassing 230,000 for individual courses (Jordan 2014). Additionally, students are drawn from increasingly heterogeneous population groups (e.g., regarding age or cultural and educational backgrounds) (Ha 2014). There is every indication that such development will be continuing for the coming years, as additional universities, companies, educational alliances, and funding agencies are increasing their commitments, and as MOOCs (along with eLearning systems in general) are frequently seen as a suitable instrument to further social inclusion on national and international levels. Last, the continuing increase in the use of mobile devices can be expected to additionally increase the use of eLearning, as learning can spread to more diverse settings, contexts, and locations outside the traditional classroom. This creates new challenges for human-computer interaction in eLearning systems.

Compared to traditional, classroom-based learning, eLearning is characterized, among other differences, by a dramatically decreased instructor/student ratio (with less time and less other resources available per student) and a dramatically increased variation in the student population and in contexts and patterns of use. In brief, there exists less option for the instructor to adapt and mediate a course's content to the individual student, and more need to do so. This is a gap that eLearning systems need to increasingly fill. In the fields of CSCW and Ubiquitous Computing, there has been a significant amount of research on systems that leverage communication or exchange between learners and instructors, or among learners, aiming to bridge this gap (e.g. Abowd et al. 1999, Di Cerbo et al. 2010). In such systems, chats, message boards, or shared documents

---

[1] Excerpts of this paper have already been presented as a short article (poster) at the Human Computer Interaction Conference, Munich, in September 2014.

help to create social awareness and ease getting in touch with fellow learners. Other contributions pointed to beneficial effects of guidance or framing in facilitating collaboration among learners in MOOCs (Kizilcec 2013). While such approaches certainly represent important contributions to effective eLearning in general, we believe that a promising approach to filling the gap lies in tailoring or mediating the standard content of online courses such that it will adequately fit and adapt to students' individual backgrounds and learning styles. The goal is to maintain efficiency and effectiveness of the individual learning experience.

Adaptivity seems of specific importance for eLearning, due to learners' differences in goals, learning styles, previous knowledge, and backgrounds, and because eLearning systems permit creating individual learning paths (Brusilovsky 1996). Adaptive eLearning systems should be able to respond to individual variables and provide a personal access to learning material (e.g. by adapting it to individual needs). This contrasts with the current state of eLearning systems, in which material is largely available in the same format for all learners (Hauger & Köck 2007).

A number of important learner variables to which a system can adapt address cognitive factors. Mayer and Massa (2003) differentiate between cognitive abilities (i.e. what people are capable of doing), cognitive styles (i.e. ways in which people process and represent information), and learning preferences (i.e. ways in which people like information to be presented to them). We will employ this categorization, while referring to Mayer and Massa's learning preferences as learning styles. One should take note that the terms cognitive and learning styles are not used consistently in the literature, nor are they always precisely defined (Riding & Cheema 1991). Riding and Cheema describe learning styles as a type of cognitive style for a learning situation. Hartley (1998) considers learning styles as the learner's individual way to solving a learning exercise. The terms are used in educational psychology to describe inter-individual differences in learning contexts (Dung & Florea 2012). Such inter-individual differences in abilities and styles correspond to the tier of individual factors described by Bertel (2010) in a tiered factor user model for joint human-computer reasoning tasks.

This paper presents original research on whether an adaptation of eLearning material to inter-individual differences in learning styles can increase learning effectiveness and efficiency, learner motivation, and learner satisfaction. We will present a behavioral study and analyze and discuss resulting data, also with regard to alternative bases for adaptation, such as cognitive styles, and to properties of distributions of styles and preferences in relevant student populations. The paper will conclude with a discussion of possible repercussions for adaptive behavior in human-computer interaction in general and of future work.

2. METHODOLOGY AND METHOD

For modeling learning styles on an individual basis, we chose to employ the *Felder-Silverman Learning Style Model* (*FSLSM;* Felder & Silverman 1988), which, though originally introduced as a model for engineering classes, has been suggested to be well suited for use with eLearning (Carver et al. 1999; Kuljis & Liu 2005). Internal reliability of the *FSLSM* has been validated and tested in various studies (Felder & Spurlin 2005), and the model is based on well-established learning styles, including the *Myers-Briggs Type Indicator* (Briggs Myers & Briggs 1962) and the *Learning Style Inventory* by Kolb (1984) (Felder & Silverman 1988). The *FSLSM*'s four dimensions of altogether eight paired styles are *sequential/global*, *sensing/intuitive*, *active/reflective* and *visual/verbal*. To identify an individual's learning styles, the self-reported *Index of Learning Styles* (*ILS*) questionnaire can be used (Felder & Soloman n. d.). It contains eleven questions for each dimension of the model. For the eight learning styles, it each distinguishes between *balanced*, *moderate*, and *strong* style expressions (cf. Figure 1). An individual learner's expressions on each of these styles are not to be seen as preferences fixed for life, but as variable ones, depending on the learning context.
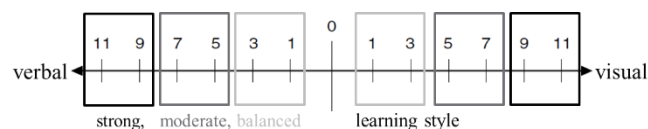
Figure 1. Visual/verbal dimension of the FSLSM and their possible values (based on Felder & Soloman n. d.).

The *visual/verbal* dimension of the *FSLSM* addresses how effectively external information can be processed through which sensory and cognitive modal channels. A predominantly visual learner remembers best what she sees as pictures, diagrams, films, etc. or when she creates a visual mental image based on external information. A predominantly verbal learner prefers words in written or spoken form to learn. For instance, on the *visual/verbal* dimension, balanced learners are able to cope with both representation formats, whereas strong visual learners will likely have problems to learn with verbal representations, and vice-versa.

Within the study reported here, we chose to focus on adapting eLearning material along the *visual/verbal* style pair of the *FSLSM*, in part because the dimension well-investigated, also in cognitive style research, and because a necessary adaptation of the presentation format of our learning material (in order to match with either a visual or verbal learning style, e.g. as pictures or text) could be achieved with limited resources. It has been argued elsewhere that *ILS* results can be used for creating user models in eLearning systems (Paredes & Rodríguez 2002), and the instrument has in fact been employed for several studies of adaptive learning environments (Dung & Florea 2012). Parvez and Blank (2007) argue that the *FSLSM* dimensions and their characteristics are simple enough so that an integration of *ILS* results into eLearning systems becomes feasible. Different learning objects, such as text, images, summaries, exercises etc., can be developed for each dimension and style of the *FSLSM*.

The present study employed our own translation of the *ILS* into German. Internal consistency of the translated version was good, as Cronbach's α for the translated version and for items of the *visual/verbal* scale was .66. This fits coefficients reported by other studies (e.g. Litzinger et al. 2007); it indicates sufficient reliability of the translated instrument (≥ 0.5 for attitude test, Tuckman and Harper 2012). Additionally, we measured students' individual cognitive styles via a translated version of the *Revised VVQ* by Kirby et al. (1988). This is an adapted version of Richardson's original *Verbaliser-Visualiser Questionnaire* (*VVQ*, Richardson 1977), which, according to Jonassen and Grabowski (1993), is the most frequently used tool to measure visual or verbal ways of thinking. Reliability coefficients for this measure for the *verbal/visual* scales in our study were α=.59 and α=.58, respectively. Though we could trace no other measurements of reliability for the *Revised VVQ* to compare our scores (other than those provided by Kirby et al.) many previous studies have employed the instrument (e.g. Choi & Sardar 2011).

We deem learner's motivation to be essential for learning outcome and believe high motivation levels to be an important precondition for sustained engagement in learning. Learning motivation can be labeled as intrinsic or extrinsic. Pure interests and curiosity have been described to persuade students to learn in a focused manner, requiring little external interventions for sustained learning, as learning is done mostly for its own sake (Brandstätter et al. 2012). In this study, we determined participants' intrinsic motivation based on a self-reported questionnaire by Isen and Reeve (2005). To determine satisfaction with the learning material, we designed a self-reported questionnaire.

Few previous studies have employed the *visual/verbal* learning style of the *FSLSM* in the context of adaptive eLearning (e.g. Brown et al. 2006). While these usually focused solely on measuring performance-related outcomes, we chose to take matters a step further for this study and also focused on emotional factors related to learner satisfaction and motivation. One can argue that, as learners are more on their own during eLearning than during traditional learning formats, there exists more need for sustained high learner motivation. Self-regulated learning is often a challenge for many learners. Intrinsic motivation and high satisfaction levels with the material are thus especially important. Our main research questions were as follows: (Q1) Is there a positive influence of a good fit between the representation format of the learning material and the learning style on learning performance? (i.e., do learning times decrease for constant performance levels? Does performance increase with constant learning times?) (Q2) Does a good fit increase learner motivation and satisfaction?

To answer these questions, we designed a study based on the *Moodle* eLearning platform. 53 participants (26 female, 27 male), with a mean age of 25.3 years [20-34 years], participated voluntarily. There was no reward in terms of money or credits. The study was conducted under laboratory conditions at Bauhaus-Universität Weimar to control and minimize effects of distraction and disruption on the study and on learners' concentration. Participants were either students, mostly of *Computer Science and Media* degree programs, or university staff. They learned at computers and were told that they would be given a quiz about the learning material. Participants were also provided with a questionnaire on their learning motivation and satisfaction. The learning material was taken from an established eLearning course intended for future civil engineers on the theory of oscillations, specifically from a section on the "Basics of Sound". The chosen chapters were comprehensible with secondary school knowledge, and no further instruction in physics or

math subjects was required. The material was reproduced in two versions for the learning styles of the *visual/verbal* dimension: one centered mostly on using illustrative diagrams, the other on using textual descriptions. The lecturer of the original course acted as an expert evaluator and ensured that both versions contained the same information and that expected learning times were each at 20 minutes.

The study was of mixed design. As the between-subject component, two groups (A & B) were formed, which received the same learning units, however in different display formats (*visual* or *verbal*). We used *Moodle* to assign a participant to a group based on her individual learning style, as established via the *ILS* instrument. One half of all units were presented according to the individual learning style, the other half were presented in the opposite format. The within-subject component contained the questions of the quiz, and all participants were given the same set of questions. Based on the research questions, the independent variable was the display format (or, more precisely, whether the format matched an individual learner's style, or whether it did not). As dependent variables, study time, test performance as well as learner motivation, and satisfaction with the learning material were used. In addition, participants' individual cognitive styles and previous relevant knowledge were established.

3. RESULTS

As it turns out, three quarters of our participants had a visual learning style (in a simple dichotomy of visual and verbal styles). This corresponds with findings of other studies that about 74% of students (*N>2800*) have visual learning styles (for an overview, see Felder & Spurlin 2005). In natural science study programs, a majority of students are visual (either moderate or strong), whereas the combined percentage of balanced and verbal learners is comparably higher in social science programs (again, see Felder & Spurlin 2005).
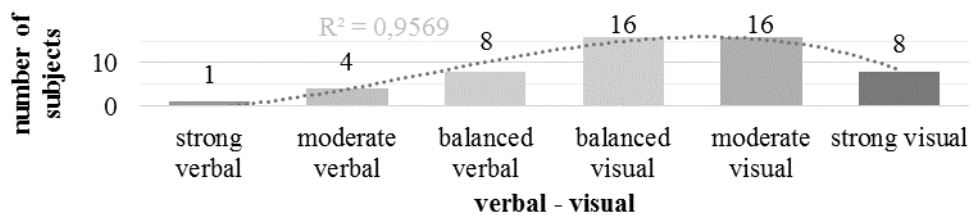
Figure 2. Distribution of the subjects on the learning styles.

A correlation analysis and a set of ANCOVAs showed that previous knowledge had no influence on learning outcomes, nor did it influence motivation, satisfaction, or learning times. Data from one participant was removed before the statistical analysis was conducted because the boxplot of the study time identified it as an extreme value (with more than the triple interquartile range). Another participant did not submit the second part of the quiz; therefore his or her data was not included in the analysis of learning outcomes. As most data was found to be non-normally distributed, we used nonparametric statistical tests (such as Mann-Whitney-U). The two key findings of the study are that (1) there was no significant influence of a good or bad fit between material format and individual learning style on study time and learning outcomes, but that (2) there was a (often, highly) significant influence of a good or bad fit on learner satisfaction and motivation.

The main focus of the further analysis lies on the group of moderate to strong visual learners, as they constituted the largest learning style group of our participants (see Figure 2). We will start by examining performance-related measures (i.e., study times & learning outcomes as measured by performance in the quiz). There were *N=13* visual style learners in study group A (lesson 1: pictures, lesson 2: text) and *N=10* visual style learners in group B (lesson 1: text, lesson 2: pictures). We found no significant differences in study times for lesson 1 between groups A (*M=13.63 min*) and B (*M=10.52 min*) (*U=40.00, Z=1,550, ns, r=−.32*), nor for lesson 2 (A: *M=10.10 min*, B: *M=9.23 min, U=56.00, Z=−0.558, ns, r=−.12*). Moreover, we found no significant correlation between the individual cognitive style and study times in matched/mismatched lessons among all subjects (*N=52*). Similarly, a comparison of learning outcomes between groups A and B showed no significant differences for visual learners (lesson 1: A: *M=79.86%*, B: *M=75.00%, U=43.50, Z=−1,340, ns, r=−.28*; lesson 2: A: *M=71.87%*, B: *M=72.29%, U=64.50, Z=−.031, ns, r=−.01*). There was no significant difference in performance results between lessons that were presented

in pictorial and text form. There was also no significant correlation between matched/mismatched individual cognitive styles and learning outcomes for all participants ($N=51$). This confirms findings by Kollöffel (2012) / Brown et al. (2006) who also did not find significant interrelationships between cognitive styles / learning styles and learning outcomes in matched/mismatched courses.

To sum up: There were no significant effects of style match/mismatch on any of the performance-related measures. As we will see in the following, this does, however, not imply that style-to-content matches/mismatches are of no consequence for eLearning and that an adaptation of eLearning content to a learner's individual style would, therefore, be unimportant. Quite the contrary: A comparison of intrinsic motivation levels between groups A and B after lesson 1 (again, for visual learning style participants) showed a significant effect of matching learning style to content format (A, pictures/match: *M=12.54*, B, text/mismatch: *M=8.70*, *U=26.50*, *Z=−2.409*, *p<.05*, *r=−.50*), though no such significant effect could be found for lesson 2 (A, text/mismatch: *M=12.23*, B, pictures/match: *M=10.60*, *U=51.00*, *Z=−0,873*, *ns*, *r=−.18*). Visual participants who received pictorial material in lesson 1 were thus significantly more motivated than visual participants who started with the text material. Interestingly, such high motivation levels did not decline after the second lesson, which was presented as a mismatch (i.e., in text form). In group B, participants started with text; for the visual participants, motivation increased significantly after lesson 2 in which material was presented as pictures. We believe that such dynamics of motivation level due to alternating matches/mismatches merit further research for adaptive eLearning in particular, but also for adaptive human-computer interfaces in general. One interpretation of our data is that high motivation levels caused by style-matched material declines slowly during a mismatch, and that it rises more quickly when mismatched material is followed by matched material.

Data on satisfaction with the learning material was gathered after each lesson, together with the data about learner motivation that we discussed in the preceding paragraph. Again for visual participants, a comparison of satisfaction levels in lesson 1 showed a highly significant difference between group A (pictures/match, *M=9.23*) and B (text/mismatch, *M=6.0*) (*U=23.00*, *Z=−2.654*, *p<.01*, *r=−.55*). This group comparison remained highly significantly different after lesson 2, although with a further increased effect size (A: *M=3.54*, B: *M=10.00*, *U=2.00*, *Z=−4.002*, *p<.001*, *r=−.83*). Even within the groups, we found highly significant effects of a style-matched presentation format on the satisfaction with the material. A Wilcoxon signed-rank test showed highly significant satisfaction differences inside groups A (*Z=−3.066*, *p<.001*, *r=−.85*) and B (*Z=−2.712*, *p<.01*, *r=−.86*). Visual learners were thus highly significantly more pleased with pictorial material. They did not like to learn with text only. Interestingly, none of these tests remain significant when aggregating data from all visual learners (including balanced visual learners). This shows that the effects reported here are really related to an expressed visual learning style, and that learners' individual strengths of style expressions may be just as important for designing effective adaptive behavior in eLearning systems as a sorting into dichotomous *visual/verbal* categories.

A secondary finding of our study is that *ILS* and *Revised VVQ* scores (for learning and cognitive styles, respectively) were highly significantly correlated. To compare the two models, we performed pairwise correlation analyses of the visual/verbal answers of the *ILS* with the corresponding visual/verbal scales of the *Revised VVQ* (visual-to-visual: *r=.84*, *p<.01*, for all our subjects, *N=53*; verbal-to-verbal: *r=.50*, *p<.01*). To our knowledge, a significant correlation between these instruments has not been reported before.

4. CONCLUSION, DISCUSSION AND FUTURE WORK

The aim of this contribution was to see how adaptive behavior can be infused into an existing eLearning platform by categorizing learners into subpopulations according to their individual learning styles, and by then presenting learning material in different matched and mismatched versions for each subpopulation. To this end, we created variants of learning material for an established eLearning course and conducted a behavioral study to investigate effects of matching *visual/verbal* learning styles to corresponding material formats onto learning performance, study times, intrinsic learner motivation, and satisfaction. For the identification of the individual learning style, the *Felder Silverman Learning Style Model* was used, reduced to the *visual/verbal* dimension of the model.

We found no significant influences of a style-matched presentation of learning material on study time and learning outcome. This finding is in line with former research on this topic. However, we equally focused on emotional factors, such as learner motivation and satisfaction. For scores of these factors, a presentation of learning material that is well matched to the individual's style of learning turned out to be highly important.

Emotional factors should not be underestimated for eLearning, as they play a substantial role for self-regulated learning. As Schiefele and Schreyer (1994) demonstrated, intrinsic learning motivation is significantly positively correlated with measures of learning success, such as grades and test results, and high intrinsic motivation encourages in-depth and conceptual forms of learning. In addition, Levy (2007) identified learner satisfaction as a major factor in students' decisions to complete or drop eLearning courses (this is, in fact, a key problem of MOOCs, specifically Jordan 2014). Even though the study on which we reported here did not show a direct influence of style-matched material onto learning success, one could argue that via the discovered strong influence of style-matched learning material on intrinsic motivation, as well as via the influence of intrinsic motivation on learning success widely established elsewhere, an indirect effect of learning style on learning success likely exists. This point clearly requires further and more systematic research.

Further work is also needed to investigate the long-term impacts of style-matched courses on the performance-related factors, either directly or indirectly via emotional factors. We thus suggest to conduct a long-term study and to employ a suitable test-retest procedure that would have to be developed. Moreover, there is a need to conduct such study with a larger sample to verify the results obtained here also for the verbal learners. Ideally such investigation could be conducted in a real learning setting, as extrinsic motivation, such as grades, also play an important, presumptively a negative, role (Lepper et al. 2005).

We argue that some of the findings presented here clearly have important implications for the design of adaptive eLearning courses, as individuals would seem to benefit from style-matched course material. A major factor of relevance of this contribution lies in establishing that a matched visual/verbal learning style is a highly significant factor for the motivation and the satisfaction of the learner. We would also argue that difficulties encountered in the present study by highly unbalanced distributions of learning and cognitive styles in relevant user population of eLearning systems pose challenges not only for developing adaptive eLearning systems, but for developing adaptive human-computer systems in general. When a user is interacting with an adaptive system on a 1-to-1 basis, it is naturally inconsequential for effective adaptive behavior how frequently that user's specific cognitive or other styles (or preferences) are encountered within the relevant user population. What remains important is that the adaptation occurs with respect to specifically those styles (or preferences). For investigating how adaptation should best occur based on a given user type, it is, however, far from being inconsequential how frequently such type is encountered. In the present study, we were largely unable to draw conclusions about users with verbal learning styles, as such users were too rarely encountered within the population of, mostly, STEM[2] students from which we sampled participants. Excluding verbal style learners from using adaptive eLearning systems as a result does not strike us as an attractive conclusion. This problem exists for interaction design in eLearning, as well as for all human-computer interaction types for which inter-individually differing, individual factors of a user will play a role.

We believe that a viable course of action may lie in combining quantitative measures about frequently encountered user types with qualitative measures applied to the more infrequent types. This would have to go hand-in-hand with a graduated approach towards confidence that the adapting system places in its actions, as well with different degrees (i.e., strengths) of adaptation. A second, promising course of action could lie in establishing a tiered user model (along the lines sketched by Bertel 2010), in which the generation of adaptive behavior would resort to being based on general cognitive factors as long as more specific information about a current user and his or her cognitive types or preferences is unavailable.

---

[2] science, technology, engineering and mathematics

REFERENCES

Abowd, G. D. et al., 1999. Anchoring discussions in lecture: an approach to collaboratively extending classroom digital media. In *Proc. of CSCL'99, C. M. Hoadley and J. Roschelle (Eds.). Intl. Soc. of the Learning Sciences*, Article 1.

Bertel, S., 2010. Supporting joint human-computer reasoning and problem solving: Blueprint of an architecture. In Rapp, D. N. (Ed.): *Proc. of Spatial Cognition 2010 (Posters), SFB/TR 8 report 024-07/2010, 6.*

Brandstätter, V. et al., 2012. *Motivation und Emotion. Allgemeine Psychologie für Bachelor*. Berlin: Springer.

Briggs Myers, I. and Briggs, K., 1962. *The myers-briggs type indicator*: Consulting Psychologists Press.

Brown, E. et al., 2006. Reappraising cognitive styles in adaptive web applications. In: *WWW '06, Proceedings of the 15th international conference on World Wide Web*. New York: ACM, 327–335.

Brusilovsky, P., 1996. Adaptive hypermedia: An attempt to analyze and generalize. In Brusilovsky, P. et al., (Eds.): *Lecture Notes in Computer Science. Multimedia, Hypermedia, and Virtual Reality Models, Systems, and Applications*. Berlin: Springer, pp. 288–304.

Carver, C. et al., 1999. Enhancing student learning through hypermedia courseware and incorporation of student learning styles. *IEEE Transactions on Education*, *42*(1), 33–38.

Choi, J. and Sardar, S., 2011. An Empirical Investigation of the Relationships Among Cognitive Abilities, Cognitive Style, and Learning Preferences in Students Enrolled in Specialized Degree Courses at a Canadian College. *The Canadian Journal for the Scholarship of Teaching and Learning*, *2*(1).

Di Cerbo, F. et al., 2010. Integrating multidimensional means in e-learning. In *Proc. of MTDL '10*. New York: ACM, 31-36.

Dung, P. Q. and Florea, A. M., 2012. An approach for detecting learning styles in learning management systems based on learners' behaviours. In *International Conference on Education and Management Innovation. IPEDR* (30), 171–177.

Felder, R. M. and Silverman, L. K., 1988. Learning and teaching styles in engineering education. *Engineering education*, *78*(7), 674–681.

Felder, R. M. and Soloman, B. A., n. d. *Index of Learning Styles.* Retrieved from http://www.ncsu.edu/felder-public/ILSpage.html

Felder, R. M. and Spurlin, J., 2005. Applications, reliability and validity of the index of learning styles. *International Journal of Engineering Education*, *21*(1), 103–112.

Ha, T.H., 2014. *MOOCs by the numbers: Where are we now?* TED.com. Retrieved from http://blog.ted.com/2014/01/29/moocs-by-the-numbers-where-are-we-now/, updated on 1/29/2014, checked on 3/30/2014.

Hartley, J., 1998. *Learning and studying: A research perspective. Psychology focus*. Routledge.

Hauger, D. and Köck, M., 2007. State of the Art of Adaptivity in E-Learning Platforms. *LWA,* 355–360.

Isen, A. M. and Reeve, J., 2005. The Influence of Positive Affect on Intrinsic and Extrinsic Motivation: Facilitating Enjoyment of Play, Responsible Work Behavior, and Self-Control. *Motivation and Emotion*, *29*(4), 295–323.

Jonassen, D. H. and Grabowski, B. L. H., 1993. *Handbook of individual differences, learning, and instruction*. Hillsdale: L. Erlbaum Associates.

Jordan, K., 2014. *MOOC Completion Rates: The Data*. Retrieved from http://www.katyjordan.com/MOOCproject.html

Kizilcec, R. F., 2013. Collaborative learning in geographically distributed and in-person groups. In *AIED 2013 Workshops Proceedings*. Volume 1, pp. 67-74.

Kirby, J. R. et al., 1988. Verbal and visual learning styles. *Contemporary educational psychology*, *13*(2), 169–184.

Kolb, D. A., 1984. *Experimental learning: Experience as the source of learning and development.* Englewood Cliffs: Prentice-Hall.

Kollöffel, B., 2012. Exploring the relation between visualizer–verbalizer cognitive styles and performance with visual or verbal learning material. *Computers & Education*, *58*(2), 697–706.

Kuljis, J. and Liu, F., 2005. A Comparison of Learning Style Theories on the Suitability for elearning. *Web Technologies, Applications, and Services*, 191–197.

Lepper, M. R., et al., 2005. Intrinsic and extrinsic motivational orientations in the classroom: Age differences and academic correlates. *J Educational Psychology*, *97*(2), 184-196.

Levy, Y., 2007. Comparing dropouts and persistence in e-learning courses. *Computers & Education*, *48*(2), 185–204.

Litzinger, T. A. et al., 2007. A psychometric study of the index of learning styles. *Journal of Engineering Education*, *96*(4), 309–319.

Mayer, R. E. and Massa, L. J., 2003. Three Facets of Visual and Verbal Learners: Cognitive Ability, Cognitive Style, and Learning Preference. *Journal of Educational Psychology*, *95*(4), 833–841.

Paredes, P. and Rodríguez, P., 2002. Considering Learning Styles in Adaptive Web-based Education. In *Proceedings of the 6th World Multiconference on Systemics, Cybernetics and Informatics.* Vol. 2, pp. 481–485.

Parvez, S. M. and Blank, G. D., 2007. A pedagogical framework to integrate learning style into intelligent tutoring systems. *Journal of Computing Sciences in Colleges*, *22*(3), 183–189.

Richardson, A., 1977. Verbalizer-visualizer: A cognitive style dimension. *Journal of Mental Imagery*.

Riding, R. and Cheema, I., 1991. Cognitive Styles—an overview and integration. *Educational Psychology*, *11*(3-4), 193–215.

Schiefele, U. and Schreyer, I., 1994. Intrinische Lernmotivation und Lernen: ein Überblick zu Ergebnissen der Forschung. *Zeitschrift für Pädagogische Psychologie*, *8*(1), 1–13.

Tuckman, B. W. and Harper, B. E., 2012. *Conducting educational research* (6th ed). Lanham: Rowman & Littlefield Publishers.

A MOOC AND A PROFESSIONAL SPOC

Xu Cui, Zhenglei Zhang and Lei Sun
Shandong Urban Construction Vocational College
Shandong Ji'nan China 250103

ABSTRACT

Higher Vocational Education is one of the most important educational forms. But in the course of implementation of Higher Vocational Education, we find three inevitable questions: Higher Vocational Educational system's length of schooling which is only three years is too short; the differences in personality of teachers affect the teaching effects; the lower quality of the students disengaged their passion to learn. MOOC is a new teaching mode which has successful cases such as a university computer course: a Computational Thinking Perspective of Shandong University. We refer to the university MOOC - a Computational Thinking Perspective, to construct a professional SPOC teaching mode and recur to the University MOOC in the process of teaching. Seen from the evaluation and suggests of teachers and students joined the MOOC and SPOC, the teaching mode not only can stimulate the teachers' teaching enthusiasm, but also can stimulate the students' learning enthusiasm.

KEYWORDS

University MOOC; Professional SPEC; Computational Thinking Perspective.

1. INTRODUCTION

With the fast-speed development of the modern information society, the recognition to the Higher Vocational Education is increasingly high. And it has reached a situation that Higher Vocational Education even is comparable to the University Education. Such a significant form of education also shows some inevitable questions when it has been in the course of implementation:

The first question is Higher Vocational Educational system's length of schooling. We must complete all the courses including theory, practice, internship, and graduation design in three years which is too short. And we must take into account the students' employment problems but also take into account the part of the students into higher education.

The second question is the differences in personality of teachers. Most teachers in higher vocational college are university graduates who have no much practicing or teaching experience. And less number of teaches, larger number of courses, faster updating of the course contents have put forward a huge challenge to our higher vocational teachers.

The third question is the quality of the students. The Higher Vocational College students have some generalities: lower grades, poorer foundation, and less learning enthusiasm, which cause teaching and learning more difficult. We must adopt better teaching methods to stimulate their learning enthusiasm, and then they will get more useful knowledge.

Fortunately, a brand-new teaching mode called MOOC [1] (Massive Open Online Courses) provides a feasible method to solve these problems above. In this article, we construct an appropriate professional SPOC (Small Private Online Courses) in Higher Vocational Colleges after analyzing a university MOOC and recur to the university MOOC in the process of teaching of the Higher Vocational College.

2. RELATED RESEARCHES

MOOC originated in the openness of the internet based courses which can be found earlier in 2007. And in the next year, Pr. Alec Couros in University of Regina developed an open online course called "Media and Open Education (EC&I 831)". Later, a true meaning MOOC called "Connectivism and connectivity knowledge" attracted 25 students and 2300 free online participation of students [2,3]. In 2012 called the year of MOOC, three world MOOC platforms - Coursera [4], Edx [5], and Udacity [6] began to provide courses to worldwide learners [7]. The NMC Horizon Report of 2013 Higher Education Edition pointed out that massively open online courses have received their fair share in 2012, and are expected to grown in number and influence within the next year [8]. Today, we have seen that the prediction has come true.

MOOC is composed of five main elements: teachers, students, subject, learning materials and learning situations [9, 10]. Through the reasonable combination and application of the five elements, it has obtained the purpose of flipped classroom and improved efficiency, standard [11] by using MOOC. Nowadays, more and more courses are joining MOOCs and more and more learners are using MOOCs.

In china, 4000 high quality courses had been constructed between 2003 and 2010. After 2011, accompanied by the ministry of education of the implementation of the national fine-designed open courses, more than 100 resource sharing lessons had been opened to public. On May 8, 2014, the Chinese University MOOC was online which marked the arrival of the era of a new course.

3. A MOOC CALLED "UNIVERSITY COMPUTER FOUNDATION: A COMPUTATIONAL THINKING PERSPECTIVE"

3.1 The Teaching Goals

In the course of "University Computer Foundation", Pro. Hao provides three teaching goals which are: Cultivating the students' information literacy, cultivating the students' computational thinking, and teaching computing science knowledge.

3.1.1 Cultivating the Students' Information Literacy (The First Ability)

Information literacy is the application and learning information technology in the work and finally obtaining the ability to solve problems by using information technology have learned [13]. The ability also tells people when you need information and how to find, evaluate and effectively use it.

3.1.2 Cultivating the Students' Computational Thinking (The Second Ability)

Computational thinking is the ability using the basic concepts of computer science technology to solve problems, design systems, and understand human behaviors, which covering a series of thinking activity of the breadth of computer science[13]. The ability also tells people how to solve problem by using systematic thinking.

3.1.3 Teaching Computing Science Knowledge (The Third Ability)

In daily life, the computer has become an indispensable facility. Mastering relevant computing science knowledge which including computer basic knowledge, data structure, algorithm design, and program design language and so on, has become the need of the times. The ability can make us well into the society, and deal with the problems encountered.

Following these three progressive targets to cultivate the learners' ability, then they will well adapt to social work and learn etc.

3.2 The Design of the Course

The design of the course determines the life of the course.

3.2.1 Problem Exiting in Current Course

"University Computer Foundation" is a required course to non-computer major in college and has the characteristics of large quantity and extent. Although has experienced several reforms, the teaching mode based on computer operation skill is still a serious challenge in the course offered. Around 2010, computational thinking for the reform of computer basis teaching had been widely recognized in domestic and foreign universities. And the teaching design also is welcomed by the students and the colleges.

3.2.2 The MOOC Course Structure Design

The course structure design facing to the real work environment comes from the following train of thought:
- Information society needs information literacy,
- Information literacy comes from computational thinking,
- Computational thinking comes from computer knowledge.

Figure 1 shows the three layer model of demand of the course structure design.
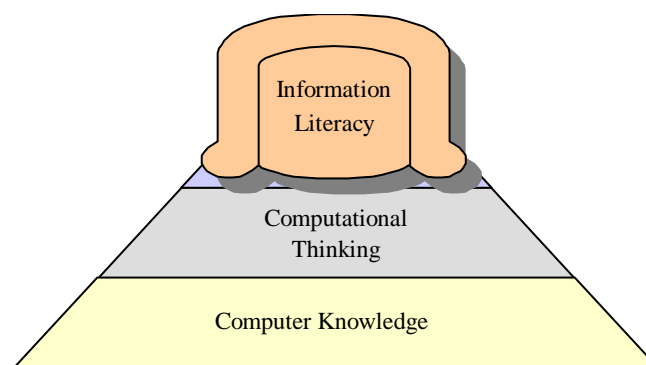
Figure 1. The three layer model of demand of the course

3.2.3 The MOOC Knowledge Module Design

Closely around the three layer model of demand, we put forward the following basic process of calculating by computer.
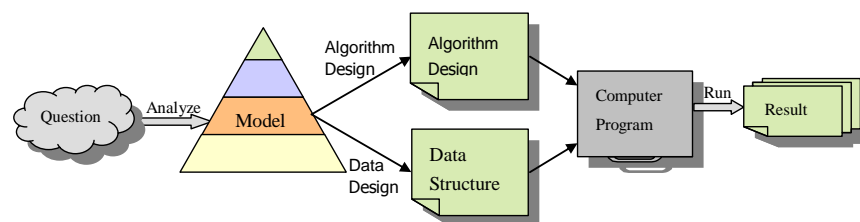
Figure 2. The basic process of calculating by computer

Referring to Figure 2, solving the problem of the conceptual model as the main line of computer, the course includes seven knowledge modules:
(1) Introduction,
(2) Compute and Computer,
(3) Problem Solving and Algorithm,
(4) Data and Data Structure,
(5) Computer Program,
(6) Computer Network,
(7) Computational Science Frontier.

In the process of knowledge module design, a number of knowledge points [14, 15] and knowledge unites [14, 15] are extracted to support the modules and courses.

4. A PROFESSIONAL SPOC CALLED "HIGHER VOCATIONAL COMPUTER PROFESSIONAL DESIGN: A COMPUTATIONAL THINKING PERSPECTIVE"

4.1 Educational System

The length of schooling of Higher Vocational Colleges is not enough long, why? In a Higher Vocational Colleges we have only four semesters to finish all professional courses and practice courses teaching, then the rest two semesters are internship, and graduation design. In the process of teaching, we must take into account the students' employment problems but also take into account the part of the students into higher education. The best way to satisfy this requirement is fusing a few door edge professional courses to meet the length of schooling. The MOOC in section 3 can finish the task. So we draw support from the MOOC's thought.

4.2 The Differences in Personality of Teachers

As everyone knows, teachers in University have doctor's degree that have strong ability of research and exploration including teaching and science technology, and the main goal of university is to culture talents with high level and knowledge. While teachers in Higher Vocational Colleges have master's degree that have lesser ability of research and exploration and lesser practical experience, and the main goal of Higher Vocational Colleges is to train skilled talents. So in Higher Vocational Colleges, we pay much attention to enhance teachers' practical ability and the same time we have less time to do scientific researches. So we can draw support from MOOC's thought which launched by university professors.

4.3 The Quality of the Students

Lower grades, poorer foundation, and less learning enthusiasm are the main characters of the Higher Vocational Colleges students. How to stimulate their learning enthusiasm is one of the most important problems. And how to explain the learning content is also important. The organization of the courses content and the proper teaching methods play an important role in the courses of teaching. Also we can draw support from MOOC's thought which adopted flipped classroom etc.

4.4 A Professional SPOC referring to a University MOOC

After analyzing the problem exiting in Higher Vocational Colleges, we propose a professional SPOC according to the university MOOC's idea.

4.4.1 The Professional SPOC Course Structure Design

According to the MOOC in section 3, the computer professional courses' structure design also facing to the real work environment comes from the following train of thought:
- Information society need information literacy and information skills,
- Information literacy and information skills come from computational thinking(software and hardware),
- Computational thinking comes from computer knowledge (software and hardware).

Figure 3 shows the three layer model of demand of the professional SPOC course structure design.
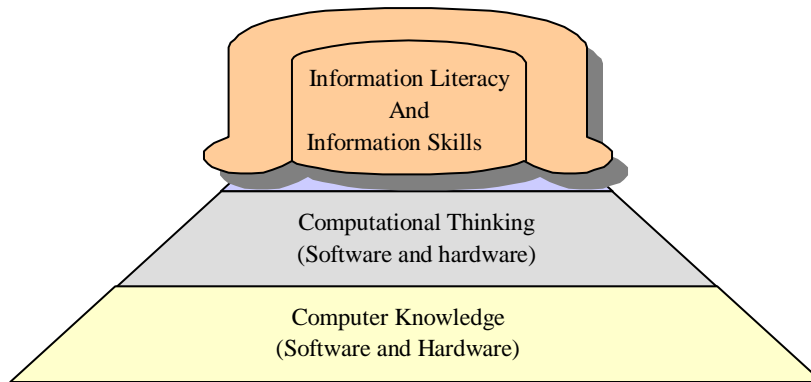
Figure 3. The three layer model of demand of the specialty

4.4.2 The Professional SPOC Knowledge Module Design

Closely around the three layer model of demand of the specialty, we put forward the following basic process of calculating by computer.
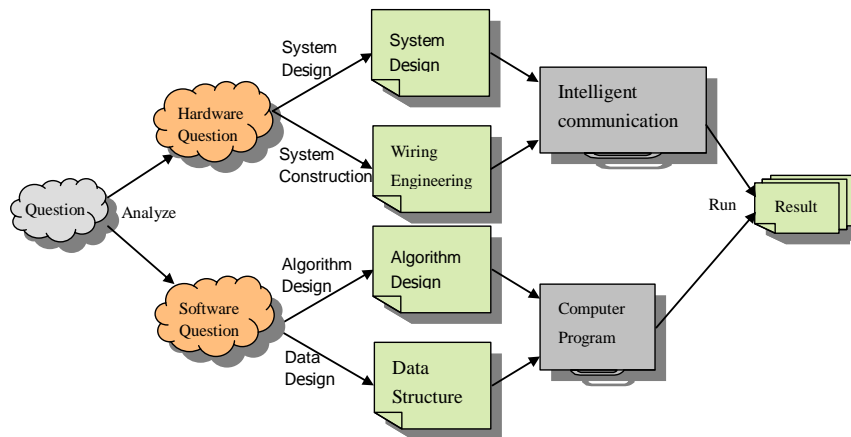
Figure 4. The basic process of calculating by computer of the computer specialty

Referring to Figure 4, solving the problem of the conceptual model as the main line of computer, the professional courses include two kinds of knowledge modules, and every module has several main courses:
(1) Hardware Module,
    (a) Basic Knowledge of Computer,
    (b) Computer Communication and Network,
    (c) Introduction to Internet of Things,
    (d) Internet Comprehensive Wiring Engineering,
    (e) Audio and video system construction,
    (f) Computer Room Construction.
(2) Software Module,
    (a) Problem Solving and Algorithm,
    (b) Data and Data Structure,
    (c) Database Basics,
    (d) Computer Program.

In the process of knowledge module design, a number of relevant courses are opened to support the specialty. And we also join some edge courses in our main module to broaden the students' vision. For example, we give lectures either by ourselves or inviting scholars of famous university.

5. WHICH IS MORE SUITABLE TO OUR STUDENTS?

We have implemented according to the design in section 3 and 4 a month long. And the course is *C Language Program Design*. We adopt the teaching method of flipped classroom as follows:

- Students learn content by micro class video,
- Students ask questions, teachers answer question, and students discuss,
- Teachers interpret the micro content again,
- Quizzing students in class and give an assignment next class.

In a month, we have gone on *Select Statement* and *Loop Statement* of *C Language Program Design* and we have a statistic data of the course's learn state in table 1.

Table 1. The learn state before and after adopting the MOOC teaching method

	Attendance(%)[a]	Enthusiasm(%)[b]	Quizzing result(Score)[c]
Before	82.3	23.0	73.4
After	87.6	43.5	86.0

Note: Table notes.

[a]Sample footnote A: the average of the attendance,

[b]Sample footnote B: the average of the number of hands to answer questions,

[c]Sample footnote C: the average of every quizzing result.

According to Table 1, the rate of Attendance, Enthusiasm, and Score (Quizzing result) have raised much. We see the effectiveness of the reform jauntily. Both teachers and students benefit from the teaching method.

There are three teaching modes which are the traditional teaching mode and the MOOC and the professional SPOC teaching mode. Which is the most suitable teaching mode to our students? Yes, the MOOC or professional SPOC teaching mode is.

6. STUDENTS' EVALUATION AND SUGGESTIONS

We cannot evaluate a kind of teaching method only from the perspective of the appearance. We should listen to the views of students. We sent a questionnaire for teaching to make students' feedback pointing at this month's teaching. We put in order students' feedback as follows in table 2.

Table 2. Students' feedback to the MOOC and professional SPOC teaching mode

	Feedback Content
Positive Feedback	We are willing to answer questions.
	We are willing to discuss problems with teachers.
	We would like to explain the class knowledge.
	We like this lesson.
Negative Feedback	We must do a lot of work after class.
	We must check the information in the library or surfing the internet
	We must think over more problems.

Note: Table notes.

   The "Positive" and "Negative" are said to student..

In fact, the MOOC's thought which has been applied to teaching and specialty constriction is successful from the results of students' feedback. All feedback is motivating their learning interests which are the ultimate aim of our teaching.

7. TEACHERS' EVALUATION AND SUGGESTIONS

Most teachers approve the organization of the specialty and the teaching method. They can mobilize the enthusiasm of the students and bring passions to their own teaching process.

REFERENCES

1. MOOCs Directory. http://www.moocs.co/

2. John Daniel, *Making Sense of MOOCs: Musings in a Maze of Myth, Paradox and Possibility*, (25 September 2012)

3. McAuley A, Stewart B, Siemens G, Cormier D (2010) *Massive open online courses. Digital ways of knowing and learning. The MOOC model for digital practice*(2010)

4. Coursera. http://www.coursera.org

5. Edx. http://www.edx.org

6. Udacity. http://www.udacity.com

7. Young JR (2012) *Inside the Coursera contract: how an upstart company might pro.t from free courses*. The Chronicle of Higher Education, (19 July 2012)

8. http://redarchive.nmc.org/publications/2013-horizon-report-higher-ed

9. Kop, R. "*The challenges to connectivist learning on open online networks: learning experiences during a massive open online course*", The International Review of Research in Open and Distance Learning, 12 (3), (2011).

10. Sara Ibn El Ahrache, Hassan Badir, Yassine Tabaa and Abdellatif Medouri, " *Massive Open Online Courses : A New Dawn for Higher Education?*", International Journal on Computer Science and Engineering ,(May 2013)

11. Kate O'Connor, *MOOCs, institutional policy and change dynamics in higher education*, High Educ68:623-635 (2014)

12. http://www.icourses.cn/imooc/

13. http://baike.baidu.com/

14. Xingwei hao, Xiangxu Meng, and Xu Cui, *Knowledge Point Based Curriculum Developing and Learning Object Reusing*, ICWL 2007, LNCS 4823,pp. 126-137,(2008)

15. Xingwei hao, Xiangxu Meng, and Xu Cui, *A New Layering Architecture of E-learning System*, ICWL 2007, LNCS 4823,pp. 218-229,(2008)

INCREASE IN TESTING EFFICIENCY THROUGH THE DEVELOPMENT OF AN IT-BASED ADAPTIVE TESTING TOOL FOR COMPETENCY MEASUREMENT APPLIED TO A HEALTH WORKER TRAINING TEST CASE

Janne Kleinhans and Matthias Schumann
University of Goettingen, Germany
Platz der Göttinger Sieben 5, 37073 Goettingen, Germany

ABSTRACT

In the context of education and training, competency measurement (CM) is a central challenge in competency management. For complex CMs, a compromise must be addressed between the time available and the number of dimensions to be measured or the quality of the measurements. Increasing the efficiency of existing tests for CMs therefore poses a key challenge. An important approach to this challenge is computerized adaptive testing. For CMs, there is currently a lack of integrated adaptive testing tools. This paper presents the implementation, integration and evaluation of an appropriate adaptive component for the example of the learning management system ILIAS used for a CM of health workers. The textbook scenario of a linear testing implementation is compared with concrete results from the adaptive testing tool implementation, and the potential for increasing the test efficiency is demonstrated.

1. PROBLEM STATEMENT

Competence measurement (CM) is a central challenge in competence management. The more exact competencies can be measured before a training, the more targeted a training can be (Klett 2010, North 2013, Draganidis and Mentzas 2006). A formative or summative assessment following trainings and lectures offers the foundation for monitoring learning progress. CMs can vary broadly in their application, ranging from large-scale assessments (e.g. the PISA study) to self-testing.

CMs are characterized by their large scope. There are typically many dimensions to consider that in turn depend on numerous characteristics of competency. Erpenbeck and Sauter differentiate various competency classes, including personal, activity and decision-making, subject and method, and social-communicative (Erpenbeck and Sauter 2013). According to Heyse and Erpenbeck, these can be divided into facets like personal responsibility, decision-making ability, analytical or communication skills (Heyse and Erpenbeck 2007). The measurement task grows with every added dimension. If for example the mathematical and linguistic abilities of a test subject are to be assessed, it is usually necessary to pose a distinct task for each. Tests cannot however be extended to assess an arbitrary number of areas due to the fatigue of test subjects, to the opportunity cost to the examiner (or test subject), or due to testing regulations. A reduction in measurement quality or dimensionality must therefore be often accepted in current practice.

The question arises as to how the efficiency of actual CM test procedures can be improved and in particular as to how the measurement quality can be raised for a test of fixed duration. Linear testing procedures present an important point for improvement. There are weaknesses in the efficiencies of linear tests of participant groups of heterogeneous abilities, as the tests must remain comprehensive to their groups. This is reflected, for example, by the use of tasks of varying difficulty. At the same time, participants must be presented with the same tasks, thereby being measured at a level that can be either too high or too low. Here, computerized adaptive testing promises significant improvements in efficiency by being able to adapt to the individual levels of participants as a test progresses. There is however a lack of tools to facilitate integrated

adaptive competence measurements. This is the motivation of this paper. At the example of a CM for health workers it will be investigated to what extend a computerized adaptive test (CAT) can increase the efficiency of a CM. An appropriate tool will be implemented and evaluated. The following research questions follow:

RQ1: *How must a tool for computerized adaptive competence measurement be constructed?*

RQ2: *Can a CAT increase the measurement efficiency of a competence assessment?*

Remarks on computerized adaptive testing will follow in section 2. In section 3, the requirements of an integrated tool for adaptive competence measurements will be presented. The system choices for the implementation of the CM for health workers will be discussed there. The implementation will be presented in section 4. The developed tool will be evaluated in section 5. The discussion and interpretation of the results comprise the conclusion in section 6.

2. COMPUTERIZED ADAPTIVE TESTING

Computerized adaptive testing dates back to the seventies, when powerful computers became increasingly available (Lord 1976, Lord 1980, Weiss 1982). Numerous publications have more recently addressed specific aspects of adaptive testing, like impacts on participants and motivation (Frey et. al 2009, Tonidandel et. al. 2002) or content balancing strategies (Zheng et. al. 2013), while others provide comprehensive considerations (Van der Linden and Glas 2000).

The special feature of CATs is that the compilation of their tasks (items), and thus the level of the exam, is first established during the test and is dependent on the ongoing performance of the tested person. A more difficult task will typically follow a correct answer, and vice versa. For the purposes of this, each item has a numeric value representing its degree of difficulty. These values are usually determined in a calibration phase, during which the tasks are given to a comprehensive group of test subjects whose performance is factored into the statistical models presented below. CATs thus provide an individual testing experience to each participant and thereby increase testing efficiency as compared to with classical linear methods, as items deemed too easy or difficult can be excluded and each item becomes diagnostically useful.

CATs aim for the maximum possible performance of the test person. Their goal is to adapt to problems for which the examinee has a 50% success rate. Unlike for a linear test, performance cannot be measured by the total number of correctly answered questions, due to the varying difficulty of the questions. For this reason, CAT is bound by Item Response Theory (IRT), which allows for an assessment of performance based on the answered tasks rather than on the test itself (Baker and Kim 2004, Harvey and Hammer 1999). The numerical ability parameter (θ) reflects the competency level of the participant and replaces the relative number of correct answered questions as the test result. The standard error of the test result is calculated in real time and provides a measure of the accuracy of the assessment.

CATs must be separated into branched and tailored types. While for the former a branch of questions is a predetermined function of the participant's answers, for the latter the participant's testing level is recalculated with each answer and the subsequent questions are chosen accordingly from all available tasks in the item pool. This offers greater efficiency (Kubinger 2009).

3. IMPLEMENTATION CRITERIA & SOFTWARE IDENTIFICATION

The requirements for an IT-based integrated CM tool will be defined in this section. General requirements and criteria from the applied sample CM for health workers are mentioned at first. The system selection for the CM implementation follows.

Both open and closed questions are of interest for CMs. Closed questions like multiple-choice facilitate an economical assessment of knowledge due to their simple structure. More complex types can address functional capacity (e.g. requiring the examinee to select the proper region of a figure). Open questions, like free text entries, can assess complex skills (like communication or problem-solving skills e.g. through the structuring of answers). The possibility for both open and closed questions is therefore a necessary criterion for task creation. Multimedia-based elements can add significant value to a CM by increasing the action of the relevant task. They can present complex stimuli (Brunken et. al. 2003) that support the situational and contextual integration of the tasks and likewise promote the transferability of the test results to real-world

situations (Bennett 1999, Jurecka and Hartig 2007, Mayer 2005). The availability of multimedia elements is therefore another required criterion. As tailored testing offers the greatest potential for increasing testing efficiency, the availability of an adaptive component that supports tailored testing is also required.

After these general requirements, criteria for the use as testing software for health workers will be derived. The vocational training of health workers in Germany follows a dual-study system. The training takes place in both a medical practice and a vocational school and requires the completion of an intermediate and final examination. The tool should work for both a large-scale summative assessment in the vocational school and an assignment in the medical practice, e.g. a formative self-test. Consequently the test tool should be highly scalable and applicable under heterogeneous conditions. These requirements could also be applied as a typical scenario for many other professions. At the same time, the evaluation must be able to provide feedback to the tested persons. The criterion of an intuitive user interface is necessary to minimize barriers for test takers not having high levels of computer literacy. As the final examination of the health workers is a summative assessment, it is essential for the later evaluation that the results are classifiable. A functionality for the archiving of test results is necessary. The encryption of data transfers and secure data storage address requirements for the testing security as set by the German federal states. Meeting these requirements ensures that the tool could be used for examinations or training purposes in future.

The test should be split into adaptive and multimedia-based parts, such that the efficiency of the CAT could be optimized regarding its layout. Multiple-choice questions without multimedia elements ensure that the test remains as simple as possible. For the multimedia-based part, graphics, videos and free text tasks are required to increase the activeness. The multimedia-based test will not be discussed here, as this paper focusses on the increase to the test efficiency through CAT.

To identify a suitable software solution, a market analysis was conducted. Following Webster and Watson (Webster 2002), a literature search was carried out using the keywords e-assessment, computer-based assessment, computerized assessment and computer-based testing, in both English and German. Through the search engines Google and Bing, 136 potential software solutions were subsequently identified.

Since no software could be found satisfying all criteria, focus was turned on finding the most expandable solution. All adaptive solutions lacked in several criteria like the opportunity to integrate multimedia elements, shortcomings in testing security, and test management. In contrast, six software solutions satisfied all criteria except for having an adaptive testing functionality. They were therefore examined more closely. The analysis was performed using the categories of issue management, test management, security, interoperability, usability, and reliability.

On this basis, the test component of the learning management system ILIAS (ILIAS 2015, Kunkel 2011) was selected for further development. As an open-source software in a standard programming language, PHP, ILIAS offered complete freedom for customization and the long-term availability. Being web-based and platform-independent, the solution satisfied the requirement for usability under heterogeneous conditions. The client server structure allowed for the central storage of all test data. In the event of a system crash, tests can be resumed from the appropriate place. There was also high scalability with support for extensive user management and numerous simultaneous users. ILIAS offers eleven question types. The analysis is largely omitted and allows for summative and formative efforts.

4. IMPLEMENTATION

In section 4.1, the concrete requirements for the implementation are described based on the functional criteria from section 3. The CM realization is presented in paragraph 4.2.

4.1 Requirements

The CAT should diverge as little as possible from other ILIAS functionalities in order to avoid barriers to the usability. For maximum compatibility, the CAT should work with the same system requirements than standard ILIAS (ILIAS 2015, Kunkel 2011). Solely a limited increase in computing power will be necessary due to the CAT algorithm. However it should be limited as the test has to be usable under heterogeneous conditions in the vocational schools or medical practice.

The CAT should be based on Item Response Theory (IRT). By using IRT, it is possible to connect the test results with one or more latent variables on an empirical foundation (Baker and Kim 2004, Embretson and Reise 2000). In the current case of performance testing, one latent variable is considered to be the participants' ability to solve the test items (θ), which is consequently represented as latent trait. The modeling of the corresponding representation, which allows the statistical calculation of the latent trait, should be done using the Rasch model. It assumes that a person's ability to solve a test item is based on the persons' latent trait – represented by the estimation of a weighted likelihood estimate – and the difficulty of the item – represented by a response model parameter estimate. Both parameters are estimated based on solution probabilities and are interdependent in iterations (Bond and Fox 2007, Fischer and Molenaar 1995). According to the Rasch model, whether or not a person solves a problem depends only on his or her ability and on the difficulty of the task, which are both measured on the same scale. This is a strong assumption, with the advantage of facilitating the modeling of the adaptive test solely on these parameters.

An extensive calibration phase (cp. 5.1) was conducted to determine the difficulty of the tasks and decide whether a one- or multi-dimensional competency model should be used. A one-dimensional model was selected as multi-dimensional models showed no significant increase in precision. However, the possibility to expand the tool later for multi-dimensional CMs should exist. There are various one-dimensional estimation methods that implement IRT (Van der Linden and Glas 2000). Since the tasks were predominantly developed from scratch and there existed no prior experience in the calibration of the CAT, the simplicity and robustness of the estimation method are a priority, given the complexity of the procedure and the precision of the measurements. The expansion for adaptive testing was divided into three parts, namely (1) the creation of tasks, (2) the processing sequence during the test procedure and (3) the storing of the test data and the evaluation of the test results.

For the creation of the adaptive tasks (1), the ILIAS task template must be extended. The difficulty of each task needs to be added as numerical value to each question type. A second numerical parameter should be created to assign different competency dimensions to the tasks for a potential later multi-dimensional CM. Furthermore the possibility should exist to deploy a task as adaptive or non-adaptive in different tests. Therefore an additional Boolean parameter should be added.

The processing sequence during test procedure (2) in case of a CAT must be constructed as the test progresses. In contrast ILIAS uses for sequencing tasks an initial test sequence, which is not changed during the test. Even though ILIAS offers an option for randomized item selection, only the initial sequence is generated randomly in this case. Therefore, a constant reordering of this test sequence during the test has to be implemented. There are three determining factors for the adaptive testing procedure. These include (a) item selection during the test, (b) item selection at the start of the test, and (c) the conditions for the completion of the test (Van der Linden and Glas 2000, Mills and Stocking 1996). All factors depend directly on the used estimation method. The expected a posteriori (EAP) approximation of Bock and Mislevy (Bock and Mislevy 1982) is chosen, combining decent precision with high robustness and low computing requirements. EAP is a Bayesian method. For item selection during the test (a) after each completed task, the ability parameter of the participant (θ) is estimated and subsequently the most informative unused item for the current θ (= item, whose difficulty is next to (θ)) is selected. EAP offers a small bias and standard error compared to other Bayesian methods (Wang 1997). The EAP estimates are calculated noniteratively. Corresponding calculations using values of the IRT-function can be performed before the beginning of the test and stored (Bock and Mislevy 1982), which reduces hardware demands. Another advantage of EAP is that it could also be used for the item selection at the start of the test (b), as the approximation is stable over the entire test length (Bock and Mislevy 1982). An average skill level ($\theta = 0$) should initially be assumed. The standard termination condition (c) in ILIAS for linear tests is met, when the last item in the test sequence is passed. For the adaptive test two termination conditions should be established, the first being the static completion of a defined number of questions and the second being the dynamic achievement of a certain level of precision with regard to the estimate of the standard deviation.

For the storing of the test data and the evaluation of the test (3), the data storage has to ensure that the data remain accessible over the long term. For the evaluation, standard functionality needs to be expanded to output the task, the updated measured competency level (θ) and standard error following each question. In addition, an aggregate index of all questions is required for the evaluation of all test persons and tasks.

4.2 CM Realization

The ILIAS task template was completed for each questions type to establish a level of difficulty, a subject area and for the identification of adaptive questions. The user can consequently create or edit adaptive tasks through the standard interface without programming skills.

The CAT algorithm is selected over standard algorithms through a new option in the interface. When a question pool is selected by the user for the creation of an adaptive test, all adaptive questions within it are used to create an initial test sequence. This ensures that all items are available for the test procedure. During the execution of the test, this sequence is continuously refined: After each completed task, the EAP estimation is applied to select the next item. The selected item is promoted to the position which is next in the test sequence. The standard error is calculated at the same time with θ. At the beginning of the test a value of $\theta = 0$ is presumed. A question number limit and a criterion for the standard error in the algorithm are possible termination conditions to be used independently or in tandem. The inputs for the termination conditions were integrated into the standard interface. When termination conditions are met, the test sequence is shortened to this point and the standard termination condition of ILIAS is used to finish the test.

The test results (θ and standard error) are continuously stored in the central ILIAS database so that the CAT can be resumed after a system crash without any loss of progress. The corresponding data and the data from all newly created input fields (e. g. difficulty of questions, termination conditions) are archived in a way consistent with the other data. For the evaluation, two new spreadsheets were created. One table shows the individual testing trajectory of the participant, including his or her skill level and the standard error. The second gives an overview of all questions posed to at least one user and how they were answered.

All possibilities for the multimedia design were retained for the CAT. This is a clear benefit in comparison to numerous special CAT software solutions. The encapsulated design of the testing tool facilitates the integration of additional functionalities, e.g. multi-dimensional estimation procedures.

5. EVALUATION

This section presents the evaluation of the testing instrument. The tool was calibrated and evaluated in a large scale scenario with real scholars in the vocational schools. A description of the general experience concerning the application is given first. A comparison of concrete measurements with those of a typical linear test is found afterwards. Lastly the specific use of the developed testing tool is addressed.

5.1 Quality Assurance and Experience with the Implementation

The newly developed tasks were tested in two ways. In a first calibration stage in order to establish the degree of difficulty of each task they were presented linearly to approximately 1.200 health worker scholars in the vocational schools. The graduating class was chosen for maximum comparability of the results for the final examination. Furthermore they were examined in expert workshops. The usability of the test proved to be very good. Since the surface of the CAT did not differ from a linear standard ILIAS test, a bias due to a different interface could be excluded. The items were coded dichotomous. Partially correct solutions were evaluated as false in order to increase their difficulty. After final revisions, scaling and testing of Rasch conformity, 88 items covering a skill range (θ) of -2,091 to 2,678 remained.

In a second stage these items were used in main survey for a span of 15 to 30 questions. As no detailed experiences regarding the expected precision were available, a fixed number of questions was chosen in favor of a variable test length. A total of 1.183 data sets were collected through adaptive testing. These data sets were not simulated, but measured using participants that differed from the first stage.

5.2 Comparison of the Linear and Adaptive Testing Procedures

To check, whether the adaptive design of the tests could increase the measurement efficiency, a textbook example of a linear test procedure was created as a basis for comparison. Five people with a skill level spanning from +2 (high) to -2 (low) were taken with a test length of 15 questions equally divided into five

difficulty levels. While the specification of skill levels in CATs depends on the statistical model, it is specified here manually to provide integer number levels of competency. The scale is interpolated to the value range of the CAT for comparison. The textbook example is shown in table 1.

Table 1. Linear testing order

task number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	θ test taker = θ task	no contribution to measurement
θ task	-2	-2	-2	-1	-1	-1	0	0	0	1	1	1	2	2	2		
test taker: θ = +2	< θ	< θ	< θ	< θ	< θ	< θ	< θ	< θ	< θ	< θ	< θ	< θ	= θ	= θ	= θ	20,0%	80,0%
test taker: θ = +1	< θ	< θ	< θ	< θ	< θ	< θ	< θ	< θ	< θ	= θ	= θ	= θ	> θ	> θ	> θ	20,0%	60,0%
test taker: θ = 0	< θ	< θ	< θ	< θ	< θ	< θ	= θ	= θ	= θ	> θ	> θ	> θ	> θ	> θ	> θ	20,0%	60,0%
test taker: θ = -1	< θ	< θ	< θ	= θ	= θ	= θ	> θ	> θ	> θ	> θ	> θ	> θ	> θ	> θ	> θ	20,0%	60,0%
test taker: θ = -2	= θ	= θ	= θ	> θ	> θ	> θ	> θ	> θ	> θ	> θ	> θ	> θ	> θ	> θ	> θ	20,0%	60,0%

The number of individual test questions is presented in the first line, the difficulty level of the tasks in the second, and the results for the individual test persons in the five following lines. The tests were completed from left to right. It is assumed that the difficulty of the tasks is the only influencing factor, such that a respondent properly completes all tasks of the same or lower skill level (test person θ >= task θ). No distinctions are made according to the content areas. A dark cell marking signifies that a task has the same skill level as the test person, while a light one signifies that it was taken as a bound. The last two columns present the portion of tasks at the skill level of the test person and the measurements of irrelevant tasks (no marking).

For all five sample test persons, the individual skill level was only matched for 20% of the tasks. The strongest test person (θ = 2) initially needed twelve items below his or her skill level before receiving items 13 to 15 at this level. For the weakest test person (θ = -2), only the first three tasks were on the appropriate level and questions 4 to 15 were too difficult. The other cases performed equivalently, with only the position of the task fitting the test person's skill level changing. Except for the strongest test person, at least one further task was necessary to delineate the upper limit of the skill level. It could be generously argued that the entire next level of difficulty is relevant to distinguishing the skill limit (light marking), such that 20% to 40% of the questions add value to the measurement. In reverse, for the present example 60% to 80% of the questions (no marking) have no direct contribution to the measurement, as they are too easy or difficult. This rate could be reduced with the difficulty level value. Apart from the loss of precision, however, the basic problem would persist.

To test whether improvements can be achieved through the CAT for this idealized scenario, the scenario was adopted and supported by measured values from the CAT application. Based on the stepped skill levels +2, +1, 0, -1 and -2, one of the 1.183 measured data sets was chosen for each test person based on which most nearly fit his or her measured θ as evaluated after 15 questions. Test persons with θ values of +1.95, +1.00, 0.00, -0.99, and -1.97 were thereby identified. Table 2 illustrates the testing procedure for these test persons, showing the measured skill values following each question.

Table 2. Adaptive testing order

Task Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	θ test taker = θ task	no contribution to measurement
test taker θ = + 1,95 (+1,5 to +2,5)	0,41	0,76	1,07	1,34	1,59	1,82	2,04	2,20	2,05	2,16	1,91	2,00	1,80	1,88	1,95	73,3%	0,0%
test taker θ = + 1,00 (+0,5 to +1,5)	0,41	0,06	-0,24	0,02	0,26	0,47	0,67	0,85	1,03	0,86	1,01	0,87	1,01	0,88	1,00	60,0%	0,0%
test taker θ = 0,00 (-0,5 to +0,5)	-0,41	-0,06	0,24	-0,03	-0,26	-0,05	-0,24	-0,42	-0,25	-0,40	-0,26	-0,13	-0,01	0,11	0,00	100,0%	0,0%
test taker θ = - 0,99 (-1,5 to -0,5)	-0,41	-0,06	0,24	-0,03	-0,26	-0,47	-0,67	-0,85	-0,68	-0,83	-0,98	-1,12	-0,99	-1,11	-0,99	93,3%	0,0%
test taker θ = - 1,97 (-2,5 to -1,5)	-0,41	-0,76	-1,07	-1,34	-1,59	-1,82	-1,60	-1,78	-1,63	-1,77	-1,89	-2,00	-2,09	-1,90	-1,97	73,3%	0,0%

The presentation follows the likeness of the previous figure. Each participant answered 15 questions, numbered left to right. Due to the adaptive nature of the test, the questions differed between participants. As there can be no universal statement of the difficulty of the tasks, the second line is omitted. For each question number, the absolute measurement result (= test person's θ, to two decimal places) following each question is presented. Questions at the skill level of the test persons are again characterized by dark cell markers. Light highlights are used to distinguish contributing questions. To determine whether a question was at the skill level of a test person, an interval of θ +/- 0.5 was taken as a basis. This would in the worst case correspond to the same accuracy limit of the linear textbook scenario: For the textbook example, the difficulty level must exceed the participant's skill level by 1 (e.g. to θ = 2 for a participant with θ = 1), whereas for the CAT an interval extending both above and below the participant's skill level is necessary (e.g. the interval θ = 0.5 to θ = 1.5 for a participant with θ = 1).

It is apparent that between 60 and 100% of the questions addressed the relevant skill level. The share of too easy or difficult questions is reduced to 0 - 40%. The portion of questions not affecting the measurement is also reduced to 0%, since each question served part of the algorithm branch and the determination of θ. As expected, the border values fall weakly for high and low θ, since the algorithm takes longer to settle on the appropriate skill level. It becomes clear, however, that a skill level within the appropriate interval is reached after seven consecutive questions and that a nearly constant θ is reached after nine questions. With question nine, each test person was given three tasks at his or her own skill level, like in the linear test. This is delineated by the vertical dashed line in table 2. On average, each test person was already posed five questions up to this point at his or her own skill level. The black vertical line in table 2 marks the point at which each test person was posed the third question at his or her own skill level. For the presented example, at least 60% of the questions (after question 9 instead of 15) would have already been reached at this point. Figure 1 underlines this effect.
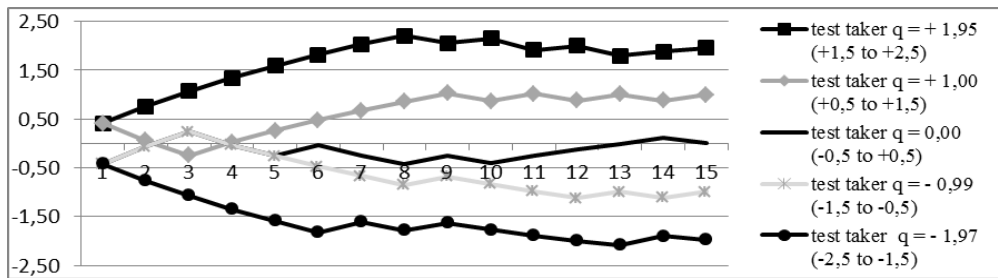
Figure 1. Graphical representation of adaptive test

The questions are shown on the x-axis, the measured θ on the y-axis. Similar to in previous figures, θ is displayed after the execution of each question, such that a nonzero value already follows question 1. Horizontal lines indicate the different intervals. The desired increase in the test efficiency due to the CAT algorithm could be confirmed by the example case. The mean value of θ was calculated over all 1.183 collected data sets after questions 9 and 15. Both values were very similar (0.261 versus 0.296). At the same time, the positive value of θ shows that the CAT was slightly easier than expected.

With regard to the items, the question arises as to how they were used in the test. Figure 2 shows which item was used in which position for all 88 tasks based on all data sets.
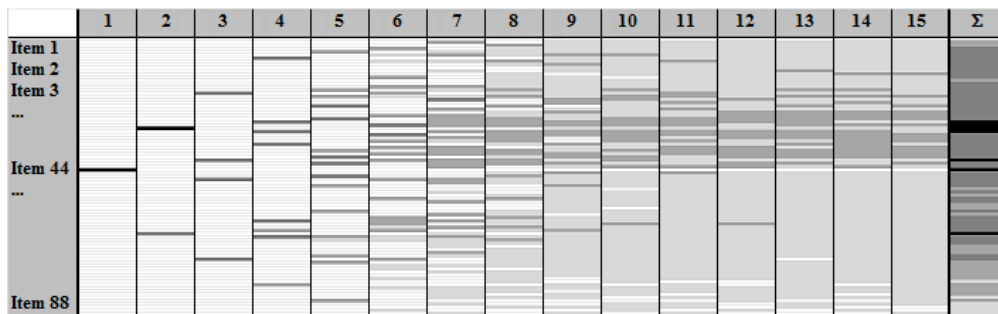
Figure 2. Item frequency and item position in test

For a test length of 15 questions, the positions within the tests are shown horizontally and the 88 items are shown vertically according to their difficulty levels, from difficult (item 1) to easy (item 88). The more test persons who were posed an item at a specific location, the darker the corresponding cell is shaded. (The darkest shading corresponds to more than 40% of the test persons being posed the item at this position, dark shading corresponds to 8-40%, light to 2-8%, and the lightest to 0-2%). The last column shows how many test persons an item was posed to in total.

It becomes clear that all test persons were given the same item with intermediate difficulty at the start of the test (see column 1). This conforms to our expectations, since all test persons have the same θ of 0 at the beginning of the test. Dependent on the correct or incorrect answering of this question, an easier or more difficult subsequent item is selected (column 2). Based on these two items, the algorithm branches to four items, then eight and sixteen. The branches may overlap for the first time with the sixth question and 30 items (column 6). By the ninth item (column 9) it becomes clear that all questions, spanning the entire difficulty spectrum, not posed up to this point belong to parallel paths. This shows how fine grained the measurement already is up to this point. It should be noted that the more difficult items were more frequently used, confirming the test was easier than expected. It also becomes clear that the frequency of the use of items of intermediate difficulty decreased towards the limits of higher or lower difficulty. This is expected, as the central difficulty range is more frequented than the edge ranges of higher and lower difficulty.

6. CONCLUSION

The central point of this contribution was to examine whether CAT could improve testing efficiency in the example of a medical competency measurement, as well as to present the relevant implementation and functional ability of an CAT component in ILIAS.

The results show that a fully valued CAT was successfully developed for the learning management system ILIAS. The test reacts adaptively to user inputs and selects the necessary subsequent tasks during runtime. The requirements in section 3 and the implementation in section 4 provide a detailed answer to research question 1, how to construct a computerized tool for adaptive competence assessment. Research question 2, focusing on the increase in measurement efficiency for a competence assessment, was addressed in section 5. A clear increase in the measurement efficiency could be achieved for the presented implementation case of a CM for health workers. As compared to a traditional testing format, the test time was reduced by 40%. The test persons were already posed three questions addressing their competency level after 9 questions in total, as compared to after 15 total questions for a linear test procedure.

In summary, an integrated tool was created for the competency measurement, with which a multifaceted adaptive competency measurement can be created from comprehensive types of questions and multimedia elements. No other tool could be identified possessing these capabilities, including extensive reporting options, graphical interface and high test security. This facilitates the potential for future implementations of combined multimedia-CATs. The tool supports large-scale testing and summative, diagnostic or formative usage. The time savings realized through the implementation of the CAT can be utilized as part of an integrated competency measurement with further testing. In practice measurement quality or dimensionality of the test can be improved for the same participants or more participants could be tested within the same time. The mapping of complex action situations in multimedia tests could replace personnel-intensive oral examinations. This benefit is not limited to CMs in the medical field.

As a contribution to knowledge, along with the time savings, the testing tool could facilitate more detailed and larger-scale competency measurements. It could enable large-scale empirical studies on the interaction between competency dimensions that are currently not feasible because of the associated expenses.

REFERENCES

Baker, F. B. and Kim, S.-H., 2004. *Item Response Theory: Parameter Estimation Techniques*. Marcel Dekker, New York, USA.

Bock, R. and Mislevy, J., 1982. Adaptive EAP Estimation of Ability in a Microcomputer Environment. *In Applied Psychological Measurement*, Vol. 6, No. 4, pp 431-444.

Bond, T. G. and Fox, C. M., 2007. *Applying the Rasch Model*. Routledge, Mahwah, USA.

Benett, R. E. et al., 1999. Using multimedia in large-scale computer-based testing programs. *In Computers in Human Behavior*, Vol. 15, No. 3-4, pp 283-294.

Brunken, R. et al., 2003. Direct Measurement of Cognitive Load in Multimedia Learning. *In Educational Psychologist*, Vol. 38, No. 1, pp 53-61.

Draganidis, F. and Mentzas, G, 2006. Competency based management: a review of systems and approaches. *In Information Management & Computer Security*, Vol 14, No. 1, pp 51-64.

Embretson, S. E. and Reise, S. P., 2000. *Item response theory for psychologists*. Lawrence Erlbaum, Mahwah, USA.

Erpenbeck, J. and Sauter, W., 2013. *So werden wir lernen*. Springer Gabler, Berlin Heidelberg, Germany.

Fischer, G. H. and Molenaar, I. W., eds. *Rasch models: Foundations, recent developments, and applications*. Springer, New York, USA.

Frey, A. et al, 2009. Effekte des adaptiven Testens auf die Motivation zur Testbearbeitung am Beispiel des Frankfurter Adaptiven Konzentrationsleitungs-Tests. *In Diagnostica*, Vol. 55, No. 1, pp 20-28.

Harvey, R. J. and Hammer, A. L., 1999. Item Reponse Theory. *In The Counseling Psychologist*, Vol 27, No. 3, pp 353-383.

Heyse, V. and Erpenbeck, J., 2007. *KompetenzManagement*. Waxmann, Münster, Germany.

ILIAS 2015, *Development*. Available from: <http://www.ilias.de/docu/>. Accessed at: 24 June 2015.

Jurecka, A. and Hartig, J., 2007. Computer- und netzwerkbasiertes Assessment. *BMBF Forschung (Hrsg.): Möglichkeiten und Voraussetzungen technologiebasierter Kompetenzdiagnostik*. Bonn, Germany, pp 37-48.

Klett, F., 2010. The interrelationship between quality and competency management – the foundation for innovative training technologies. *Information Technology Based Higher Education and Training (ITHET), 9th International Conference*, Cappadocia, Italy, pp 174-178.

Kubinger, K. D., 2009. *Psychologische Diagnostik*. Hogrefe, Göttingen, Germany.

Kunkel, M., 2011. *Das offizielle ILIAS 4-Praxisbuch*. Addison-Wesley, München, Germany.

Lord, F. M., 1976. Some likelihood functions found in tailored testing. *C. L. Clark (Ed.), Proceedings of the First Conference on Computerized Adaptive Testing*, Washington DC, USA, pp 79-81.

Lord, F. M., 1980. *Applications of item response theory to practical testing problems*. Lawrence Erlbaum, Mahwah, USA.

Mayer, R. E., 2005. *The Cambridge handbook of multimedia learning*. Cambridge University Press, Cambridge, UK.

Mills, C. N. and Stocking M. L., 1996. Practical Issues in Large-Scale Computerized Adaptive Testing. *In Applied Measurement in Education*, Vol. 9, No. 4, pp 287-304.

North, K. et al, 2013. *Kompetenzmanagement in der Praxis*. Springer Gabler, Wiesbaden, Germany.

Tonidandel, S. et al., 2002. Computer-adaptive testing: The impact of test characteristics on perceived performance and test takers' reactions. *In Journal of Applied Psychology*, Vol 87, No. 2, pp 320–332.

Van der Linden, W. J. and Glas, C. A.W., 2000. *Computerized Adaptive Testing*. Kluwer, Dordrecht, Netherlands.

Wang, T. 1997. Essentially unbiased EAP estimates in computerized adaptive testing. *Annual meeting of the American Educational Research Association*. Chicago, USA.

Webster, J. and Watson R., 2002. Analyzing the past to prepare for the future. *In MISQ, Vol.* 26, Nr.2, pp xiii–xxiii.

Weiss, D. J., 1982. Improving measurement quality and efficiency with adaptive testing. *In Applied Psychological Measurement*, Vol. 6, No. 4, pp 473-492.

Zheng, Y. et al, 2013. Content-balancing strategy in bifactor computerized adaptive patient-reported outcome measurement, *In Quality of life research,* Vol. 22, No. 3, pp 491-499.

COGNITIVE PRESENCE IN VIRTUAL COLLABORATIVE LEARNING: ASSESSING AND IMPROVING CRITICAL THINKING IN ONLINE DISCUSSION FORUMS

Jennifer Beckmann and Peter Weber

Fachhochschule Südwestfalen, Department of Electrical Engineering
Lübecker Ring 2, 59494 Soest, Germany

ABSTRACT

The paper introduces a virtual collaborative learning setting called 'Net Economy', which we established as part of an international learning network of currently seven universities. Using the Community of Inquiry framework as guidance and Canonical Action Research (CAR) as the chosen research design, the discussion forum of the online course is assessed regarding its critical thinking value. We thereby measure critical thinking with the help of the according model provided by Newman et al. (1995), which differentiates 40 indicators of critical thinking from ten different categories. The calculated critical thinking ratios for the analyzed two discussion threads indicate a strong use of outside knowledge, intensive justification as well as critical assessment of posts by the students. But at the same time there are also weak spots, like manifold repetitions. Based on these results we derive changes for the next course cycle in order to improve the critical thinking of the students.

1. INTRODUCTION

Learning with new media is becoming increasingly popular in times of MOOCs and a continuing growth in the use of mobile devices. Outside the traditional classroom, learning can spread to more diverse settings, contexts, and locations. As at the same time virtual collaboration is gaining significance in business, virtual collaborative learning (VLC) as a sophisticated type of eLearning setting gains growing attention in both research and higher education practice. The accompanying pedagogical and technological innovations thereby create new challenges for the instructors and also redefine their roles.

Successful eLearning requires learning environments that motivate the students and facilitate meaningful and worthwhile learning. A suitable design and a well-structured learning process need to consider social, technical and didactic challenges as interdependent dimensions of a good learning experience (Garrison 2011). VCL-settings thereby aim at the skills that are required and considered indispensable for virtual collaboration, involving team members working from various international locations and with heterogeneous cultural and educational backgrounds.

This paper introduces our own VCL learning scenario 'Net Economy' as part of a continuous build-and-evaluate loop, while our improvement efforts follow the iterative steps of canonical action research (CAR): diagnosis, action planning, intervention, evaluation, and reflection (Davison et al. 2004; Susman & Evered 1978). Action research is committed to "[…] the production of new knowledge through the seeking of solutions or improvements to 'real-life' problem situations." (McKay & Marshall 2001) It thus serves both, research and practice by studying the real world while considering a particular theoretical framework.

For our eLearning action research the Community of Inquiry (CoI) as introduced by Garrison et al. (2000) serves as the required theoretical framework, consisting of the three interdependent elements of 1) social presence, 2) cognitive presence and 3) teaching presence. While social presence is "the ability of participants to identify with a group, communicate purposefully in a trusting environment, and develop personal and affective relationships progressively by way of projecting their individual personalities"

(Garrison 2011, p. 23), cognitive presence is "the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse in a critical community of inquiry" (Garrison et al. 2001). Teaching presence, finally, is "the design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes" and thus merges all elements in a balanced and functional relationship.

While in previous papers we developed solutions mainly for various problems of teaching and social presence, like e.g. the use of a dedicated social network instead of a learning management system, we have so far not explicitly addressed the eLearning elements of the setting with regard to the required cognitive presence. According to the CoI framework students need to be "engaged in a collaborative and reflective process which includes understanding an issue or problem, searching for relevant information, connecting and integrating information, and actively confirming the understanding" (Garrison 2011, p. 94). An obvious instrument to do so seem to be discussion forums, which are therefore commonly used in eLearning. Computer-mediated communication tools, like discussion forums, provide ways for learners to interact. Research suggests that asynchronous online discussions are even superior with regard to critical thinking and knowledge co-construction due to the available time for reflection and more critical and constructive contributions when compared to synchronous face-to-face discussions (Wang et al. 2009). On the other hand, in practice, it usually stays unassessed and questionable whether the initiated discussions really provided for the intended critical and reflective interaction among the participants and thus for cognitive presence.

In the following we, therefore, measure and analyze the critical thinking ratio of the discussion forum that we established in our 'Net Economy' setting as part of a required discussion task. Based on this diagnosis step we will then derive interventions that aim at improving the critical and reflective thinking and thus the cognitive presence. After a short introduction of our VCL-setting in section 2, we will outline the diagnosis approach as adapted from Newman et al. (1995) and assess the critical thinking in our implemented discussion forum in section 3. In section 4 we will then derive interventions as improvement suggestions for the next course cycle before we conclude in section 5.

2. THE NET ECONOMY VCL-SETTING

'Net Economy' is an annual cross-location virtual collaborative learning setting (VCL) in the framework of an international learning network which we established in 2008. The setting targets participants with heterogeneous educational backgrounds in the fields of business and economics, business informatics, international economy and hotel & tourism management, as well as different cultural backgrounds from Germany (Berlin, Mühlheim an der Ruhr, Soest), Indonesia (Jakarta), Crimea (Simferopol) and Sweden (Kristianstad). The course is taught in English and deals with entrepreneurship and business models in the net economy. Between 80 and 150 students took part in each course cycle so far and worked in virtual intercultural teams on exercises concerning eBusiness models and virtual collaboration. All partners agreed on the general learning scenario, leading to a stable VCL-concept which we systematically improve using the previously mentioned canonical action research approach.

'Net Economy' is a complete online class with only three parallel classroom meetings at the various locations at the beginning of the different phases of the course, as depicted in fig. 1. A closed social network (established with Wordpress and several plugins) serves as the major coordination platform for the course and facilitates social presence. Every student needs to set up a profile and join a team within the first weeks of the class, called Preparation Phase. During these weeks, the whole concept is introduced and the different tasks and roles within a team are described and assigned. The students team up to groups of five, in which every team member has a very specific role to fulfill. Only two members of the same university are allowed to be part of the same group so that a high diversity is given in each team. In the following Knowledge Development Phase, the students are then introduced to some major characteristics, concepts and challenges of eCommerce and the Web 2.0 and to major types of business models on the web. On each of the topics introduced by the instructors via eLecture, the individual students as well as the teams have to complete and submit assignments. Each participating location is responsible for one of these eLectures and an according online assignment. Knowledge Development Phase, ends with a multiple choice test on the topics covered in the eLectures. In the final Case Study Phase every team is then asked to apply the acquired knowledge and develop a business plan for an assigned business model type using the so-called business model canvas. This

Case Study Phase includes a peer review process in which each team receives feedback from at least two other teams. The top rated teams then present their business plan during a final live online meeting, in which all participants will vote for the top E-Venture of the class.
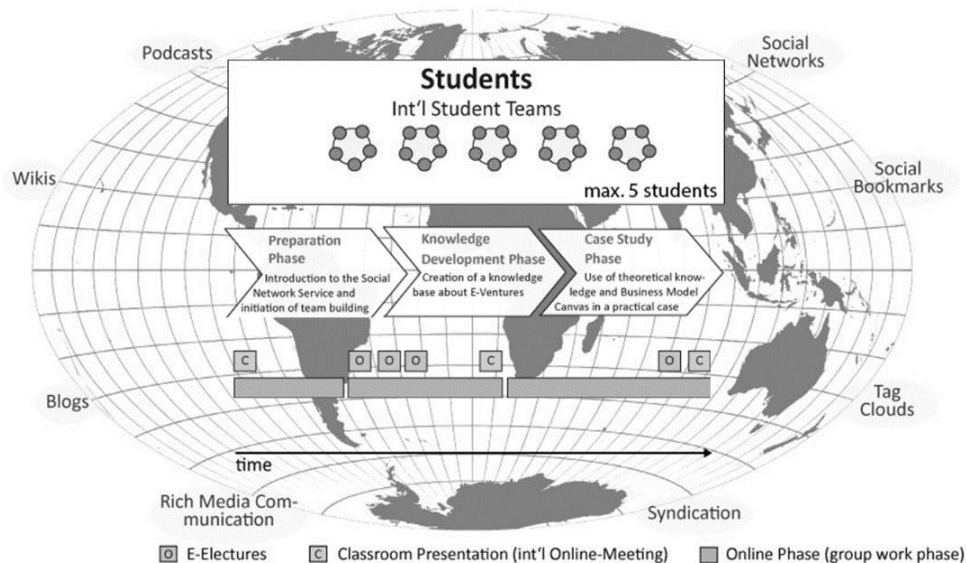
Figure 1. The Net Economy Learning Scenario

In the last course cycle accomplished between October 2014 and February 2015, students were asked to contribute to an online discussion individually as a first assignment. They could choose between two discussion threads on which they got a reading and had to write a first forum post pointing out their personal opinion and thoughts regarding the topics of the articles. In addition, they had to comment on at least two other posts and emphasize in their statements whether they support or rebut the post they are answering to, in order to facilitate critical and reflective thinking. Discussion thread 1 discussed the online available WIRED article "The Web is dead. Long live the Internet." by Chris Anderson and Michael Wolff and initiated discussion with the question: "How does the article and the discussion around it reflect today's eCommerce trends and what consequences would you expect from the development for popular online businesses?" Discussion thread 2 dealt with the as well online available Fast Company article "Encyclopaedia Britannica (EB) is dead, long live Encyclopaedia Britannica", raising the question: "Why did the original business model have to change and how did the Encyclopedia Britannica adapt? Do you believe in the viability of the business model?" The not any further moderated forum aimed to facilitate discourse and make the students think critically about the provided articles.

In total 80 members were registered on the 'Net Economy' network in the last course cycle. Next to the lecturers 13 teams of five active students, in total 65 students, were working on the platform. 56 students (86%) participated in this first individual assignment and 166 replies were posted, which are about three posts per participating student, indicating that the students fulfilled their task of writing one statement and two replies. To investigate the qualitative value of the forum posts, however, a closer look has to be taken at the posts themselves and a more qualitative analysis is required, as accomplished in the following chapters.

3. METHODOLOGY & APPLICATION OF METHOD

3.1 Critical Thinking

In the literature, many definitions of critical thinking can be found. According to the Foundation for Critical Thinking (2015) the word "critical" derives etymologically from two Greek roots: "kriticos" (meaning discerning judgment) and "kriterion" (meaning standards). Etymologically, then, the word implies the development of "discerning judgment based on standards." Ennis (1993) defines critical thinking as

"reasonable reflective thinking focused on deciding what to believe or do." In his opinion, a person needs to e.g. judge the credibility of sources and the quality of arguments, identify conclusions, reasons, and assumptions or develop and defend a position on an issue. Critical thinking therefore requires a wide set of information, generating processes and standards to base one's thinking on and relies on the person involved to have the intellectual commitment to make use of these skills and standards to guide his/her behavior.

Thus, critical thinking is a state of thinking that is beyond one's own, or even groups, interests and is dependent on the quality of standards and depth of experience the thinker has in respect to a particular problem or question. It also depends on different values and cultures, as differences in culture can have different effects and interpretations of being critical, as "in some cultures, being critical may be interpreted as 'argumentative' or 'being critical of others'" (Woo & Wang 2009). Simplified one can say that critical thinking involves seeking information, analyzing alternatives, evaluating the alternatives in relation to your aims and requirements and reaching a conclusion to the problem or answer.

In addition, critical thinking can also relate to other important areas in learning. Lai (2011) for example, says that "critical thinking skills relate to several other important student learning outcomes, such as metacognition, motivation, collaboration, and creativity." Being able to assess one's own arguments and reasoning is necessary for self-regulated learning. Tasks, which spark interest and are challenging the students usually call for critical thinking and trigger motivation. Collaboration requires the students to think in diverse perspectives and the more diverse they can think the better collaborators they may become. Opportunities for collaboration may also encourage higher quality thinking itself. Finally, also creative thinking incorporates attributes of critical thinking, such as open-mindedness and flexibility. All these attributes enhance the learning experience for the students and stimulate intellectual and personal growth (Lai 2011).

3.2 Assessing Critical Thinking through Content Analysis

In literature, many instruments are described which focus on content analysis and aim at providing evidence of learning and the knowledge construction taking place. These instruments represent a wide variety of approaches and differ in their level of detail, type of analysis categories and most important the diversity of their theoretical base (Wever et al. 2006). Content analysis instruments need to be objective, reliable, replicable, and systematic (Rourke et al. 2001). Instruments to measure critical thinking in terms of content analysis in a thematic unit of analysis were for example introduced by Newman et al. (1995) and Bullen (1998).

Whereas Bullen's framework is based on different conceptualizations of critical thinking and consists of four different categories of critical thinking skills, Newman et al.'s approach is based on Garrison's (1991) five stages of critical thinking and Henri's (1992; cited in: Wever et al. 2006) cognitive skills. In his papers, Garrison describes critical thinking as a problem-solving process in which the critical thinker will move through five stages: *problem identification, problem definition, problem exploration, problem applicability, problem integration*. Marra et al. (2004) evaluate the Newman et al. protocol to be good for high-level descriptive data of what is happening in a discussion and clearly defined with numerous codes and coding rules. In our study we, therefore, used this approach to analyze the critical thinking of our students in the above-described discussion scenario.

A prerequisite for this method, however, is that critical thinking indicators are identifiable, or in other words "critical thinking should be defined in such a way that it is measurable" (Woo & Wang 2009). In order to cover all possible types of posts in a discussion forum, Newman et al. (1995) expanded the five stages into the following 10 categories of critical thinking indicators: *Relevance, Importance, Novelty, Ambiguity, Outside Knowledge, Linking ideas, Justification, Critical Assessment, Practical Utility and Width of Understanding*. Each of the indicators has a pair of opposites, one for in-depth processing, and one for surface learning (Newman et al. 1995). Newman et al. have developed a full set of 40 indicators within the ten categories, as depicted in fig. 2.

Figure 2. Excerpt of coding indicators of the Newman et al. framework (Marra et al. 2004)

While the categories are provided in the left column, the individual indicators and their pairs with the matching codes follow in the second and third column. A positive indicator for the Novelty category could, for example, be new problem-related information (NP+) provided by a student or the welcoming of new ideas (NQ+). Negative indicators would, for instance, be repetitions (NP−), or even the dismissal of new ideas of a previous speaker (NQ−) as well as irrelevant statements (R−).

Along these provided categories with their various indicators, every post needs to be evaluated separately and codified accordingly. Statements may cover phrases, sentences, paragraphs or mere messages containing one unit of meaning and referring to least one of the indicators. It may even happen that some indicators overlap with each other (see figure 3 for example). This is why the coding needs to be carried out in chronological order, evaluating the first post first and the later posts to the end of the evaluation sequence. Only in this manner, the posts can be assessed properly and new content or repetitions can be identified correctly. Furthermore, the links between the different individual threads can be identified this way. But rather than classifying and coding every single word it is reasonable and even suggested to mark and count the obvious examples, and ignore the intermediate shades of gray (Newman et al. 1995).

After assessing all posts in this way the approach allows for the calculation of a critical thinking ratio based on formula 1 depicted below. The x ratio with x identifying the category is calculated by subtracting the sum of all negative indicator from the sum of all positive indicators, divided by the sum off all indicators. The resulting measure thereby expresses solely the quality of the text without depending on the quantity of participants. This way ten critical thinking ratios are calculated, one for each category, and all of them in a range of −1 (all uncritical, all surface) to +1 (all critical, all surface) (Newman et al. 1995).

$$x\ ratio = \frac{x^+ - x^-}{x^\pm}$$

Formula 1. Calculation of critical thinking ratio (simplified according to Newman et al. 1995)

3.3 Forum Analysis

The following analysis of the above-explained discussion forum was conducted with the help of the students of the 'Net Economy' course themselves. One student of each team was assigned the role of a research partner and as such had to mark the transcripts of the discussion thread that he did not participate in himself. The research partners were introduced to the job and the approach in a web conference, and, in addition, a short tutorial was provided on how the free coding software QDAminer Lite can be used to do the job. The transcripts of the forums were provided to the students together with the indicators as a predefined project in QDAminer Lite. Nine out of the 13 research partners submitted complete and acceptable coding projects with four students covering discussion thread 1 and five students covering thread 2.

The analysis to follow is a merger of these nine complete coding projects provided by the students. Fig. 3 shows how the coding of a post looks like in QDAminer with the positive and the negative indicators being depicted in the right. Building on to these individual codings we then proceeded by summing up all appearances of the different indicators and by calculating the critical thinking ratio for each category. While the two discussion threads were coded separately we later also merged the results, since both threads were set up and managed in the exact same way. This way we were able to calculate critical thinking ratios also for the discussion forum as a whole.
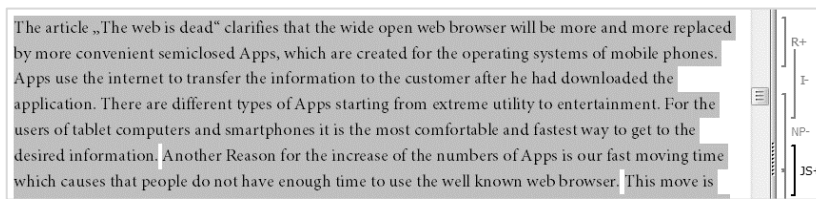
Figure 3. Coding of forum posts

Several problems accompanying the chosen analysis approach and research design need to be considered. Next to the apple-and-pear problem because of possible variances between the different codings of the students, also very small numbers of appearances of specific indicators lead to the risk of over-interpretation. We, therefore, do not consider the critical thinking ratios of the *Practical Utility* and the *Width of Understanding* category in our analysis, as these indicators were used too rarely. Another limitation to keep in mind is that the chosen critical thinking model does not answer any specific question or solve any specific problem, but rather develops an overall rating for the quality of the interactions between the students and their discussion behavior.

4. RESULTS & ACTION PLANNING

After merging the coding projects, the results shown in table 1 can be calculated for the ten categories. We were able to evaluate eight of the ten categories when considering the sample sizes. Only for the *Ambiguity* category a negative result was calculated, indicating that the coding students found many confusing statements. All other ratios are positive with mostly rather small differences between the ratios for the discussion threads 1 and 2. As Newman et al. do not provide a scheme for interpreting the results except for -1 indicating all uncritical and surface posts and +1 indicating all critical and deep contributions, there is a clear need to compare the derived ratios with the ratios of comparable settings. This actually matches our CAR approach of a continuous build-and-develop loop, since we will derive interventions in the next step that aim at improving the critical thinking in the implemented discussion forum, with the critical thinking ratios allowing us to assess and evaluate any achieved improvement.

Table 1. Critical thinking ratios in the 'Net Economy' forum calculated after Newman et al. (1995)

Category		Topic 1			Topic 2			Combined		
		Indicator		Ratio	Indicator		Ratio	Indicator		Ratio
		+	−		+	−		+	−	
R±	**Relevance**	118	46	0,44	125	85	0,19	243	131	0,30
I±	**Importance**	58	53	0,05	34	11	0,51	92	64	0,18
N±	**Novelty**	201	156	0,13	158	75	0,36	359	231	0,22
A±	**Ambiguity**	35	72	−0,35	19	42	−0,38	54	114	−0,36
O±	**Outside Knowledge**	189	27	0,75	102	14	0,76	291	41	0,75
L±	**Linking Ideas**	62	41	0,20	29	31	−0,03	91	72	0,12
J±	**Justification**	184	20	0,80	137	31	0,63	321	51	0,73
C±	**Critical Assessment**	55	12	0,64	74	6	0,85	129	18	0,76
P±	**Practical Utility ***	10	0	* (1)	5	5	0	15	5	* (0,50)
W±	**Width of Understanding ***	15	2	* (0,76)	12	7	0,26	27	9	* (0,50)

* These categories are not considered any further due to too small samples.

The high scores (CT≥0,70) among the above results nevertheless point at several positive characteristics of the students discussion behavior. Outside knowledge was used a lot (CT=0,75), justifications were regularly provided (CT=0,73) and the posts were mostly critically assessed by fellow students (CT=0,76). A drill-down into one of the higher and one of the lower scores provides a clearer view of the assessed discussion. Table 2 adds an overview of the samples of single indicators from the two categories *Linking Ideas* and *Outside Knowledge*. Personal experience and previous knowledge, as well as additional course material and external resources, were introduced frequently by the students. Furthermore, they were also able to link facts and ideas, but thereby continuously repeated information and statements provided by other students before.

Table 2. Closer Look on the Outside Knowledge and Linking Ideas category and the according numbers

Category	+ Indicator		Count	− Indicator		Count
O± bringing outside knowledge / experience to bear on problem	OE+	Drawing on personal experience	129	OQ−	Squashing attempts to bring in outside knowledge	6
	OC+	Refer to course material	54	O−	Sticking to prejudice or assumptions	22
	OM+	Use relevant outside material	60			
	OK+	Using previous knowledge	41			
	OP+	Course related problems brought in	19			
	OQ+	Welcoming outside knowledge	1			
L± linking ideas, interpretation	L+	Linking facts, ideas and notions	81	L−	Repeating information without making inferences or offering an interpretation	34
	L+	Generating new data from information collected	10	L−	Stating that one shares the ideas or opinions stated, without taking these further or adding any personal comments.	38

While these results indicate an overall positive discussion behavior from our point of view, the total number of posts points at a rather tightly focused fulfillment of the discussion task (one post + two replies). Students seem not to have participated in the discussion based on pure interest, curiosity or fun, but rather because it was a required task. The chosen topics and the way of raising and structuring the discussion seems not to have managed to turn the students' extrinsic motivation into intrinsic motivation, which should have resulted in some sort of over-fulfillment of the discussion task. The identified numerous repetitions of information support this interpretation.

As it is our goal to foster critical and reflective thinking and thus cognitive presence, we aim at engaging the students' in a more intrinsically motivated discussion in the future. Considering the above results we derived the following three interventions regarding the implementation of the discussion forum for the upcoming course cycle: 1) More polarizing discussion starters will be developed, including other media types, like e.g. video statements, pictures or podcasts in order address the students media behavior more systematically. 2) The instructors will contribute to the discussion with prepared statements that open up new directions of thinking from time to time so that the students get new ideas and notice that their posts are not only counted but read. 3) Discussion forums with consistent requirements and settings will be used in several phases of the course and critical and reflective thinking as a desired learning outcome will be turned into a subject of discussion itself in order to evolve a discussion culture.

After the next course cycle, we will assess the discussion forums and calculate the according critical thinking rations again in order to evaluate our interventions. This way we hope to have started an improvement process for the discussion forums as a major instrument of cognitive presence in eLearning.

5. CONCLUSION, DISCUSSION & FUTURE WORK

In this paper, we introduced the VCL-course 'Net Economy' and our iterative Canonical Action Research (CAR) approach aiming at a systematic improvement of the setting. Using the Community of Inquiry framework (CoI) as guidance, we focused on cognitive presence as one major requirement of successful online learning, which we intended to provide for by implementing a discussion forum and an according discussion assignment among other tasks. We evaluated the discussion forum regarding its cognitive value by calculating the critical thinking ratios for all ten categories suggested by the Newman et al. (1995) critical thinking diagnosis model. Using this approach we were able to diagnose some strength and weaknesses of our discussion setting and derived interventions to be implemented in the upcoming course cycle.

The Newman et al. model was simple to use and user-friendly since all categories and indicators are predefined. It provided for quality scores indicating the cognitive value of our discussion forum while not

depending on the number of participants. But despite this well-organized and user-friendly model, it turned out to be quite tedious and time-consuming to work through the assessed forum with regard to all 40 indicators contained in the model. A problematic aspect is also the interpretation of the derived results. While it is clear that the more the values tend towards −1 or +1 the worse respectively better discussion behavior they indicate, there is no guidance as where a good value might start or a bad value might end.

Regarding the analyzed discussion forum we found that the students frequently introduced outside knowledge to the discussion, that they argued intensely, and that they thereby addressed posts critically. On the other hand, they often repeated information and posted a high number of rather confusing statements. However, the various cultural and educational backgrounds of the students might also play an important role in this matter, opening up the field for further research. From the calculated results, we finally derived interventions for the upcoming course cycle aiming at turning the students' initial extrinsic discussion motivation into a more intrinsic one. A comparison of the results after the next course cycle will then allow us to assess the effects of the implemented changes, which would not be possible without a critical thinking diagnosis approach like the one provided by Newman et al. (1995) and used in this paper. Also, the process of analyzing a forum in such detail helped us a lot to understand the effects of the chosen discussion task with its strength and weaknesses better.

REFERENCES

Bullen, M., 1998. Participation and critical thinking in online university distance education. *International Journal of E-Learning & Distance Education,* Vol. 13, No. 2, pp. 1–32.

Davison, R. et al., 2004. Principles of canonical action research. *Information systems journal,* Vol. 14, No. 1, pp. 65–86.

Ennis, R. H., 1993. Critical thinking assessment. *Theory Into Practice,* Vol. 32, No. 3, pp. 179–186.

Foundation for Critical Thinking, 2015. *The Critical Thinking Community. Our Concept and Definition of Critical Thinking.* Available online at http://www.criticalthinking.org/pages/our-concept-of-critical-thinking/411, 5/6/2015.

Garrison, D. R., 2011. *E-learning in the 21st century. A framework for research and practice.* Routledge, New York.

Garrison, D. R. et al., 2000. Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education. *The Internet and Higher Education,* Vol. 2, No. 2-3, pp. 87–105.

Garrison, D. R. et al., 2001. Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of distance education,* Vol. 15, No. 1, pp. 7–23.

Garrison, D. R., 1991. Critical thinking and adult education: a conceptual model for developing critical thinking in adult learners. *International Journal of Lifelong Education,* Vol. 10, No. 4, pp. 287–303.

Henri, F., 1992. Computer conferencing and content analysis. *Collaborative learning through computer conferencing.* Springer, pp. 117–136.

Lai, E. R., 2011. Critical thinking: A literature review. *Pearson's Research Reports,* Vol. 6, pp. 40–41.

Marra, R. M. et al., 2004. Content analysis of online discussion forums: A comparative analysis of protocols. *Educational Technology Research and Development,* Vol. 52, No. 2, pp. 23–40.

McKay, J. and Peter M., 2001. The dual imperatives of action research. *Information Technology & People,* Vol. 14, No. 1, pp. 46–59.

Newman, D. R. et al., 1995. A content analysis method to measure critical thinking in face-to-face and computer supported group learning. *Interpersonal Computing and Technology,* Vol. 3, No. 2, pp. 56–77.

Rourke, L. et al., 2001. Methodological issues in the content analysis of computer conference transcripts. *International Journal of Artificial Intelligence in Education (IJAIED),* Vol. 12, pp. 8–22.

Susman, G. I. and Roger D. E., 1978. An assessment of the scientific merits of action research. *Administrative science quarterly*, pp. 582–603.

Wang, Q. et al., 2009. Investigating critical thinking and knowledge construction in an interactive learning environment. *Interactive learning environments,* Vol. 17, No. 1, pp. 95–104.

Wever, B. de et al., 2006. Content analysis schemes to analyze transcripts of online asynchronous discussion groups: A review. *Computers & Education,* Vol. 46, No 1, pp. 6–28.

Woo, H. L. and Qiyun W., 2009. Using weblog to promote critical thinking-An exploratory study. *Proceedings of World Academy of Science: Engineering & Technology,* Vol. 37, pp. 431–439.

DEVELOPING A MOBILE LEARNING MANAGEMENT SYSTEM FOR OUTDOORS NATURE SCIENCE ACTIVITIES BASED ON 5E LEARNING CYCLE

Ah-Fur Lai[*], Horng-Yih Lai[**], Wei-Hsiang Chuang[*] and Zih-Heng Wu[**]
Department of Computer Science, University of Taipei
**National Taiwan University*
No.1, Ai-Guo West Road, Taipei, 10048 Taiwan

ABSTRACT

Traditional outdoor learning activities such as inquiry-based learning in nature science encounter many dilemmas. Due to prompt development of mobile computing and widespread of mobile devices, mobile learning becomes a big trend on education. The main purpose of this study is to develop a mobile-learning management system for overcoming the difficulties of outdoor learning activities. In addition, this study conducted a learning experiment on marine education in an elementary school for investigating its impact on the learners' learning achievement and attitudes, and evaluating the suitability of this system. The results show that the mobile learning model with the system developed by this study has positive and significant effect on learners' cognitive achievement. Nevertheless, the learners' attitudes toward marine education is not enhanced after experiment. In addition, the result of system evaluation reveals that the experts show high appraisal toward this system including system usefulness, suitability and operational easiness.

1. INTRODUCTION

Inquiry is the process of humankind for seeking information and understanding, and it is a thinking approach as well (welsh Klopfer & Aikenhead, 1981). Inquiry-based learning is an open ended, student-center teaching strategy, emphasizing hands-on instructional context. In order to construct this kind of learning environment, there are many theoretical approaches proposed, including structured inquiry, guided inquiry, open inquiry, and learning cycle (Colburn, 2000).

In inquiry-based learning (IBL for abbrev.), the students have to represent their problems, develop hypothesis, design experiment, collect and analyze data, propose evidence, and reflect their process. As a result, IBL can make learning more meaningful and enhance the effect of learning transfer (Brown & Campione, 1994; Collins, Brown & Holum, 1991; Linn & His, 2000; Slotta, 2002; White & Frederickson, 1998; Lin, 2004). Nevertheless, IBL has not been widespread applied on educational practicum. Some literature revealed the possible reason of aforementioned phenomena including misunderstanding the meaning of inquiry, IBL regarded as suitable for high ability students merely, uneasy to manage learning activities, inappropriate teaching preparation (Colburn, 2000). In addition, Lai (2014) proposed some factors affecting the teachers' rejecting the IBL, including delay the teaching schedule, bringing too much workload on teachers, the students' time management problem, the teachers unfamiliar with IBL practical models, and lack of suitable digital management system. To reduce the aforementioned dilemma, some suitable learning models are required for practicum, and ICT-based learning management system is also necessary for delineating the teachers' work load and providing real time supports for the students.

Many IBL models offering concrete guidance can be suitably used for practical teaching and learning, such as Bishop and Bruce model (2002), Learning-for-use model (Edelson, 2001), and 5E learning cycle. The stages of Bishop and Bruce model consist of Ask, Investigate, Create, Discuss and Reflect. According to perspectives of constructivist, 5E learning cycle proposed by Biological Science Curriculum Improvement Study (BSCS) is regarded as an effective science pedagogy (Bybee & Landes, 1998; Bybee et al., 2006; Liu, Peng, Wu & Lin, 2009). 5E learning cycle is comprised of five stages including Engage, Explore, Explain, Elaborate and Evaluate.

2. SYSTEM FRAMEWORK AND FUNCTIONS

In order to support outdoor science activities, this study developed a mobile learning management system (MLMS for abbrev.), and its framework is shown as Figure 1. MLMS consists of teacher-side learning management subsystem and learner-side learning support subsystem.

Based on the theory of 5e learning cycle, the functions of learning support subsystem (Android-based APPs) for the students designed by Android java are depicted as follows: (1) Engage: To invoke the learners engage in the outdoor activities, the task-notify APP is designed, shown as Figure 1. (2)Explore: In this stage, the Kelly-grid APP can help the learners to observe the object specified by the teacher. Figure 2 presents a learning task of observing the crab of seashore specified in Kelly grid by the teacher. When the learners finish their task, the corresponding diagnostic message will be sent in mobile device for feedback or suggesting one furthermore observation if the student's answer is incorrect. (3)Explain: In this stage, the teachers will provide the opportunities for explaining their learning, so the mobile-based worksheet App can facilitate the learner to collect and depict their findings by capturing image, annotating and writing text in their mobile devices, shown as Figure 3. When they encounter some problems, they can use QRCode for acquiring correct concepts or seeking solutions through Wikipedia and other search engines. (4)Elaborate: According to the cognitive elaboration theorem, the teachers can propose challenging and minds-on problems, and the learners are asked to solve it using elaborating concepts. In this study, the location-based knowledge construction App is offered when the learners are asked to finish a task, such as introducing the seashore spot of Taiwan, shown as Figure 3. (5)Evaluate: How to assess the learners' performance is an important duty. In this study, the teachers can conduct peer assessment activities for evaluating the students' works or ask the students to take a mobile-based test at the end of an outdoors activity. Figure 4 shows the peer assessment frame of mobile device and presents a mobile-bases test. Moreover, the profile of the learners will be recorded and upload into web server for further analysis.

As for the teacher-side functions, the web-based learning management subsystem can be divided into the following modules: (1)Kelly grid authoring: The teachers can edit Kelly grid for providing a series of observation task; (2) mobile test editing: The teachers can manage the test item bank and schedule a task of mobile test, as shown as Figure 5; (3) peer assessment management: The teachers can schedule a peer assessment task for some mobile worksheets; (4)task scheduling: All of task can be assigned and tuned by teachers. (5) viewing the learning status and outcomes: the teachers can monitor the learner's task status, observation result in Kelly-grid, and score of test or peer assessment, as shown as Figure 6.

Figure 1. (A)partial system menu (B)Task-notify APP

Figure 2. Kelly-grid and its feedback

(A)   (B)
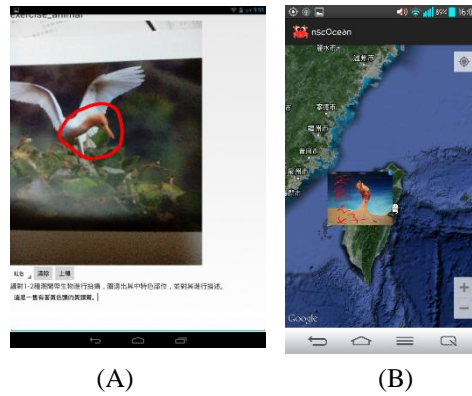
Figure 3. (A) mobile worksheet (B) An example of location-based knowledge construction

After finishing the development of this system and APP, this study employed 17 experts for evaluating the aforementioned system and APP, including 14 experienced teachers of elementary schools, 3 project managers, and 2 experienced programmers. The evaluation questionnaire adopted 5-point Likert scale, ranking from strongly agree to strongly disagree. The facets of this instrument consist of system helpfulness, suitability and operational easiness. After analyzing the data collected from pilot study, the Cronbach's alpha of each facet is over 0.7, revealing that this instrument is reliable.

(A)   (B)
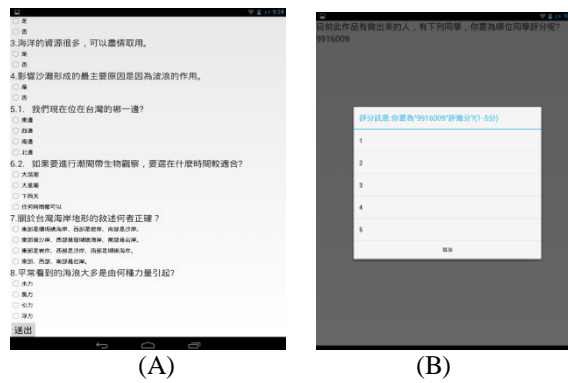
Figure 4. (A) mobile-based test (B) peer assessment

Figure 5. Mobile test editing

Figure 6. Viewing the learners' mobile worksheets

3. OUTDOOR MOBILE LEARNING EXPERIMENT

In order to investigate the learning effect of outdoor mobile learning, this study conducted a learning experiment by employing quasi experimental design. The subjects are 160 fifth graders from six classes in Taipei city, divided into experiment group (n=80) and control group (n=80). The experiment group accepted mobile learning approach, while the control group accepted traditional learning pedagogy. All of the subjects were asked to explore the plants and animals of specified seashore spot at northern Taiwan. The experiment group used Android Pads with aforementioned system and APPs for outdoor learning activities, on the contrary, the control group used traditional devices for recording their observation under directions of paper-based worksheets and learning materials. The educational target of outdoor learning of this activity is one of the elementary marine education. The subjects were asked to take cognitive tests of marine achievement and to fill out the self-reported inventory of learning attitudes toward marine education. The experimental design for outdoor activity in this learning experiment is shown as Table 1.

Table 1. Experimental design for outdoor activity

Pretest	Treatment	Posttest
O_1O_2	X	O_3O_4
O_1O_2		O_3O_4

O_1 : pretest of achievement test on marine education
O_2 : pretest of learning attitudes towards marine education
X: experiment group accepts mobile learning model, and control group accepts traditional learning pedagogy
O_3 : posttest of achievement test on marine education
O_4 : posttest of learning attitudes towards marine education

The inventory of learning attitudes consists of interest, usefulness, importance, and awareness toward marine education, adopting 5-point Likert scale. This instrument is validated by experts of marine educations. Its Cronbach's alpha is .806 by analyzing the data collected from pilot test, indicating that it is highly reliable. The achievement test of marine education contains the concepts of plants and animals of seashores. After item analysis from pilot test, its difficulty index range from 0.4 to 0.7, and its discrimination index range from 0.4 to 0.8, depicting that they are all suitable for assessing the learners' achievement based on viewpoint of Ebel and Frisbie (1991).

4. RESEARCH RESULTS

4.1 Results of Achievement test for Marine Education

The descriptive statistical results of achievement test for marine education are shown as Table 2, and its results of independent t test are depicted as Table 3. As for pretest of achievement test, there is no significant

difference between experiment group (M=4.90, SD=2.949) and control group (M=4.31, SD=2.917), t=1.237, p>.05, indicating that those two groups possess the same prior knowledge on marine education before learning experiment. As for posttest of achievement test, there is significant difference between experiment group (M=9.61, SD=3.438) and control group (M=7.94, SD=4.018), t=2.727, p<.01, indicating that the experiment group divergently outperform on achievement test of marine education than the control group after learning experiment. In other words, the outdoor learning model with the aforementioned system and mobile devices can enhance the learning effect on marine education. The research results are same as those of Lai, Chou, Wu and Lai (2010) which employed RFID and PDA for conducting an experiment of learning aquatic plants in an elementary school.

Table 2. Pretest and posttest scores of achievement test for marine education

Test	Group	n	Mean	SD
Pretest	Experiment group	73	4.90	2.949
	Control group	77	4.31	2.917
posttest	Experiment group	72	9.61	3.438
	Control group	77	7.94	4.018

Table 3. Results of independent t test on achievement test for marine education

Achievement Test	Levene's Homogeneity test		t	df	Sig.
	F	Sig.			
pretest	.046	.831	1.237	148	.218
posttest	2.877	.092	2.727[**]	147	.007

$**p<.01$

4.2 Results of Learning Attitudes towards Marine Education

The inventory of learning attitudes towards marine education is a kind of self-reported instrument, and it consists of four facets including interest, usefulness, importance, and awareness towards marine education. Its results of independent t test are depicted as Table 4. As for pretest of learning attitudes, there is no significant difference between experiment group (M=89.54, SD=13.311) and control group (M=91.1, SD=15.656), *t=-.589, p>.05*, indicating that those attitudes of two groups are the same before learning experiment. As for posttest of learning attitudes, there is no significant difference between experiment group (M=89.95, SD=12.975) and control group (M=91.65, SD=14.436), *t=-.706, p>.05.* In other words, mobile learning model cannot promote the learners' learning attitudes in a short-term leaning time.

Table 4. Results of independent t test on learning attitudes towards marine education

Learning attitudes	Levene's Homogeneity test		t	df	Sig.
	F	Sig.			
pretest	.333	.565	-.589	122	.557
posttest	1.191	.277	-.706	129	.481

4.3 The Results of System Evaluation

The results of system evaluation are shown as Table 6, and average of each item range from 3.41 to 4.35. The average of this system evaluation is 4.016, revealing that the experts show high appraisal toward this system. Nevertheless, the system flow is required to revise in the future.

Table 5. The results of system evaluation

Items	A(%)	B(%)	C(%)	D(%)	E(%)	M	SD
This APP on mobile inquiry learning is helpful.	23.5	76.5	0	0	0	4.24	.437
This APP is useful for mobile inquiry learning in elementary school.	35.3	64.7	0	0	0	4.35	.493
This system recording the learners' behaviors is helpful to capture learners' status for the teachers	11.8	76.5	11.8	0	0	4.00	.500
The testing function of this APP is help for outdoor learning activities.	5.9	94.1	0	0	0	4.06	.243
The operational flow of this APP is smooth.	11.8	35.3	41.2	5.9	5.9	3.41	1.00
This APP make outdoor learning more fun.	5.9	88.2	5.9	0	0	4.00	.354
This APP can attract the learners engage in learning.	23.5	70.6	5.9	0	0	4.18	.529
This mobile outdoor learning mobile is suitable.	5.9	76.5	17.6	0	0	3.88	.485
The multimedia materials through QRcode is helpful.	41.2	41.2	17.6	0	0	4.24	.752
Operating this system is easy.	5.9	58.8	35.3	0	0	3.71	.588
The web-based management of this system is easy to use.	5.9	58.8	29.4	5.9	0	3.65	.702
This system and APP can be used for different outdoor activities.	23.5	76.5	0	0	0	4.24	.437
This APP is suitable for indoor, campus-wide and outdoor learning activities.	23.5	58.8	17.6	0	0	4.06	.659
The functions of task-hinting is useful.	11.8	82.4	5.9	0	0	4.06	.429
The Kelly-grid and its real-time feedback is helpful for understanding their learning drawbacks.	11.8	52.9	29.4	5.9	0	3.71	.772
The mobile worksheet is suitable.	23.5	76.5	0	0	0	4.24	.437
The peer assessment of this system is helpful.	17.6	76.5	5.9	0	0	4.12	.485
The mobile worksheet integrating image and voice recording is interesting.	29.4	70.6	0	0	0	4.29	.470
If I am a teacher of nature science, I am willing to apply it in my teaching practicum.	23.5	64.7	11.8	0	0	4.12	.600
I am willing to recommend this system to other teachers.	35.3	47.1	17.6	0	0	4.18	.728

A: strongly agree, B: agree, C: medium, D: disagree, E: strongly disagree

5. CONCLUSIONS AND FUTURE WORKS

In order to offer real time support for outdoor learning activities, this study adopted mobile computing technology to develop a mobile learning management system and APP. Based on the theory of 5e learning cycle, this system provides different functions for each inquiry learning stage including Engage, Explore, Explain, Elaborate, and Evaluate stage, in outdoor inquiry-based learning. After system evaluation, the experts show high appraisal toward this system including system usefulness, suitability and operational easiness. Through short-term learning experiment on marine education, the outdoor mobile learning model can significantly improve the achievement of experiment group as compared to those of control group under traditional teaching pedagogy. Nevertheless, the learning attitude towards marine education is not promoted divergently after learning experiment.

In the future, this study will launch a long term learning experiment for nature science, and apply it on different learning domain for investigating its effect on learners' high order thinking skills including metacognition, communication skills and science process skills by using mobile learning model.

ACKNOWLEDGEMENT

REFERENCES

Bishop, A. P, & Bruce, B. C. (2002). Using the web to support inquiry-based literacy development. *Journal of Adolescent and Adult Literacy, 45*(8), 706-714.

Brown, A. L. & Campione, J. (1994). *Guided discovery in a community of learners*. In K. McGilly (ED.), Classroom lessons: integrating cognitive theory and classroom practice. Cambridge: MIT/Bradford.

Bybee, J. W., & Landes, N.M. (1998). The biological science curriculum study (BSCS). *Science and children, 25*(8), 36-37

Bybee, R.W., Taylor, J.A., Gardner, A., Van Scotter, P., Powell, J.C., Westbrook, A., & Landes, N. (2006). The BSCS 5E instructional model: Origins, effectiveness, and applications, Colorado Springs: BSCS.

Colburn, A. (2000). An inquiry primer. *Science Scope, 23*(6), 42-44.

Collins, A., Brown, J. & Holum A. (1991). Cognitive apprenticeship: making thinking visible. *American Educator 15*, 6-11,38-39.

Ebel, R. L. & Frisbie, D. A. (1991). *Essentials of Educational Measurement (5th ed.)*. Englewook, NJ: Prentice Hall.

Edelson, D.C. (2001). Learning-for-Use: A Framework for the Design of Technology-Supported Inquiry Activities. *Journal of research in science teaching, 38*(3), 355-385.

Lai, Ah-Fur (2014). The teaching strategies and models of ICT-integrated into innovative instruction. *The elementary Education Journal, 61*(4), 28-45.

Lai, Ah-Fur, Chou, Kuan-Chih, Wu, Chien-Hsun & Lai, Horng-Yih (2010). Integrate hand-held device and RFID to support context awareness environment for outdoor inquiry learning activity. The proceeding of the 6th IEEE International Conference on Wireless, Mobile, and Ubiquitous Technologies in Education, 132-136.

Lin, B.-R. (2004). Challenges and issues in designing inquiry on the Web. *British Journal of Educational Technology, 35*(5), 627-643.

Linn, M. C. &His, S. (2000). *Computers, teachers, peers: science learning partners*. Mahwah, NJ: Lawrence Erlbaum Associates.

Liu, T.-C. Peng. H., Wu, W.-H. &Lin, M.-S. (2009). The Effects of Mobile nature-science Learning Based on the 5E Learning Cycle: A Case study. *Educational Technology & Society, 12* (4), 344-358.

Slotta, J. (2002). Designing the web-based inquiry science environment (WISE).*Educational Technology, 42*, 6-15 Cambridge 20.

Welch, W.W., L.E. Klopfer, & G.E. Aikenhead (1981). The role of inquiry in science education: Analysis and recommendations. *Science Education, 65*(1), 33–50.

White, B.Y. & Frederickson, J. (1998). Inquiry, modeling, and metacognition: making science accessible to students. *Cognition and Instruction, 16*, 3-118.

BEHAVIORAL FEATURE EXTRACTION TO DETERMINE LEARNING STYLES IN E-LEARNING ENVIRONMENTS

Somayeh Fatahi[1, 2], Hadi Moradi[1, 3] and Elaheh Farmad[1]

[1]*School of Electrical & Computer Engineering, University of Tehran, Tehran, Iran*
[2]*Department of Computer Science Department, Halifax, Canada*
[3]*Intelligent Systems Research Institute, SKKU, South Korea*

ABSTRACT

Learning Style (LS) is an important parameter in the learning process. Therefore, learning styles should be considered in the design, development, and implementation of e-learning environments. Consequently, an important capability of an e-learning system could be the automatic determination of a student's learning style. In this paper, a set of features which are important in extracting the learning style automatically from students' behavior has been determined. These features, which are recognized based on Myers-Briggs Type Indicator's (MBTI), play a key role in predicting learning styles in an online course. The features are determined and ranked using pattern recognition techniques, such as K-means clustering algorithm, to show which features can be better to separate learning style dimensions. The results show several features can be used to predict learning styles with high precision.

KEYWORDS

Learning style, e-learning, MBTI, learner's behavior

1. INTRODUCTION

Today, access to the web and the general use of computers have created several opportunities for e-learning systems, such as fully online and blended learning systems. E-learning environments, like all other tools, offer advantages such as access to different online resources, self-directed learning, and self-paced learning. Despite all the advantages, this kind of learning environment lacks the necessary attractiveness and the dynamic characteristic of the face-to-face learning setups. In other words, it is crucial to pay attention to the human characteristics and use them in the design and development of e-learning environments, aiming to make them more realistic and attractive [1]. This characteristic can give students the sensation that there is a human tutor involved in the process who follows their learning progress and cares about them [2]. Consequently, matching an e-learning environment with individuals' needs and personality characteristics helps them to learn more efficiently, than a system without adaptation to the learners' characteristics. One of the most important characteristics in the learning process is the learning style which can be different between each two students. For example, while a group of students may like to listen and speak, the other prefer to analyze a text, or just listen to a visual media. When students cannot grasp a course's materials, because of a mismatch with their learning styles, they lose their motivation for further learning [3]. This indicates that the better learning takes place when e-learning systems consider the learning style of the students. Thus, an automatic learning style recognition system significantly improves interactive training and learning systems.

Several studies have been carried out in order to consider human characteristics such as learning styles in human computer interaction such as e-learning environments. In 2011, Gong and Wang [4] used support vector machine (SVM) in order to determine learning style in an e-learning environment. Haron suggested a learning system including a learning module which can be adapted to each learner and utilizes fuzzy logic and MBTI personality test [5]. Abrahamian and his colleagues designed a user interface for learners based on their personality type using MBTI test [6]. They considered two dimensions of MBTI in their research. In [7], Bayesian networks is used in detecting the learning style of a student in a tutoring system. In [8], the students' behavior in a web-based course were studied. Results indicated that students with different learning styles use different ways to learn and interact with the course. The authors also presented a framework for automatic detection of a learner's learning style based on the Felder-Silverman model. Fatahi and her

colleagues [9] designed and implemented a virtual tutor and virtual classmate agent that had personality and emotion features similar to a human being. They used the OCC model for emotion modeling and MBTI for personality modeling. The system was tested and the results showed that the learning quality and the learners' satisfaction are improved by incorporating the human features in the interaction with the learners.

As mentioned above, several studies have been carried out in order to consider human characteristics in e-learning environments. Although there have been few studies trying to extract a student's learning style and attempt to adapt the courses to it, none of these studies has taken into account the relationship between learning contents and learning styles. In this paper, we extracted a set of features which are important in determining learning styles from students' behavior automatically based on the MBTI model. The proposed approach uses students' behavioral features during the interaction with a learning content management system. We use clustering methods such as K-means to extract the best features that can distinguish learning style dimensions. In addition, we use MBTI personality type for detecting learning styles of learners whereas most of previous studies focused on Felder-Silverman learning styles.

2. MATERIALS AND METHODS

2.1 Learning Styles and MBTI

According to the Keefe's definition [10], "Learning style consists of cognitive, emotional, and physiological features which are used to recognize how the learner understands the concepts, interacts with the learning environment, and reacts to the environment". There are many questionnaires categorizing each person in line with his/her learning styles [11]; such as Kolb's, Honey and Mumford's [12], GRSLSS's learning styles [12] and Felder-Silverman [13]. In comparison to the other questionnaires, the MBTI has been widely used and validated in the educational sciences [14]. It should be noted that MBTI can be considered as one of the most powerful tools to determine a learner's learning styles.

MBTI is an assessment tool based on the Jung Personality Theory [15]. Based on Jung's personality theory, every person has instinctive priorities that specify their behavior in different conditions [16]. Jung's type theory specifies three dimensions: Extraversion/Introversion (E/I); Sensing/Intuition (S/N); and Thinking/Feeling (T/F). Myers and Briggs added another dimension to Jung's typological model, i.e. Judging/Perceiving (J/P) [17]. These dimensions determined the learner's learning style [17] [18]. Sixteen personality types result from mixing four two-dimensional functions. Individuals are categorized into these types after filling out the questionnaire [19]. For example, people in ESTJ group are all extrovert, sensing, thinking, and judging.

2.2 Research Design

In this paper, we focus on the learning style features that can be obtained automatically through a learner's behavior. In the following, a procedure for extracting the human behavior traits, based on a selected learning style model in an e-learning environment, is proposed here.

//The algorithm for selecting the best online behavioral features, in an e-learning environment, to determine
//learning Style (LS)
//Output: The vector of best online behavioral features for predicting LS
Step 1: Select a learning style (LS) model
Step 2: Determine the behavioral features related to the selected LS
Step 3: Determine the mapping between LS behavioral features and users' behavior in the e-learning environment
Step 4: Data collection
      For all students
         a.   Determine their LS
         b.   Determine features' values based on logged behavior
Step 5: Feature selection
      For each user's behavioral features
        Find the relationship between each set of all dimensions of LS
      For each cluster of all LS dimensions
        If the relationship between LS dimensions and students' behavioral feature is positive
           Add this feature to the vector of best features

In this paper, in the first step of the procedure, we chose MBTI which is an assessment tool related to Jung's personality theory. According to the Center for Applications of Psychological Type [20], MBTI is the most commonly used personality inventory in history, with approximately 2,000,000 people have used MBTI for their personality detection every year. Moreover, the validity of MBTI theory has been widely shown [14] [21] [22]. The MBTI model is chosen and the general human behavior traits of this model related to the selected e-learning environment have been selected. In step 2, for each dimension, a few human behavior traits which are general and independent of the e-learning domain have been selected. These behaviors expressed in the most of studies about MBTI [18] . In step 3, we defined a mapping between LSs and a user's behavior presented through the interaction logs based on psychological studies [18]. Our goal is to define features that can be extracted from e-learning logs which correspond to the LS behavioral features. For example, in the MBTI learning style model, psychologists suggest that extroverts are interested in group working [18]. Consequently, we expect them to have a large number of interactions in group-based and collaborative tasks such as forums, group projects, and team-based homework. In contrast, introverts prefer listening more than talking [18]; hence, it is anticipated that these learners prefer viewing forums and read posts more than writing in forums. The list of the features are presented in table 1.

Table 1. List of features extracted from Moodle

Forums	Homework	Chat	Folder	Other
• The number of viewing discussions • The number of deleting discussions • The number of adding discussions • The number of viewing posts • The number of deleting posts • The number of adding posts • The number of updating posts • The frequency of viewing forums that includes students' discussion • The frequency of viewing forums that includes TA news	• The time of the first view of HWs files since uploading • The upload time of a HW • The number of viewing feedback from a HW • The number of viewing HW file from the second update to last update • The number of viewing homework file since the first to second update • The number of viewing homework file to the first update • The number of times viewing homework solutions	• The number of messages sent • The chat view times **Project** • The frequency of viewing discussion about projects • The time of the first view of project files since uploading • The number of times viewing project files **Quiz** • The number of viewing quiz page • The time of the first view of a quiz since uploading • The time spent on answering quiz • The number of reviews in each question • The number of viewing quiz grade	• The number of times viewing slides of the book • The number of times viewing the chapters of the book folder • The number of times viewing the summery slides folder • The first time viewing the slides of the book • The time of the first book files' view since uploading • The time of the first book chapter folder viewing • The first time viewing the summery slides folder	• The notes view times • The blogs view times • The number of times using the search option • The changing the account password times • The number of times updating the profile • The number of times viewing the units information folder • The number of viewing the final exam sample files • The number of viewing the midterm exam sample files • The first time viewing the exam sample files

In Step 4, in order to find the most important behavioral features to automatically determine the LS dimensions of a student, adequate data should be collected that can show a significant correlation between the behavioral features and the learning styles. Our goal is to select the best behavioral features that can determine the learning styles dimensions. Thus, in step 5, each feature is used to cluster the students into different groups. If the clustered groups highly correlate to a set of learning styles dimensions, then the feature is added to a feature vector suitable for determining the learning styles dimensions of a learner.

To extract the important features based on the features explained in Table 1, we define features based on the context (Context-based Learning Activity Feature or CLAF for short). Since the context of learning activities could impact the interaction of a student with it, the CLAFs are determined considering the context of the activities. For instance, in our study, there were 9 homework in our course with different context resulting into nine CLAFs for a Learning Activity Feature. In our course, we came up with 112 CLAFs.

3. EXPERIMENTS

This study is based on a blended learning environment for the "Introduction to computing systems and programming" (ICSP) course. The course is taught to the first-year students at the school of electrical and computer engineering at the University of Tehran in Iran. The course runs for 18 weeks, and is composed of two lectures and a laboratory part each week. The online part of the course includes general discussion forums, a place to receive and submit homework, download slides and notes, and check grades which are managed through Moodle Learning Content Management System.

To evaluate our proposed algorithm, we have collected data from two hundred and twenty six students who participated in this study. At first, they registered for the course and filled the MBTI questionnaire to determine their learning styles, as our ground truth. However, only two hundred and three of these students filled out the questionnaire. The time student spent to complete the MBTI questionnaire was recorded. The data of students who spent less than three minutes or more than eighteen minutes on the MBTI questionnaire were discarded to avoid contaminating the data with unreliable data. Consequently, data from five students were discarded. Finally, data from one hundred ninety eight students were used in this study. Table 2 shows the learning styles' distribution for all dimensions. In addition, Figure 1 shows the distribution of personality types in each dimension of MBTI.

Table 2. The distribution of the learning styles for the students

Learning Styles	Extroversion	Introversion	Sensing	Intuition	Thinking	Feeling	Judging	Perceiving
Number of Students	69	129	108	90	149	54	106	92
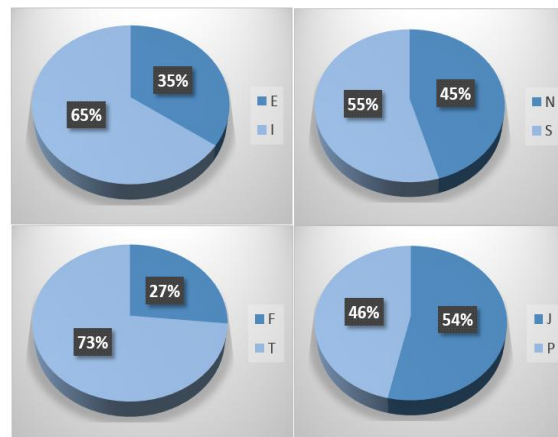
Figure. 1. Distribution of personality types at the school of ECE, University of Tehran, in each dimension of MBTI

Although there are not equal number of people in each dimension, we selected equal number of samples to select best features in each dimensions. if we do not consider equal number of samples in each dimension, the clustering`s results are biased toward the class with more samples.

Total of 35,155 interaction records were collected of the students from the Moodle's log file. Each record includes "time", "IP address", "action", "URL", "info", "username", "first name", "last name" and "email of the corresponding student". The "time" shows the duration of time students did an activity and the "info" includes an id uniquely assigned to the page accessed/used by the students.

4. RESULTS

As mentioned earlier, the data were collected, i.e. the learning styles of the students and their e-learning behavioral interactions with the system, for 198 records of students. As mentioned earlier, in our study, there were 9 homework in our course with different context resulting into nine CLAFs for a Learning Activity Feature. In our course, we came up with 112 CLAFs.

To determine the best features for determining the learning styles, we run many important clustering methods through Weka tools. K-means (k=2) was the suitable method for separating two MBTI dimensions. It seems clear that the k-means is one of the simplest algorithm which uses unsupervised learning method to solve known clustering issues. It is fast, robust and easier to understand. The k-means produce tighter clusters than other methods for example hierarchical clustering, especially if the clusters are globular. It gives best result when data set are distinct or well separated from each other. The disadvantage of the k-means method is predict k-value. In this research, this problem solved because there are two clusters in each dimension of personality type.

Finally, k-means reports the better results rather than others. We run k-means method on all features. Tables 3, 4, 5, and 6 report which features have the high percentage of correctly clustered instances in each dimension in MBTI.

Table 3. The list of context-based learning activity features to determine LSs in E/I dimension

Feature	Personality Dimension	Extroversion	Introversion
The response time of the Quizzes	Precision	0.62	0.63
	Recall	0.66	0.57
	Accuracy	0.62	0.62
	F-measure	0.64	0.60

Table 4. The list of context-based learning activity features to determine LSs in S/N dimension

Feature	Personality Dimension	Sensing	Intuition
The frequency of the folder view (the folders which includes the summery slide about each chapter of the course)	Precision	0.63	0.94
	Recall	0.63	0.42
	Accuracy	0.7	0.70
	F-measure	0.63	0.58
The frequency of the homework solution view (the homework which is about the assembly language)	Precision	0.70	0.59
	Recall	0.44	0.81
	Accuracy	0.62	0.62
	F-measure	0.54	0.68
The frequency of the homework solution view (the homework which is about the assembly language)	Precision	0.70	0.59
	Recall	0.44	0.81
	Accuracy	0.62	0.62
	F-measure	0.54	0.68
The number of times viewing HW_1 file (which is about flowchart)	Precision	0.70	0.59
	Recall	0.44	0.81
	Accuracy	0.62	0.62
	F-measure	0.54	0.68

Table 5. The list of context-based learning activity features to determine LSs in T/F dimension

Feature	Personality Dimension	Thinking	Feeling
The frequency of viewing the forum (that includes the TAs news)	Precision	0.67	0.73
	Recall	0.78	0.61
	Accuracy	0.70	0.70
	F-measure	0.72	0.67
The number of times viewing the units information folder	Precision	1	0.64
	Recall	0.44	1
	Accuracy	0.72	0.72
	F-measure	0.61	0.78
The number of messages sent in the chat rooms	Precision	0.61	0.87
	Recall	0.94	0.39
	Accuracy	0.67	0.67
	F-measure	0.74	0.54

Table 6. The list of context-based learning activity features to determine LSs in J/P dimension

Feature	Personality Dimension	Perceiving	Judging
The time of the first view of the phase 3 file of the project since uploading	Precision	0.65	0.63
	Recall	0.62	0.66
	Accuracy	0.64	0.64
	F-measure	0.63	0.64

This paper aimed at determining the relationship between human behavioral features and learning styles dimensions in e-learning systems. Results in table 3, 4, 5 and 6 show there is a significant relationship between the human behaviors and the learning styles that can help to determine the learning style dimensions of a learner.

Results in tables 3, 4, 5, and 6 indicate that there are features in each dimension of MBTI that are relevant to learners' interaction with the e-learning system. Based on the fact that extroverted people tend to be fast in doing tasks, act quickly and sometimes without thinking, while the opposite is true for introverts. Our result confirms these behaviors because the response time of the quizzes is a feature that can cluster extroverts and introverts. Extrovert students have a high-speed in answering quizzes and do not waste time, but introvert students spend more time for thinking about the quizzes.

Intuitive people attend more to the whole concept than to the details. In contrast, sensing people learn best from an ordered sequence of details, like to know the "right way" to solve problems, and wish to answer homework in details. Our result confirms such behavior. Frequency of folder viewing that includes summary slide about each chapter of the course is a suitable feature for clustering intuitive and sensing people. Results show intuitive people have more tendency to view summary slides than sensing people because they attend more to the whole than the details. Also, frequency of a detailed homework solution viewing, which was Homework 2 in our case, is an appropriate feature to separate sensing and intuitive students. This is because sensing students welcome details, especially difficult subjects such as assembly language which was the subject of the 2nd homework. The frequency of viewing homework solutions, especially related to algorithms and flowcharts, are well-suited features to separate S/N dimension. Sensing people learn best from an orderly sequence of details and love to know the "right way" to solve problems.

Thinking people like specific and logical courses and objective subjects. Feeling people are personal, like warm people relationships, and they are more interested in people than things or ideas. Consequently the frequency of discussion viewing and frequency of posting to forums are the best features to separate feeling students from thinking ones. These features confirm that feeling people tend to interact and relate to other students through forums and discussion rooms. Table 5 shows that feeling students used chat rooms more than thinking people. Since thinking students prefer specific and detailed information, they used and downloaded materials from a special folder that included their program of study charts which explain the courses that the students should take during their four years of study.

While the perceiving people have a flexible lifestyle and do not worry about deadlines, the judging people prefer a systematized life and regulated thoughts and ideas and care about activities which they can do on time. Our results show that the first time viewing files after uploading is a relevant feature that separates judging and perceiving students. Judging students are ordered, organized, and systematic, so they immediately view a file after uploading in the learning content management system.

As the results show, there is one feature which is related to E/I and J/P dimensions while we initially estimated many behavioral features for these dimensions. This is due to the fact that many features, which are detectable in the face-to-face environment, are not detectable in e-learning environment. Consequently, we have a limited number of behavioral features in e-learning environments and the number of features vary based on the each dimension.

5. CONCLUSION

In this paper a set of features suitable for automatically determining the learning style dimensions of a learner is presented. These learners' behavioral features, which have been extracted from the logged interaction of the learners with an e-learning system, have been determined using clustering approaches. We have used the MBTI model for identifying learning styles of students. The automatic recognition of users' learning styles would be an important feature for intelligent tutoring systems' designers to develop adaptive systems capable of adjusting to a user's learning style. If these systems offer courses in harmony with learning styles of students, they have made a substantial progress in the learning process. A significant finding in this paper is

finding a suitable feature vector to determine learning styles of students in automatic way. Furthermore, it has been shown that the context and content play an important role in the learning process based on learning styles.

One limitation of the study is the number and diversity of the participants. Another limitation is the nature of blended learning structure of our e-learning system. Consequently, the students do not show all their behavior through online system and the off-line behaviors are not captured and used for learning style recognition.

The findings in this study can be used as the basis for further research and improvements for providing advanced adaptability, especially in Learning Management Systems (LMS). Future work will deal with automatic student modeling process of learning styles and evaluating its effectiveness in improving the accuracy. Likewise, finding a sequence of human behavior will be of great value in predicting learning style.

REFERENCES

[1] A. Niesler and G. Wydmuch, "User Profiling in Intelligent Tutoring Systems Based on Myers-Briggs Personality Types," in In Proceedings of the International Multi Conference of Engineers and Computer Scientists, 2009.

[2] X. Mao and Z. Li, "Agent based affective tutoring systems: A pilot study," Computers & Education, p. 202–208, 2012.

[3] B. S. Jong, C. H. Lai, Y. T. Hsia and T. W. Lin, "Using Game-Based Cooperative Learning to Improve Learning Motivation: A Study of Online Game Use in an Operating Systems Course," IEEE Transactions on Education, pp. 183-190, 2013.

[4] W. Gong and W. Wang, "Application Research of Support Vector Machine in E-Learning for Personality," in In IEEE International Conference on Cloud Computing and Intelligence Systems (CCIS), 2011.

[5] N. Haron and N. Salim, "Empirical Evaluation of Mixed Approach in Adaptive Hypermedia Learning System," in Postgraduate Annual Research Seminar, 2006.

[6] E. Abrahamian, J. Weinberg, M. Grady and . C. M. Stanton, "The Effect of Personality-Aware Computer-Human Interfaces on Learning," Universal Computer Science, pp. 27-37, 2004.

[7] P. García, A. Amandi, S. Schiaffino and M. Campo, "Evaluating Bayesian networks' precision for detecting students' learning styles," Computers & Education, p. 794–808, 2007.

[8] S. Graf and . T. C. Liu, "Analysis of Learners' Navigational Behaviour and their Learning Styles in an Online Course," Journal of Computer Assisted Learning, pp. 116-131, 2010.

[9] S. Fatahi and N. Ghasem-Aghaee, "Design and Implementation of an Intelligent Educational Model Based on Personality and Learner's Emotion," International Journal of Computer Science and Information Security, pp. 1-13, 2010.

[10] L.-f. Zhang, "Thinking styles and personality types revisited," Personality and Individual Differences, pp. 883-894, 2001.

[11] T. Anderson and F. Elloumi, Theory and practice of online learning (1rd ed.)., Athabasca: Athabasca University Press, 2003.

[12] K. Logan and P. Thomas, "Learning Styles in Distance Education Students Learning to Program," in In Proceedings of 14th Workshop of the Psychology of Programming Interest Group, 2002.

[13] R. Felder and L. K. Silverman, "Learning and Teaching Styles," Journal of Engineering, 1988.

[14] J. Kim, A. Lee and H. Ryu, "Personality and its effects on learning performance: Design guidelines for an adaptive e-learning system based on a user model," International Journal of Industrial Ergonomics, pp. 450-461, 2013.

[15] D. Schultz and S. Schultz, Theories of Personality, Wadsworth publishing, 2008.

[16] T. Dewar and D. Whittington, "Online Learners and their Learning Strategies," Journal of Educational Computing Research, pp. 415-433, 2000.

[17] S. Rushton, J. Morgan and M. Richard, "Teacher's Myers- Briggs personality profiles: Identifying effective teacher personality traits," Journal of Teaching and Teacher Education, pp. 432-441, 2007.

[18] "MBTI Web Page," [Online]. Available: http://www.myersbriggs.org/my-mbti-personality-type/mbti-basics/.

[19] S. Jessee, A. Paula , N. O'Neill and R. O. Dosch, "Matching student personality types and learning preferences to teaching methodologies," Journal of Dental Education, pp. 644-651, 2006.

[20] "Center for applications of psychological type.," [Online]. Available: http://www.capt.org/.

[21] M. Malik and . S. Zamir, "The Relationship between Myers Briggs Type Indicator (MBTI) and Emotional Intelligence among University Students," Journal of Education and Practice, 2014.

[22] V. Rodrı́guez Montequı́n and J. M. Mesa Ferna´ndez,, "Using MBTI for the success assessment of engineering teams in project-based learning," in International Journal of Technology Design Education, 2013.

MAXIMIZING AND PERSONALIZING E-LEARNING SUPPORT FOR STUDENTS WITH DIFFERENT BACKGROUNDS AND PREFERENCES

Olga Mironova, Irina Amitan, Jelena Vendelin, Jüri Vilipõld and Merike Saar

Faculty of Information Technology, Department of Informatics,
Chair of Software Engineering, Tallinn University of Technology, Akadeemia tee St. 15A, Tallinn 12618, Estonia

ABSTRACT

The present paper introduces some strategies used in teaching an Informatics course for non-IT first year university students. The strategies were developed during several years, using the main principles of flexible and blended learning. The methodology has been based on the results of experiments with students from social sciences, economics and technical faculties. Numerous tests were carried out to find out the level of prior knowledge and the preferred learning styles of each student. According to the results, students were divided into separate groups within an e-learning environment.

The authors considered three main aspects: student's background, the level of knowledge and the most suitable style of learning. The success of the experiment presented in this paper is demonstrated by comparing the academic results of the test group who was taught using the new strategy with the reference group, taught in a common way.

1. INTRODUCTION

High level higher education is one of the most important aspects in the social development of a country. How can a learner get it? What can an educator do to provide it? First of all, both parties should be aware and using modern techniques that help raise learning effectiveness.

At present there are so many opportunities to deliver information and knowledge, especially with the help of the World Wide Web. The Internet has quickly spread into all areas of human life around the world. In our country it is impossible to imagine an everyday activity without some e-components: e-government, e-school, e-health, etc. Furthermore, e-learning is also a rapidly developing possibility with various platforms.

The main goal of e-education is to provide knowledge for each learner in the most suitable form. However, huge amounts of information from different sources do not guarantee perfect knowledge. Therefore, educational e-materials have to be carefully selected and structured to provide for the needs of the learners. It is a new paradigm of the present-day education.

In modern times, all information and, as a result, all knowledge is rapidly changing, making it impossible for educators to predict exactly what the contemporary student will need to know tomorrow – on the next level of his study or in their future work. Instead, teachers have to be helping students to develop the necessary habits and skills which would enable students to learn whatever they might need in their future.

At the moment, Informatics is a continuously and rapidly changing subject in the university curriculum. The main purpose of computing courses, therefore, should be to develop computational thinking and skills needed to use the standard PC equipment on an advanced level, as well as to help users understand and follow the latest trends in the field of IT.

The contents of an Informatics course often seem to be inextricable for the first year non-IT students. There are several reasons for it: from low motivation to the absence of the real IT-projects during the first year at the university. Gradually, it has become obvious that IT-courses need to be innovated and the needs of the target audience have to be taken into account: we need more flexible learning possibilities and as much individualization in the teaching process as possible.

2. THE COURSE OUTLINE

The Informatics course under discussion belongs to the curriculum of all specialities and it has been designed for the first year non-IT students. It lasts for two semesters and is taught in three languages.

The main purpose of this course is to develop computational thinking by means of creating applications (using spreadsheets and some programming environments). The learning process starts with processing and analysing data in MS Excel: writing formulas, using built-in functions and drawing charts. The amount and topics of practical tasks and the theoretical material depend on the students' faculty: social sciences, economics, chemistry, civil engineering or mechanics.

In the second part of the course students learn the basics of modelling and programming in practice. Python and Visual Basic for Application (VBA) are the programming languages used.

It should be mentioned that this part of the Informatics course used to be rather complicated for most of the students, especially students from the economics and social sciences departments. Difficulties at the start of programming tasks were solved by implementing graphical programming as an introduction to the course. After several years of experiments we chose the graphical programming environment Scratch as the main tool to introduce the main programming steps (MIT Media Lab, 2015). Scratch is a very intuitive language and greatly helps learners to take on board the main concepts and terms of modelling and programming such as the variable, subroutine, process, branching or cycle.

During the course, we try to use and combine different styles of teaching and learning: the orthodox face-to-face classroom method, pair or group work and, especially, students' independent learning in the e-environment. A learning environment such as Moodle (Moodle Trust, 2015) provides us with a great variety of different additional opportunities which enable making the learning process more flexible and more individual. A major way is the learning pace adjustment and variety in the number of learning assignments, which are based and matched with students' level of knowledge and their learning styles.

3. THE COURSE EVOLUTION

3.1 The Background

Unfortunately, teachers cannot provide all learners with one-to-one tutoring at all educational institutions. However, this fact has not affected the main aim of the educational process – to guarantee high-quality knowledge and modern skills. During the experiments with our course structure and content, we considered the differences in students' characteristics, especially their background (the faculty and the level of prior knowledge) and their preferred learning styles.

Since 2010, a group of lecturers started applying a new approach to the design of the computer science courses. Year by year this approach has become more flexible and adaptive to the nature of every student.

At the beginning, we randomly divide all the students into equal reference and test groups. The division is not linked to the students' specialization. The average number of members in each group is about 100-150; it varies depending on the general number of students. It should be noted that students are not aware of the research. The reference group is taught using the same course materials but these students are not supported with any additional systems. The students of the test group are directed in choosing their e-learning materials based on the data obtained through the tests in the e-environment.

Our intention here is to compare the results of these two groups at the beginning and at the end of the course.

At the beginning of the course the students are tested to find out their level of knowledge in the Informatics subject. Experience has shown that such testing is necessary for the development of the course content. The purpose is to keep track with new times and main trends, as the computer science is one of the fastest-developing sciences (College Board, 2015), (CSTA, 2015).

The nature of the tests for both groups is similar and based on the concepts defined in the European Computer Driving License (ECDL) (ECDL Foundation, 2015). The assignments focus on some principles of the work with the PC, like creating text documents and presentations, handling information using the spreadsheets, and elementary programming knowledge. Tests include both practical and theoretical tasks.

The programming category of the questions was added to the test some years ago and is currently developing rapidly. We bear in mind that a new elective course "Basics of Application Development and Programming" was recently included in the secondary school curriculum in our country and assume that this is already showing the first results.

The current situation of teaching computer sciences at schools in our country is quite discrepant. Some secondary schools do not have informatics lessons at all, in some schools it is taught only for two or three years, which is a very short period to prepare students for the university level. This drawback is associated with two main reasons. The first one being that there is no nationwide Informatics curriculum in our country. The second one is that Informatics subjects are not mandatory in our primary schools. A logical consequence of these reasons is the situation where each primary school teacher introduces learners to the material at his own discretion: certain pupils draw in Paint, others learn the computer hardware in theory, etc.

In connection with this, the level of PC skills among non-IT learners falls every year and reduces to commonplace Facebook usage. The follow diagram (Fig. 1) shows the last year statistics about non-IT testing at the beginning of the Informatics course. The feasible maximum number of points is 100. As can be seen, the level of computer skills is quite low and steadily decreasing.
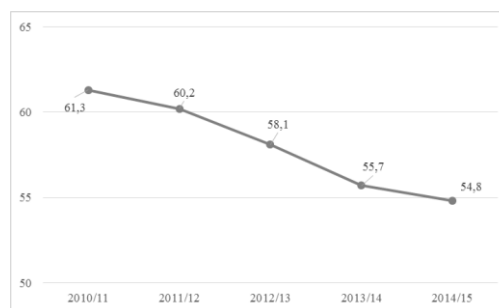
Figure 1. The averages of the beginning test

We are also faced with another problem: school pupils who have obtained sufficient informatics-knowledge at their schools or additional courses often become IT students at university level. Unfortunately, they are not our audience.

In the current work for innovating the Informatics course and individualization of the learning process the authors can name the main strategy – a maximally effective use of the e-environment with its possibilities. E-learning allows modern students (with a personal computer, connected to the internet) to attend the course anywhere and at any time. It is very important to get the material or submit the homework on time regardless of whether the student is or is not at the university.

3.2 E-course

The first phase, which we named "e-course", includes the adaptation of educational materials for the e-environment in Moodle.

Uploading a set of lecture materials and exercises into a learning environment does not ensure that students comprehend it and obtain necessary knowledge. Therefore, in order to make study materials suitable for an e-course all teaching materials (theory as well as materials for practice) were thoroughly revised. Our aim was to provide an effective delivery of the online content. To achieve this goal we aimed at working out a new pedagogical and didactic policy as well as strategies for the new e-course.

Theoretical materials were innovated and supported with learning videos. It should be noted that in our course we use not only video lectures but also short screen-captures, which explain the most complicated tasks. Creating these videos, the authors adhered to the principles of Khan Academy (2015). Practical tasks of the course were reconsidered and supplemented with various group and pair work tasks and also self-tests. These innovations made the Informatics course more dynamic and attractive for our students. Both groups, the test and the reference group got access to this renewed course.

At the same time, we have not abandoned the standard lessons in computer classes. They were held as usual but now we got many advantages. Due to the e-lectures and visual explanations in Moodle we had

more time for practical training in contact lessons. It is necessary to mention that students have no access to practical exercises unless they solve the tests which are based on the theoretical material of each topic. Thereby students come to the lessons already prepared for the practical tasks. Often they get a few small practical tasks in the e-environment and afterwards, in class, they use already ready solutions to solve the bigger tasks.

It is generally known that effective computing is impossible without practice. During face-to-face lessons students work in pairs or groups and are given an opportunity to try the obtained knowledge in practice. Moreover, such kind of work develops teamwork skills, which is very important, especially for the first-year students during their first semester.

In such case, the role of the classical educator is slightly different – the lecturer becomes more of a supporter in the students´ team work of their learning assignments. During contact lessons learners have an opportunity to ask questions related to their homework and share their practical skills and experience with the rest of the group. Practical knowledge transferred in such a way is obtained much faster than in standard lectures. This fact was confirmed by the results of student tests and feedback.

In their feedback students named another advantage of such practical lessons: they have an opportunity to get support or to ask something not only from their teacher but from other students, too. It should be mentioned that this form of support is equally important and useful for both sides: the one who gets it and, especially, for the one who gives it. To detect, explain and, afterwards, to correct a mistake in calculations or in the program code is a substantial practical skill in computer science subjects.

In addition, in an e-environment students get their practical assignments in accordance with their specialities but still united under a common subject topic. For example, students from the economics department get more tasks related to table calculations; social sciences students implement the information filtration, statistics calculations and various requests.

It should be noted that the course materials are organized sequentially and it is not possible to get a new portion of theoretical materials and practical tasks without solving the previous ones. Thanks to checking opportunities in the e-environment, like tests or self-tests, teachers do not have to spend time on routine inspection of the assignments at all. Using the automated checking tools gives students an opportunity to learn within their own pace. They do not have to wait for the feedback on the assignments from the lecturer and his/her manual permission to proceed onto the next level. E-checking systems do it faster and as many times as is needed.

In addition to the aspects mentioned above we and our learners use forums very actively in our course. This way the students get an opportunity for online communication and fast online help. Our aim was to show that they can get support and advice any time, and can also share their ideas, problems and solutions. Through these forums we often get perfect brainchildren for group work and individual assignments.

Another advantage that non-IT students have when they participate in the e-course is that their technical skills improve.

Transition to the Moodle e-environment gave our educators an opportunity to follow students´ progress and it became fairly easy to get the statistical data of different samples for analysis, development and improvement of the implemented learning methods.

It makes no sense now to recount all the advantages that we achieved during the first stage of our modification of the course. Such benefits have already been systematized and described in detail in different sources (Broadbent, 2002). However, we would like to mention the first positive results of our work: students' feedback and increase in academic achievements. The data was extracted from an e-environment, where students and teachers get information about the courses and curricula, students declare courses, keep results and give anonymous feedback on their educational process. The authors do not present specific data in numbers in this paper because the transition of the course into e-learning took place a long time ago.

3.3 Prior Knowledge

Starting from the second stage, which the authors entitle "prior knowledge", experimental work takes place only with students from the test group. The students of the reference group are taught as usual.

At the beginning of the course we start with dividing the students into three e-streams based on their readiness for Informatics subjects. This division was realized through an e-test and implemented in the Moodle environment. The students, however, were not aware of the experiment.

In the described division we proceeded from the level of students' knowledge required to start the course. Those students whose e-test results are more than 85 points we named "experts"; "advanced users'" result is between 60 and 80 points, other students are called "beginners".

The named groups of students receive different amounts of practical and theoretical tasks in Moodle, with different levels of difficulty. To move to the next topic the mandatory set of exercises has to be solved. In the e-environment, the "beginners" and "advanced users'" have to solve their sets of tasks before they get access to "experts'" exercises – the main material of the course curriculum. "Advanced users" solve their tasks and can proceed to the main topics.

These additional sets of tasks are catered for exactly what learners need to know for the current Informatics course. Students do not need to pay for any additional IT-courses and they get all the materials and assignments centrally, in one place – the Moodle e-course, in parallel with their main studies.

To automate and speed up the checking of the increased number of tasks we have developed a special e-tests system.

Thereby, we could increase the amount of practical assignments for students with different levels of readiness without increasing the subject hours and students' load. This stage of the course innovation gave us an appropriate level of the students' readiness for face-to-face lessons.

The above mentioned method provided our Informatics teachers with actual and important information about what the learners knew before starting the course. Every year we get an overview of the current situation of Informatics subjects at secondary schools in our country. Moreover, according to the results, we are able to provide students with the necessary learning materials.

3.4 Learning Style

The third part of our innovation experiment with the course modification is the "learning style" phase and it was also realised in Moodle. This stage is a continuation of the test group's students division into groups. There is a lot of research about the individualization of learning depending on students' abilities (Kolb, 1984), (Palmer, 2011), (George Lucas Educational Foundation, 2014). In our course Felder-Silverman model was picked out as the basis for the distribution (Felder & Spurlin, 2005), (Felder & Brent, 2005). In this stage we could maximize the use of the Moodle e-opportunities.

Learning styles are characteristic cognitive, affective, and psychological behaviours that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment. Students learn best when instruction and learning context match their learning style.

Depending on their learning style, Felder differentiates between the following groups of learners:
- active and reflective
- sensing and intuitive
- visual and verbal
- sequential and global.

For better comprehension of the topic we give a brief description of the learners' types.

Active learners acquire new knowledge best by doing, discussing and explaining it to others in a group. At the same time reflective learners first think about it alone.

Sensing learners like learning facts and solving problems by well-known methods. Intuitive learners prefer discovering new possibilities and relationships and they are more innovative.

Visual learners remember pictures, diagrams, charts and videos best. Verbal learners prefer written and spoken explanations.

Sequential learners like step by step studying, where each step follows logically from the previous one. Global learners prefer to get information by large portions and randomly.

Through a test, we learned that the majority of our course participants in the test group were active and visual learners and they had very strong preferences for their learning process. These preferences were detected according to the Felder test, which was held at the beginning of the course. It should be noted that each year the number of active and, especially, visual students increases (Fig. 2).
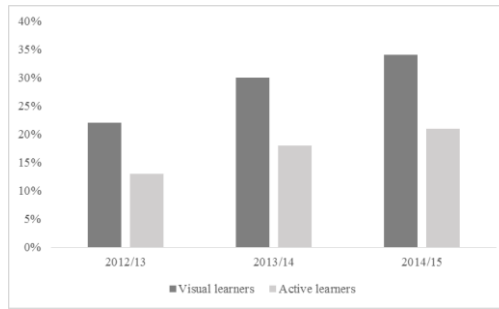
Figure 2. The increase of the number of the visual and active learners

Throughout the educational process, students were provided with necessary learning materials and activities in accordance with Felder's instructions.

For example, active learners automatically received more group work and opportunities to help others – they could check and correct other students´ work and assignments in Moodle; they answered questions in the e-course forums and took the role of a tutor in face-to-face classes. It should be mentioned that they did it with pleasure. For visual learners, a great variety of visual representation of the educational materials (that was already mentioned above) was provided. Interests and preferences of the other types of learners were also taken into account.

4. PROGRAMMING BASIS FOR VISUAL LEARNERS

As mentioned above, the majority of the course participants are visual and active learners. For visual learners it is very important to see "how it works" and for active – "to try it out". In the most complicated module of the Informatics course, programming, we found a solution – maximum visualization.

Our introductory module, with Scratch as the main tool with its graphical elements, is already perfectly visualized. Scratch´s dynamics and attractiveness helps visual students to understand the main ideas of the created applications. Working in this programming environment, active learners can manually modify some program elements and immediately see the result. Moreover, there are no syntax mistakes in Scratch that greatly facilitates the programming process. Therefore, introduction to programming in our course has already been visualized (Fig. 3).

The next module, VBA or Python, is rather complicated for non-IT students. What can be visualized there?

VBA already has a built-in visualising tool: students can follow the code execution using the Locals Window (Fig. 4). The named window automatically displays all the declared variables in the current procedure, their names, types and values in the real time. When the Locals Window is active and visible, it automatically updates during the time the program is running – visual students can follow the code and check each step and its result in their applications, especially if they run programs in step-by-step mode.
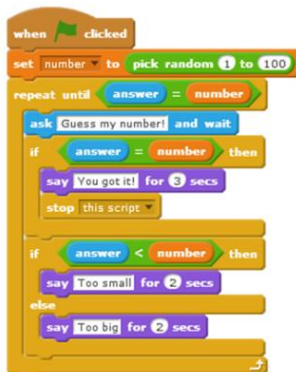
Figure 3. Scratch program
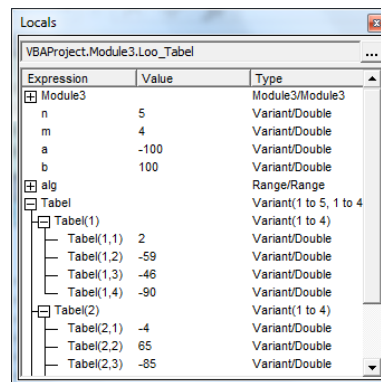
Figure 4. VBA visualizing tool – Locals Window

78

Besides the Locals Window it is possible to use the Immediate Window to reach the same goal: check and correct mistakes and understand the program structure.

Unfortunately, Python does not have such an opportunity, but in spite of this, it still needs to be visualised for the beginners in programming. Therefore, we introduce the Online Python Tutor to our students. Using this internet application they can follow each step of their program code and check the variables' values, types and the order of the operators during the execution. It has to be mentioned, though, that the online tool has some drawbacks, as it does not support the Python graphics, time functions and files processing. However, for the beginners in coding the application gives an understanding of the main principles of program construction and code execution (Fig. 5). There have been cases when students started to write the program not in Python environment but directly there, on the internet.
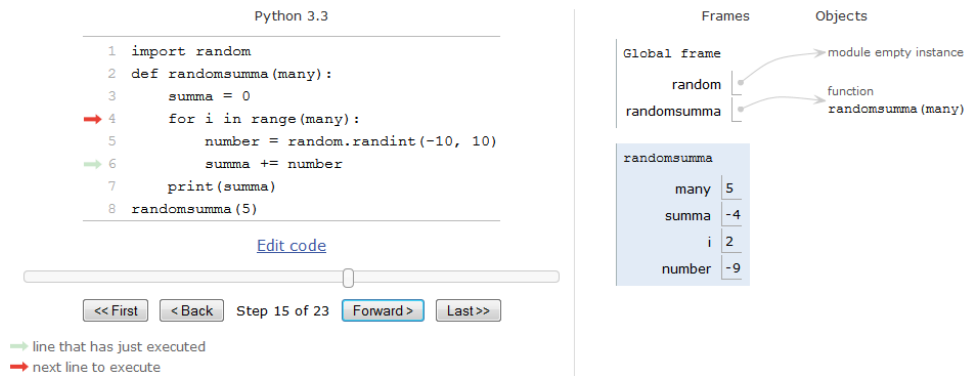
Figure 5. Python visualizing tool

Using these online and built-in tools we could raise the interest to programming among the non-IT students in the second part of the Informatics course.

5. COMPARING THE RESULTS

Figure 6 shows the results of both groups´ tests at the beginning and at the end of the course. The possible maximum number of points is 100.
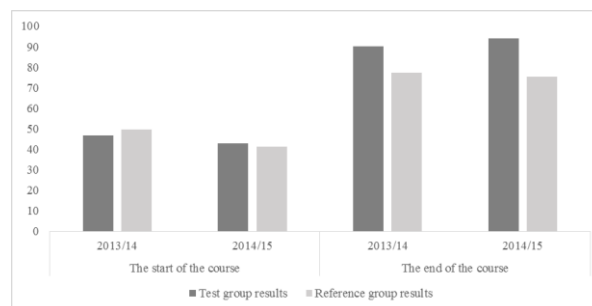
Figure 6. The testing results of the both groups

As can be seen, the average test results of the reference group students are high enough - approximately 76 points, but test group students' average results are 16 points higher – about 92. The given outcomes confirm the topicality of our research and the suitability of the chosen method of the course innovation.

6. CONCLUSIONS

During the process of upgrading the Informatics course, we were able to create a model of individualization of the educational process in an e-environment, which considers the level of students´ prior knowledge and their preferences in the learning process (Fig. 7).
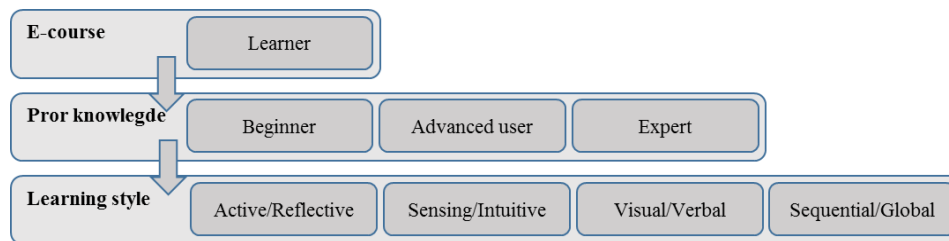
Figure 7. The model of the course

Applying this model, we try to find an individual approach to each student in our e-course and make it more flexible.

The experiment results, presented in the article, show positive outcomes of the strategy and suggest that there are no unreachable aims in an educational process. The authors intend to continue with the created model and develop the Informatics e-course for non-IT students in the chosen direction, trying to maximally adapt it to students with different preferences.

ACKNOWLEDGEMENT

REFERENCES

Broadbent, B., 2002. *ABCs of e-Learning: Reaping the Benefits and Avoiding the Pitfalls.* 1st ed. NY: John Wiley & Sons, Inc.

College Board, 2015. *AP Computer Science Principles.* [Online] Available at: https://advancesinap.collegeboard.org/stem/computer-science-principles [Accessed 4 5 2015].

Computer Science Teachers Association, 2015. *Computational Thinking Task Force.* [Online] Available at: http://csta.acm.org/Curriculum/sub/CompThinking.html [Accessed 2 5 2015].

ECDL Foundation, 2015. *ECDL Foundation.* [Online] Available at: http://www.ecdl.com [Accessed 1 5 2015].

Felder, R. & Brent, R., 2005. Understanding Students Differences. *Journal of Engineering Education,* 94(1), pp. 57-72.

Felder, R. M. & Spurlin, J. E., 2005. Applications, Reliability, and Validity of the Index of Learning Styles. *Intl. Journal of Engineering Education,* 21(1), pp. 103-112.

George Lucas Educational Foundation, 2014. *Project-Based Learning.* [Online] Available at: http://www.edutopia.org/project-based-learning [Accessed 24 11 2014].

Khan Academy, 2015. *Khan Academy.* [Online] Available at: https://www.khanacademy.org/ [Accessed 3 5 2015].

Kolb, D., 1984. *Experiental Learning.* Engle Cliffs: Prentice Hall.

MIT Media Lab, 2015. *Scratch - Imagine, Program, Share.* [Online] Available at: http://scratch.mit.edu/ [Accessed 6 5 2015].

Moodle Trust, 2015. *Open-source learning platform | Moodle.org.* [Online] Available at: https://moodle.org/ [Accessed 6 5 2015].

Palmer, S. R., 2011. The Lived Experience of Flexible Education – Theory, Policy and Practice. *Journal of University Teaching & Learning Practice,* 8(3).

USABILITY OF A WEB-BASED SCHOOL EXPERIENCE SYSTEM: OPINIONS OF IT TEACHERS AND TEACHER CANDIDATES

Zülfü Genç

Firat University
Faculty of Education, Department of Computer Education and Instructional Technology, 23119, Elazig, Turkey

ABSTRACT

With advances in information and communication technologies, the classical nature of educational institutions has changed. One innovative effort within teacher training is the Web-Based School Experience System (WBSES) developed by the researcher. In this study, the usability of an existing WBSES is evaluated from both teachers' (n = 13) and students' (n = 96) perspectives. A non-experimental survey method was applied to collect participant opinions. A usability questionnaire was designed, and analysis yielded five significant factors for the system: usefulness, helpfulness, visual effectiveness, customizability, and smoothness. To obtain more in-depth information, participants were asked to delineate their responses to five open-ended questions. Generally, students and teachers liked the tool in terms of its usability, but they also provided recommendations for design issues.

KEYWORDS

School experience, teaching practice, teacher training, web-based learning environments, usability

1. INTRODUCTION

Qualified human resources are imperative for modern societies to function and keep pace with the changing age. Teachers have a leading role in educating these human resources, socializing and preparing future generations by transferring culture and values to them (Özden, 2005). The future of any country depends on the competence and success of its teachers (Ataünal, 1997). Teachers shape human behaviors, making this profession both important and challenging. They are expected to be proficient in subject knowledge and content, teaching plans, general and specific teaching methods, and technology, requiring substantial education. Teacher training has been described as "a systematic program arranged for improving knowledge, skills and attitudes of teachers related to teaching and classroom activities" (Rıza, 1996). In Turkey, important decisions have been made about teacher training, especially at the National Education Council, and the coordination of teacher training has been assigned to the education faculties of universities.

Teacher training has two components in Turkey: theory and practice. School Experience and Teaching Practice are two essential courses that allow teacher candidates to develop knowledge, skills, and attitudes related to their profession. Fourth year education students gain their first teaching experience with these courses. The School Experience course takes place in the seventh semester and consists of one hour of theory and four hours of practice each week. In practice hours, teacher candidates observe at schools, learning about the environment and teaching. They also create lesson plans, notes, and other materials.

In order for teacher training to be effective, the most important factor is cooperation between the faculty and the practice school. Effectively putting the theoretical and occupational knowledge of teacher candidates into practice is the fundamental objective of this course (Ağaoğlu and Şimşek, 2006). Therefore, cooperation between faculties, school administrators, course instructors, and teachers is quite important to its success. Known cooperation problems include an insufficient number of faculty members to mentor teacher candidates, weak communication between the faculty and practice school, a lack of meeting hours between teacher candidates and course instructors, lack of cooperation between department coordinators and practice school coordinators, and lack of program compliance (Şahin, 2004; Turgut, Yılmaz, & Firuzan, 2008). In a

study conducted in the Department of Computer Education and Instructional Technologies at Anadolu University, Dursun and Kuzu (2008) grouped such problems and their solutions under four sub-sections: consultation, communication, evaluation, and program. In order to eliminate these problems, close and effective cooperation between the faculty and practice schools should occur. A web-based learning model may be a possible solution for improving cooperation in School Experience and Teaching Practice courses, as all processes could be easily conducted and monitored.

A web-based learning environment supports and develops rich, flexible, and interactive activities by using the Internet, an intranet, or other technology components linked to a local network (Şendağ, 2008). Few studies have investigated the use of online or web-based systems in teacher training. In one experimental study, Liu (2005) concluded that a web-based cognitive apprenticeship model was more effective than a traditional teacher training course in terms of pre-service teacher performances and attitudes related to instructional planning. According to Barnett, Keating, Harwood, and Saam (2002), when pre-service teachers learn how to be good teachers in university-based courses, web-based conferencing provides further opportunities to interact and reflect with in-service teachers. In a study where a web-based learning model was used with teacher candidates from the English Language Teaching department of Anadolu University, Caner (2009) found that the model increased meeting hours between teacher candidates and instructors and formed a more productive learning environment by increasing peer feedback quality. The usability of web-based learning environments is very important to their acceptance by teachers and students. A central requirement is ease-of-use with minimal training. Usability refers to user interfaces and has five quality elements: learnability, efficiency, memorability, errors, and satisfaction (Nielsen, 2012). The ultimate goal of computer-based systems is tied closely to their usability and usefulness (Harms & Adams, 2008).

The aim of the current study is to offer recommendations for developing better web-based learning environments in higher education institutions by analyzing the usability of the WBSES, which is already in use at Fırat University. The study seeks to increase the effectiveness of the School Experience and Teaching Practice courses included in the curriculum of the education faculties by using a Web-Based School Experience System (WBSES) developed by the researcher. To this end, the system was tested with 96 fourth year students of the Computer and Instructional Technologies department of the Education Faculty of Fırat University and 13 Information Technologies teachers in Elazığ. The opinions of the teacher candidates and practice school teachers on the use of the WBSES were collected through a non-experimental survey method. The following research questions will be investigated in the current study:

1.   What are the opinions of the teacher candidates on the use of the Web-Based School Experience System for the Teaching Practice course?

2.   What are the opinions of the practice school teachers on the use of the Web-Based School Experience System for the Teaching Practice course?

3.   What are the satisfaction levels of the teacher candidates with the Teaching Practice course that applied the Web-Based School Experience System?

2.   WEB-BASED SCHOOL EXPERIENCE SYSTEM (WBSES)

The general objective of the developed system is to provide an environment where all stages of the School Experience and Teaching Practice courses can be conducted through the Internet. The most important users of the system are the course instructors, practice school teachers, and teacher candidates. Access for these users is under the control of a program manager. This user assigns and connects schools, teacher candidates, school practice teachers, and course instructors. Course instructors conduct operations for their assigned teacher candidates, practice schools, and practice school teachers; practice school teachers conduct operations related to their teacher candidates. The program manager is the highest level user and has the following permissions: checking information related to faculty and department, matching teacher candidates to practice schools, assigning roles to users, authorizing user information, and creating questionnaires. The course instructor has the following permissions: updating personal information, arranging groups, accessing the videos and documents of teacher candidates, administering end-of-semester questionnaires, and monitoring attendance. Practice school teachers have similar permissions to the course instructor. Finally, teacher candidates use the program to share documents and videos and fill out forms and questionnaires.

3. METHOD

The study aimed to determine the opinions of teacher candidates and practice school teachers about the use of the Web-Based School Experience System (WBSES) in the School Experience and Teaching Practice courses and was conducted via non-experimental survey. Qualitative and quantitative data collection were completed concurrently. Fraenkel and Wallen (2000) have identified three important problems related to such studies: (a) clarity of study questions, (b) honesty of self-reported answers, and (c) sufficient sample size. The first issue was resolved with factor analysis and a content validity check by field experts and linguists, and an assumption was made that participants would be honest in their answers, addressing the second problem. Elimination of the third problem was verified through statistical analysis of the data.

3.1 Participants

The participants included all teacher candidates attending the School Experience course offered by the education faculties of Turkey and their practice school teachers. According to Fraenkel and Wallen (2000), in situations where randomized or systematic sampling is not possible, researchers should use accessible sampling. Therefore, the researcher formed the sample with teachers and students in Elazığ to which he had ready access.

Table 1. Types of education and gender

	Gender		
Education Type	Male	Female	Total
First Program	20	28	48
Second Program	12	36	48
Total	32	64	96

As seen in Table 2, the majority of participants had their own Internet-connected computers. Most of the participants reported logging in to the system at least 15 times.

Table 2. Computer ownership and use of WBSES

	WBSES Use				
Have computer	5–10	10–15	15–20	More than 20	Total
Yes–with Internet connection	1	13	15	32	61
Yes–without Internet connection	1	4	17	9	31
No computer	0	3	1	0	4
Total	2	20	33	41	96

The opinions of IT teachers in the practice schools (n = 13) were also collected. Among these teachers, eight were female and five were male. Except one, they all had their own computers with Internet connections. The WBSES was accessed more than 20 times by five teachers, 15–20 times by two, 10–15 times by five, and 5–10 times by one.

3.2 Data Collection Tools and Analysis

The first draft of the WBSES attitude scale was compiled based on studies investigated during the literature review. Since no appropriate scales were found, the researcher developed a new attitude scale for the WBSES. The item pool of the scale consisted of 57 items. After a language check, content validity was conducted based on the opinions of field experts. Participants were asked to complete a five-point Likert scale ("strongly agree" to "strongly disagree"). Four demographic questions were also added to the scale about participant education type, gender, computer ownership, and system-use frequency. In addition, the following five open-ended questions were asked to collect detailed data:
1. What are your opinions (visual design, navigation, etc.) of the WBSES?
2. What are your three most liked features of the WBSES?
3. What are your three most disliked features of the WBSES?

4. Did any functions cause trouble while using the WBSES? If so, which ones, and why did you have trouble?
5. Which features do you believe aid ease of use of the WBSES? Why?

In order to determine satisfaction levels of teacher candidates, the 11-item Web Based Teaching Practice Course Satisfaction Survey was adapted from Chejlyk (2006).

Required permissions to implement the questionnaires were taken from the education faculty of Fırat University and the Ministry of Education. All participants were informed about the developed system and process. At the end of the semester, the questionnaire was distributed on a voluntary basis to practice school teachers and teacher candidates using an online survey system (www.questionpro.com). Results were transferred to SPSS, and the frequency distribution of demographic information was calculated. Moreover, factor and validity analysis (Cronbach's alpha) were conducted on the 57-item questionnaire. After the modification of the scale, average and standard deviation calculations were completed.

Tests related to the demographic features were also conducted. Education type (first or second education) and gender were tested by an independent sample t-test to reveal differences. In addition, gender was tested with an independent sample non-parametric Mann-Whitney U test, since no normal distribution existed due to the number of participants. An independent sample single factor analysis of variance (ANOVA), a parametric test, was used to determine possible differences between teacher candidates in terms of having a computer (with Internet connection, without Internet connection, or no computer); teachers were tested with an independent sample Kruskal-Wallis H test, a non-parametric test. To determine where possible differences occurred, necessary post-hoc tests were conducted. An ANOVA was also used to determine possible frequency differences between teacher candidates in terms of WBSES use (5–10 times, 10–15 times, 15–20 times, more than 20 times); results were tested with an independent sample Kruskal-Wallis H test, a non-parametric test. To determine where possible differences occurred, necessary post-hoc tests were conducted. The five open-ended questions were investigated by qualitative techniques, and frequency distributions were calculated.

4. FINDINGS

4.1 Factor Analysis of the Attitude Scale of WBSES Use

The student questionnaire had 57 five-point Likert questions ("strongly disagree" to "strongly agree") answered via an online survey after finishing their exams. After the final data set, the questionnaire was checked by factor analysis. First, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were conducted. According to George and Mallery (2001), the KMO measure tests whether the distribution of values is sufficient for conducting factor analysis, and the coefficient should be greater than 0.60. Moreover, George and Mallery clarified that Bartlett's test of sphericity must be statistically significant as a measure of the multivariate normality of distribution. The KMO coefficient was found to be 0.87, and the approximate $X2$ (595, n = 95) was equal to 2525.350, p < .00. Since the tests were positive, factor analysis continued.

The dimensionality of the 57 questions from the usability evaluation was analyzed using principal component exploratory factor analysis. Four criteria were used to determine the number of factors to rotate: the a priori hypothesis that the measure was unidimensional, the Cattell scree test, the variance explanation, and the interpretability of the factor solution. The scree pilot indicated that the initial hypothesis of unidimensionality was incorrect; there were five breaking points. After fifteen items were reduced by factor loadings and eigenvalues and when the interpretability criteria and total variance explained criteria were taken into consideration, five factors were rotated using a Varimax rotation. The rotated solution yielded five interpretable factors: usefulness, helpfulness, visual effectiveness, customizability, and smoothness. At the end of the factor analysis, the inter-reliability of each factor was calculated. Table 3 shows the coefficient alpha values for each factor, as well as all items in the questionnaire.

Table 3. Coefficient alpha values for each factor and all items

Factor	Number of items	Coefficient alpha
Usefulness	12	0.94
Helpfulness	6	0.90
Visual effectiveness	4	0.90
Customizability	6	0.85
Smoothness	4	0.78
Total	32	0.96

4.2 Student Usability Concerns about the WBSES

fter factor analysis, a WBSES questionnaire was created with five dimensions; usefulness, helpfulness, visual effectiveness, customizability, and smoothness. Researchers checked each item to calculate minimum and maximum scores, means, and standard deviations. Afterwards, to determine whether the number of times using the tool made a significant difference on usability perceptions of students, a one-way ANOVA test was conducted on the data set.

When the first dimension, usefulness, was statistically analyzed, mean scores varied from 3.57 to 4.08; in other words, students were satisfied with the usefulness of the system. The lowest score (M = 3.57) belonged to the item, "The video panel in WBSES (the video showing me while lecturing to be watched by my friends and teachers) made me active in the lesson." For helpfulness, the mean scores ranged from 4.12 to 4.35, which confirmed that students were satisfied. Visual effectiveness scores ranged from 4.14 (the background color and text color were consistent) to 4.27 (overall visual attractiveness). Font, background color, and font color (M = 3.62) were acceptable to students, and the font color and background color were considered harmonious. Customizability mean scores ranged from 3.94 to 4.40, also indicating satisfaction. Students felt that their existing computer knowledge was sufficient to use the system (M = 4.40). Smoothness scores ranged from 3.40 to 4.36, and login and logout (M = 4.36) processes were easily managed.

To gather more in-depth information, students were asked five open-ended questions. The first question involved overall ideas about the system (see Table 4). The majority of students (n = 59) described the system as visually good. Moreover, they felt the WBSES was useful (n = 18), easy to navigate (n = 12), and simple in design (n = 11). One male student offered his impressions of the system: "I think it is a good system. Although we set up mail groups, which were unsuccessful, this system was successful. The system having a good visual design and easy navigation was especially effective in assignment uploading and filling out questionnaires." The students also expressed complaints about the system (see Table 5). Negative comments were made about site navigation (n = 12) and the design of the system (n = 7). A female student observed, "Visual design of the system is good, but links not working when navigating through the system is a problem which can be solved easily. Moreover, the plug-ins needed to upload a document can be bothersome." WBSES, though liked very much in terms of visual design by some, was not liked by others (n = 5). A male student expressed: "WBSES has a good design and appearance in general. However, I think the system is not useful because one time I forgot my password, but the feature for resetting the password was not working. I solved the password problem with the support of the system manager."

The second open-ended item asked for the three points that students liked most about the system (see Table 6). Answers included visual design, user-friendliness, the questionnaire, video and assignment upload capabilities, and online support. In the third question, students were asked what they did not like about the system (see Table 7). Six students expressed that there were no features that they disliked, while others complained about the uploading features, especially in terms of videos. Complaints were also made about accessing and staying connected to the system, as well as experiencing failure with different browsers. In addition, broken links were a problem. One male student explained, "The system does not allow uploading videos directly but through the YouTube links. The other thing I disliked is the requirement to log into the system frequently. The last problem with the system is that uploading long videos into the system was not possible." In the fourth open-ended question, students identified processes they felt hard to manage (see Table 8). Many students (n = 23) experienced no difficulty with the tool. On the other hand, nearly half of the students had trouble uploading videos. In addition, students reported trouble with forgotten passwords, and three students had trouble accessing the system. The fifth question asked about processes students completed easily in the system (see Table 9). Generally, students mentioned navigation, uploading assignments, and filling out questionnaires.

Table 4. Positive opinions of teacher candidates about the use of WBSES

Qualitative code	Frequency
A visually good system	59
Useful system	18
Easy navigation	12
A simple design	11
Color harmony	5
Good content	2
Assignment upload	2
Site manager	2
Videos	2
Interesting	1
Easy to search	1
Questionnaires	1
Menu structure	1
Similar to Web 2.0 tools	1

Table 5. Negative opinions of teacher candidates about the use of WBSES

Qualitative code	Frequency
Problematic navigation	11
A need for improving the design	7
Not useful	5
Decreases in performance	4
Problematic color matching	3
Complex system	3
Assignment upload	3
Needs for installation of some plug-ins	2
Turkish character problem	1

Table 6. Most liked features of WBSES according to teacher candidates

Liked features	Frequency
Visual design	35
User friendliness	25
In-site navigation	16
Questionnaire property	16
Video upload	14
Assignment upload	14
Online support	13
Simplicity	12
Video watching	10
Colors	10
Quick work	7
Attendance	6
Support for teaching practice	6
Easy access to the system	5
Peer evaluation	2
Effective searching	2

Table 7. Most disliked features of WBSES according to teacher candidates

Disliked features	Frequency
Video upload	30
Logging out from the system	21
Assignment upload	17
Access to the system	14
System errors	13
Broken links	12
Password problems	10
Visual design	8
Filling out questionnaire	7
Color matching	4
Font size	3
Problems with different browsers	2
Photograph upload	1
Lecture content	1
Lacking of chat feature	1

Table 8. Problems experienced with the WBSES by teacher candidates

Problems experienced	Frequency
Video upload	41
Assignment upload	21
Getting user password	9
Filling out questionnaire	7
Access to the system	3
Navigation through the links	2
Working with different browsers	1

Table 9. Ease of using WBSES features

Ease of use	Frequency
Navigation	17
Assignment upload	13
Questionnaire use	12
Video upload	8
Membership system	5
Visual design	5
Fast working	4
Contact with the system manager	3
Attendance check	2
Access to the system	2
Video watching	1
Simplicity of the interface	1

4.3 Practice School Teachers' Usability Concerns about the WBSES

The teacher questionnaire included 32 questions, but because only 13 teachers responded, it could not be factor analyzed. On the other hand, since it asked the same questions (except student-oriented questions), it was still used. The 13 teachers who responded used the system approximately one hundred times. In general, all instructors had positive ideas about the login and logout processes and noted that the tool was easy to learn. They were moderately satisfied with the visual screen design. Mostly, they reported no problems using the system.

The teacher questionnaire also included five open-ended questions:
1. What is your overall opinion about the tool?
2. List the three features of the tool that you liked most.
3. List the three features of the tool that you liked least.
4. When you used the tool, were any processes difficult? How so?
5. When you used the tool, were any processes completed easily? How so?

Five teachers expressed that the system was useful, and six teachers considered the system good in terms of visual design. Moreover, six teachers expressed that the system was successful in terms of color harmony. Four teachers felt the system had easy navigational features. Only one teacher had negative opinions about the design. One female teacher expressed, "The design and color matching in the system are really nice. The web-site was useful and I can do all the operations easily." The most liked feature by the teachers was the attendance panel. Three teachers liked the video features best, including uploading capabilities and watching student contributions. One teacher expressed that the system was very useful in that it allowed students to realize their mistakes by watching videos. The other most liked feature was the ability to create questionnaires (n = 7). Another teacher liked the visual design, response time, web mapping, and access to the faculty instructor in the system.

Among 13 practice school teachers, 9 expressed that there were no features that they disliked. One teacher did mention early problems that were resolved over time. One teacher expressed a complaint about broken links, while another did not like the content arrangement. In the fourth open-ended question, nine teachers noted that they experienced no problems. One teacher said that after accessing the system, he did not see the expected screen. Another teacher described problems with the attendance feature, since there was no grouping according to date. In addition, one teacher complained about a failure sending messages. Two teachers did not answer the last question, while five said that all features of the system were user friendly. One teacher said that he liked working without paper, and another expressed that he easily completed all operations without the need to refresh the page. One teacher commented, "In general, there are features that make the system user-friendly. Especially, I found the access panel and design of the system successful. In addition, navigation between the pages was very fast and stable."

4.4 Teacher Candidate Satisfaction Levels with the WBSES

The averages and standard deviations of answers given by teacher candidates about the WBSES course conducted through the web are shown in Table 10. The satisfaction levels are grouped under four headings: overall satisfaction, contribution to professional development satisfaction, feedback satisfaction, and online communication and interaction satisfaction.

Based on these results, teacher candidates were generally satisfied with the course. The responses of teacher candidates to item 6 showed that 75% were satisfied and 14.29% were strongly satisfied with the web-based school experience course, and 85.72% of participants strongly agreed that they would recommend the course to others. Analysis revealed that 82.14% of participants considered this course as effective as face-to-face courses. According to results, teacher candidates were satisfied with the contribution of this course to their professional development. They also expressed that course documents, lesson plans, and lesson practice videos facilitated their learning and that this web-based course was as useful as a face-to-face course. The teacher candidates' responses to the satisfaction survey showed that they were satisfied with the timely feedback from their teachers and the system manager. In terms of satisfaction with online communication and interaction, participants believed that this course provided a sense of community among the students.

Table 10. Satisfaction levels of teacher candidates with the WBSES

Question Item	N	Average	S.D.
Overall Satisfaction			
6. I am very satisfied with this web based school experience course.	96	4.04	0.50
9. I would recommend this course to others.	96	3.79	1.13
11. I feel the web-based school experience course is as effective as face-to-face courses.	96	3.68	0.81
Contribution to Professional Development Satisfaction			
1. The course documents, lesson plans, and lesson-practice video files used in this class facilitated my learning.	96	3.71	1.01
3. The materials that were linked to this course facilitated my learning.	96	3.82	0.54
7. I feel this web-based school experience course improved my teaching skills.	96	3.86	0.50
10. I learned at least as much as I would have in a face-to-face course.	96	3.86	0.80
Feedback Satisfaction			
2. I received timely feedback from my teacher and system administrator.	96	3.75	0.84
Online Communication and Interaction Satisfaction			
4. This course created a sense of community among students.	96	3.79	0.68
5. In this class, I was able to share my viewpoint with other students.	96	3.86	0.75
8. This web-based teaching experience course encouraged students to discuss ideas and concepts with other students.	96	3.68	0.86

5. DISCUSSION AND SUGGESTIONS

Literature related to teaching practices reveals that teacher candidates often encounter problems with sufficient feedback and meetings with course instructors. Lack of cooperation between the faculty and practice school and inadequate duration of implementation are other known problems. A solution should be found to eliminate these problems in order for teaching practice courses to be effective. To this end, a web-based system to be used in teaching practice and school experience courses was developed in the first stage of this study. In the second stage, usability analysis of the system was conducted by collecting the opinions of practice school teachers and teacher candidates. Moreover, satisfaction levels of teacher candidates related to web-based learning were investigated in order to determine whether the system met learning needs. The study primarily focused on the design, development, usability, and formative evaluation of a teaching practice course conducted through a web-based system.

The majority of the users defined the system as having high usability. Moreover, the teacher candidates expressed that system managers having an active role in the system increased usability. They expressed that the system contributed to the course and met their learning needs. The opinions of the teacher candidates towards the WBSES was positive. They believed that having taken the course with this model contributed to their professional growth. In summary, the web-based teaching training model increased course effectiveness, enhancing the performance and experience of the teacher candidates.

The web-based system in the current study was tested with students from the Computer and Instruction Technologies department and IT teachers with high computer knowledge. Therefore, this study should be repeated with students from other departments in order to investigate the attitudes of teachers and teacher candidates with less computer experience.

REFERENCES

Ağaoğlu, E., & Şimsek, Y. (2006, October). *The collaboration between education faculty and schools in Turkey.* Paper presented at the 31st Annual Conference of Association for Teacher Education in Europe, Portoroz, Slovenia.

Ataünal, A. (1997). *Türkiye'de ilkokul öğretmeni yetiştirme sorunu (1923-1994) ve ABD, İngiltere, Fransa ve Almanya'daki çağdaş uygulama ve eğilimler* [*Primary school teacher training problems in Turkey (1923-1994) and contemporary practices and trends in USA, UK, France, and Germany*]. Ankara, Turkey: MEB.

Barnett, M., Keating, T., Harwood, W., & Saam, J. (2002). Using emerging technologies to help bridge the gap between university theory and classroom practice: Challenges and successes. *School Science and Mathematics*, *102*(6), 299–313.

Caner, M. (2009). *A study of blended learning model for teaching practice course in pre-service English language teacher training program* (Unpublished doctoral dissertation). Anadolu University, Eskisehir, Turkey.

Chejlyk, Sheri. (2006). *The effects of online course format and three components of student perceived interactions on overall course satisfaction* (Unpublished doctoral dissertation). Capella University, Minneapolis, MN.

Dursun, Ö., & Kuzu, A. (2008). Öğretmenlik uygulaması dersinde yaşanan sorunlara yönelik öğretmen adayı ve öğretim elemanı görüşleri [Opinions of teacher candidates and supervisors regarding problems experienced in teaching practice]. *Selçuk Üniversitesi Ahmet Keleşoğlu Eğitim Fakültesi Dergisi* [*Selçuk University Ahmet Keleşoğlu Education Faculty Journal*], *25*, 159–178.

Fraenkel, J. R., & Wallen, N. E. (2000). *How to design and evaluate research in education* (4th ed.). New York, NY: McGraw-Hill.

George, D., & Mallery, P. (2001). *SPSS for Windows step by step: A simple guide and reference, 10.0 update* (3rd ed.). Boston, MA: Allyn and Bacon.

Harms, M., & Adams, J. (2008, March). *Usability and design considerations for computer-based learning and assessment*. Paper presented at the Annual Meeting of the American Educational Research Association, New York, NY.

Liu, T.-C. (2005). Web-based cognitive apprenticeship model for improving pre-service teachers' performances and attitudes towards instructional planning: Design and field experiment. *Educational Technology & Society*, *8*(2), 136–149.

Nielsen, J. (2012). *Usability 101: Introduction to usability*. Retrieved from http://www.nngroup.com/articles/usability-101-introduction-to-usability/

Özçelik, D. A. (1989). *Eğitim programları ve öğretim* [*Curriculum and instruction*]. Ankara, Turkey: ÖSYM Eğitim Yayınları.

Özden, Y. (2005). *Eğitimde yeni değerler* [*New values in education*]. Ankara, Turkey: Pegem.

Rıza, E. (1996). *Teacher characteristics and training: Teacher training for the twenty first century*. İzmir, Turkey: Dokuz Eylül University Press.

Sahin, Ç. (2004). Okul deneyimi-ii isbirliğinde tarafların karşılıklı beklentileri [Education faculty and practicum school expectations at school experience course-II]. *Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi* [*Atatürk University Social Sciences Journal*], *1*, 13–27.

Şendağ, S. (2008). *Çevrimiçi probleme dayalı öğrenmenin öğretmen adaylarının eleştirel düşünme becerilerine ve akademik başarılarına etkisi* [*The effect of online problem based learning on the pre-service teachers' critical thinking skills and academic achievement*] (Unpublished doctoral dissertation). Anadolu University, Eskisehir, Turkey

Turgut, M., Yılmaz, S., & Firuzan, A. (2008). Okul deneyimi uygulama sürecinin değerlendirilmesi üzerine bir araştırma [A research on evaluation of school experience process]. *Üniversite ve Toplum* [*English Translation*], *8*(2).

METHODOLOGICAL PROPOSAL FOR ELABORATION OF LEARNING MATERIALS IN SIGN LANGUAGE IN UNIVERSITY TEACHING

J. Guillermo Viera-Santana[1], Dionisio Rodríguez-Esparragón[1],
Juan C. Hernández-Haddad[1] and Jesús Castillo-Ortiz[2]

[1]*Departamento de Señales y Comunicaciones. Universidad de Las Palmas de Gran Canaria*
Campus Universitario de Tafira. 35017 Las Palmas. Spain.
[2]*Departamento de Ingeniería Eléctrica. Universidad de Las Palmas de Gran Canaria*
Campus Universitario de Tafira. 35017 Las Palmas. Spain.

ABSTRACT

Hearing impairment may constitute a barrier for accessing to information and communication in public places. Since the oral communication forms the basis of the learning process, this problem becomes of particular relevance at schools and universities. To cope with this situation is not enough to provide a textual translation for people with hearing disabilities, society via educational authorities must facilitate alternatives that improve access to information and education to this collective. According to this reality, the possibility of having an alternative tool of communication based in the Spanish Sign Language (SSL) emerges as a contribution to help overcoming the communication obstacles that the students with this difficulty usually find. The spanish law 27/2007 recognizes and regulates that the sign language has to be used as the means of support for oral communication for deaf, hearing disability and deaf-blind people. It also determines the rights of the people to decide loosely how to communicate, to not to be discriminated because of it and lays different application areas. According to this law, the design of a communication system based on SSL is proposed, with the aim of contributing to the Universal Accessibility as indicated by the International Convention on the Rights of the Persons with Disability.

KEYWORDS

Avatar, Hearing impairmed, Higher education, Integration, Rotoscoping, Sign language.

1. INTRODUCTION

Inside the group of hearing impaired people, many of them, as first way of communication and in some cases as the only way, use the sign language. In this sense, Fuertes and others indicate that the access to higher education is "one of the most complex problems that the groups of hearing impaired people have to face" [1]. The same authors show that to solve this problem, it is required "the combination between the Spanish language and the SSL".

Obviously, the access to higher education is an integration problem and not about intelligence for the hearing impaired. In their path arriving to university, many students that have had this disability since they were born have been using the SSL as their habitual language of communication. However, when applying to the higher education, they find a model of communication based in the oral and written language which is used by the people without disability and that it is not adapted to their necessities and knowledge.

In the particular case of people that do not feel comfortable with this disability, it is necessary to put at their reach all the available resources to access information "to the knowledge and independent learning, without which the technologies of information and communication, which may be an opportunity, become a new barrier" [2]. An example of this could be in the widely attended public places (airports, subway stations…) where the messages of general interest for the users are not received by everybody easily. For some of the people who suffer hearing disability it is difficult and in many cases is impossible to receive those messages. Things like this make us think in the new technologies, with international design patterns, favoring a true framework of inclusion in the society [3]. In this sense, over the last few years many

improvements have been created to facilitate the communication and the access to information for the people who suffer hearing disability. Between these facilities, it stands the installation of magnetic loops in public places to provide audible information that makes it clearer for the people who use hearing aid or cochlear implant. However, these interventions do not completely solve the communication problems which people who only use the sign language as the only way of communication usually encounter.

As it is known, "there is not a universal sign language" [4]. Every country has its own sign language. Even inside every Spanish community there are variants of this language. Due to this situation, for the creation of the application which is raised, the Spanish language was selected as the official language in the Law 27/2007, in the 23rd October, which states that the Spanish sign languages were recognized and the means of support for oral communication for deaf, hearing impaired and deaf-blind people were regulated [5].Inside Spain, there are some variations between the sign languages that are used in the different parts of the country, exceptionally Cataluña, where those are more significant.

Nowadays, the majority of universities use virtual learning platforms to support classroom teaching and, in some cases, "e-learning" for distance learning. These systems can contribute as a support tool to the group of hearing impaired, independently of the education levels they are in. The objective is to obtain the information that is given in class and to deepen in it more carefully. However, this solution does not completely solve the problem neither in the classroom nor in the learning platform, as both of these options do not give support tools based in the sign language [1].

2. PURPOSE AND OBJECTIVES

The purpose of the study consists in the integration of the students with a significant hearing impairing and those who use the SSL as their way of communication through the projection of subtitled videos, where an avatar presents the translation of the oral expositions that the teacher have created in sign language.

The proposal raised here consists in an inclusive intervention which can be implemented in any learning level, from primary school to higher education. In this case, it focuses on a university for the higher knowledge and its performance. With this proposal, it is almost simultaneous that the oral expositions which the teachers imparts in the classroom are shown with videos in sign language, which expose the same contents and even introduces the subtitles with the corresponding text, but translated to SSL to cover a broader spectrum of communication. Also, these videos will be in the virtual campus, with the rest of the documentation of the subject. With this action we pretend to facilitate the access to the information to the students with this disability, contributing to the independence and integration of these people in the society, as well as the improvement of the quality of life and the fulfillment of the "Universal Accessibility of the people with disability".

It is a pilot project due to perform in a concrete subject. To start up this intervention, we will choose a place where there are students who have this disability and demand support through the SSL. The design requires a coordinate action between the teachers and the Office of Learning support (GAP) of the ULPGC, who will give the necessary support for the preparation of the exposed texts through the subtitles in the videos and will be responsible for the translation to SSL.

The recording of the translations will be made separately for each class session. Then a multimedia installation will be performed by inserting subtitles and converting the real image into an avatar. The use of an animated character in two-dimensions (2D) is justified with the goal of dispensing real people's faces and avoids the monotony in audiovisual generated animations. In this sense, we have taken into account the positive valuations that the members of the Association of People with Hearing Disability in Gran Canaria did, who were asked about the project. 84% of the people asked, did agree with the use of an avatar in 2D instead of an individual.

In turn, for each class, small videos explaining each section will be performed. This way, we will have multiple videos of short duration for each topic of the class, which you can access through a graphical environment that allows the organization per unit and paragraph referenced within each topic. The performance of the graphical environment will aid the students to locate and access in a structured and fast way the concept he wants to play. Likewise, the use of the short duration videos is aimed at avoiding the distraction during the view or an excessive tiredness at the time of its viewing.

Finally, the inclusion of subtitles comes motivated by the possibility of offering all the students the use this multimedia material to understand the explanation of the contents which are being treated, so it is not only a useful tool for the hearing impaired, but also for the rest of students.

3. METHODOLOGY

The performance of this project is structured in different stages, which keep a direct and sequential interrelationship between them: center and subject selection, faculty coordination with the GAP, elaboration of a screenplay with the preparation of the class, translation to the sign language, design of the character and the conversion of the videos to animation in 2D and the performance of an interactive graphical environment for the call and presentation of animations.

Figure 1 shows the sequencing phases of the proposed work for this project's development.
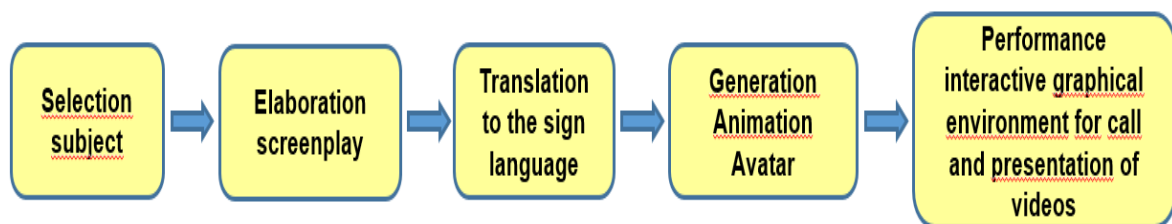
Figure 1. Phases for the elaboration of the project

3.1 Center and Subject Selection

The first step of the implementation of the project will be the selection a teaching center in which we can find students with hearing disability and they request support through translation to SSL.

Once the center is chosen, the next step will be to select the subject which is going to be intervened. A basic subject is proposed, where these students highly and where the first priority is the science. The reason of choosing a basic subject is because these subjects are imparted in several degrees of the same branch, with identical or very similar contents, so it would benefit a higher number of students. Meanwhile the predilection for the science area is justified by having a higher content of mathematic issues and fewer texts than a subject of another area, which reduces and simplifies the translation to SSL and the elaboration of a final multimedia product. Based on these arguments, the "Calculus" subject is chosen for the implementation of this pilot project, meeting the premises established.

3.2 Coordination of the Teaching Staff with the GAP

This is a multidisciplinary project, covering the teaching staff, the GAP of the university and the responsible of the audiovisuals performance. Due to this, it requires coordination between the different parts and a clear and concise planning, with the statement of each person's responsability and a performance schedule which allows achieving the final product, with the programmed quality and in the stipulated dates.

3.3 Elaboration of a Screenplay with the Preparation of the Class

This task will take on a previous work of selection and preparation of the texts for its posterior translation to the sign language. Since in the chosen subject you have to work on a board and there are many expressions which are repeated, a previous work should be made, where those common phrases are collected. This will suppose a significant saving of the subsequent tasks. The next task will consist in the performance of a screenplay with recorded texts. The recordings will be made by the faculty, experts of the subject, who will choose texts which will be translated to SSL and will be included as subtitles in the final video. Therefore, in this phase we will analyze and synthesize the net language used as pilot project.

3.4 Translation to Sign Language

After the elaboration of the screenplay of each class and the selection of the texts, the next step in the execution of this multimedia project will consist in the translation of these texts to SSL. To performance this step, is necessary to count with an interpreter of SSL. This task will be entrusted to the GAP, who trough his Translation Cabinet is responsible of the translation of the selected material. To avoid the confusions in these phases of the project, we must record each class in different and independent videos, classifying them with the numeration and identification of each topic.

3.5 Character Design and Conversion of 2D Animation Videos

Currently there are many programs for creating vector animations easily, offering all kinds of tools which range from the most basic to others that require more skills and licensing fees. There are others which are completely free, although these generally do not have the same benefits. Depending on the level of animation it is wanted to achieve, it should be chosen the one that best suits the requirements of the final product. At this phase, an analysis of the main tools available today was made in the field of computer animation, both professional and amateur. The most common vector animation programs can be differenced in two types: free open source, like Ajax Animator, KToon, Pencil or Synfig, and the ones which require a payment, such as Adobe Flash, Adobe AfterEffects, Anime Studio or Toon Boom, among others. In this sense, and with the goal of facilitating the choice, it is proposed the use of a specific software for animation, known as Adobe Flash CS5, which is an application shaped studio working on "frames" and it is intended to the production and delivery of interactive content. It has been used in similar projects, obtaining a high level of satisfaction.

It uses vector graphics and raster images (bitmap), sound, programs code streaming video and two-way audio. In addition, this program incorporates an animation technique called rotoscoping. Its advantage is that its use is that it can replace the faces of people, who can be more or less attractive, for an animation character.

The use of the rotoscoping in this project would be very appropriate for obtaining vector animations. With this animation and the incorporation of some of the elements in the scene as a stage, wallpaper, etc. the final videos in SSL would be obtained, in which the interpreter becomes an animated character.

In figure 2, a rotoscoping process is shown, where the conversion of video frame is performed to a 2D animation.

1° Phase   2° Phase   3° Phase

4° Phase   5° Phase   6° Phase   7° The last frame
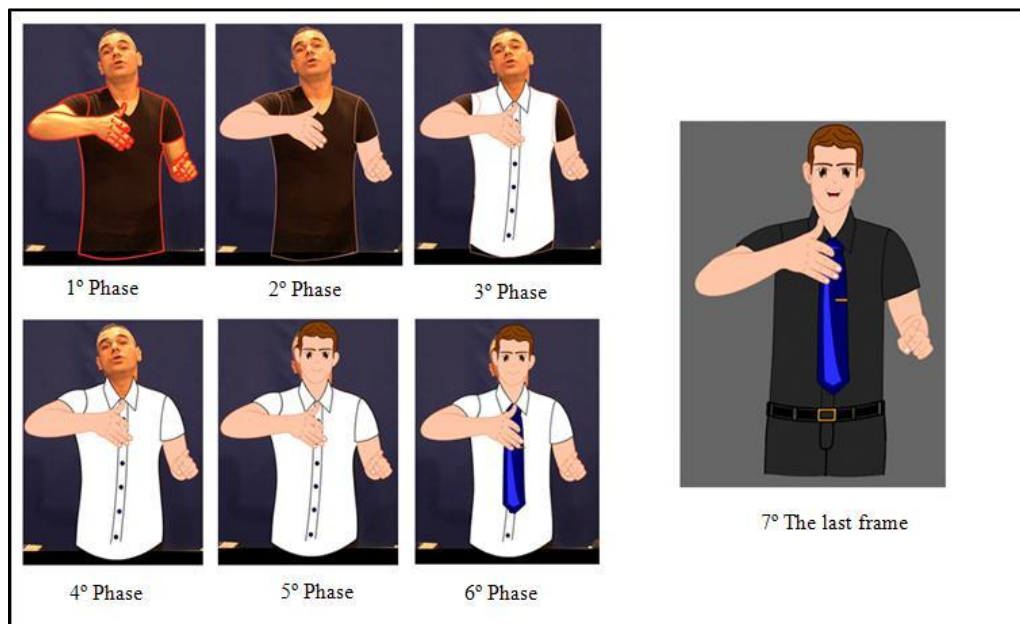
Figure 2. Changes in a single frame, during the animation process.

The animation consists of image succession, in order that when they are showed with a determinate speed, they produce the feeling of movement. Adobe Flash has some amenities when animating elements because of it interpolated animation function. The produced changes on the objects are performance easily and efficiently by setting key frames. This marks the initial and final points of the animation. Adobe Flash automatically generates the content of the intermediate frames modifying the necessary parameters, like the position, the size, the rotation or even the form of an object [7].

In the development of the videos, formal aspects must be taken care of, such as the scene background colors, the character, the speed of the gestures, the inclusion of subtitles or symbology, with the goal of capturing the users' attention.

3.6 The Performance of an Interactive Graphic Environment for the Call and the Presentation of the Animations

As it has been commented before, it is pretended to obtain short duration videos in SSL, thus leading to a large number of them. Due to this and with the goal of facilitating their identification and call in a quick and ordered way, it is proposed the creation of a multimedia app that facilitates the access to the users and the selection of the videos. It is about the design of a simple setting, interactive app which allows the interaction of the users with the shown elements in the screen, such as folders with the number and name of the topic. Inside each folder will be placed call buttons to videos, created for that particular subject. By selecting each of these buttons, which will have the name of the concept it represents, the corresponding video will start. In turn, in the videos the corresponding start, forward, pause, and final buttons should be placed. These orders will be made through a peripheral that controls these interfaces, to obtain the requested information. For the development and programming of these apps, it is proposed the software "ActionScript 3.0", which is the native programming language of Flash.

Without prejudice to what was mentioned earlier, it would be convenient, once the first version of the graphic environment is performed, to solicit opinions and suggestions from experts in SSL communication, like the GAP of the university. In this way, it would be obtained a customized product directed to the real needs and demands of the targeted population and its chances of success will be greater.

A technical detail to be considered for the correct performance of this app is that the videos in SSL should be stored in the same medium in which the multimedia application is, to obtain a greater speed in the call and reproduction of the videos.

In the figures 3 and 4 it is shown a first approximation of the proposal made for this project.
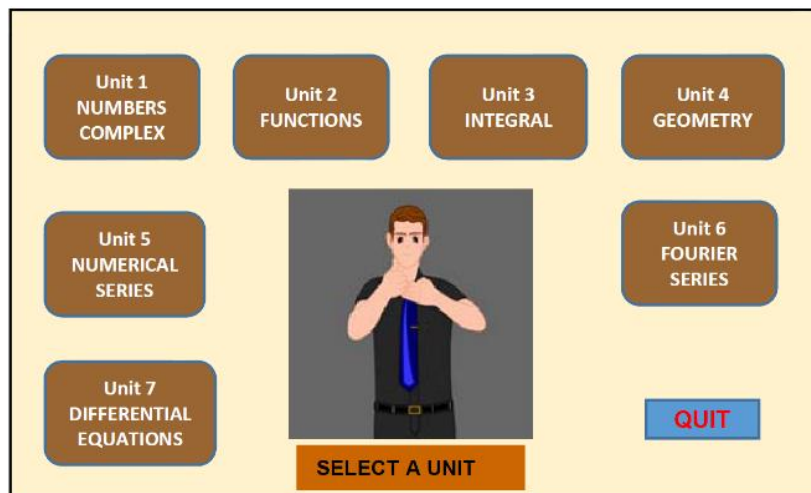
Figure 3. Principal page of the graphic environment.
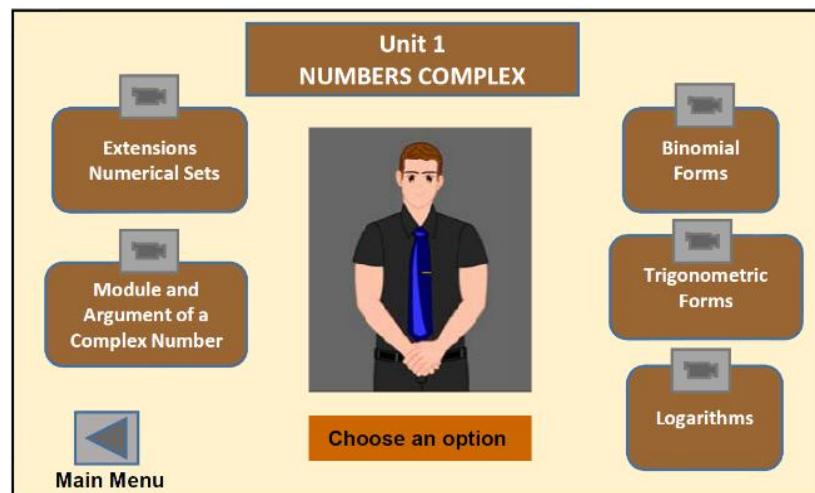
Figure 4. Screen for the selection of the videos.

4. CONCLUSIONS

The performance and implementation of this project would make the access to the information that is provided in the class to students that suffer hearing impairment easier. Furthermore, the same compliance would be given to the law on disability, in relation to "the rights of individuals to decide freely the media and not to be discriminated for it."

On the other hand, it would contribute to a didactic material in SSL available for the students which demand it in this university, and which can be shared with other Spanish university, provided that subjects chosen for translation are basics subjects, because the system of higher education is included in the European Higher Education Area (EHEA), which uniformity is required in basic subjects. Its use in an interuniversity level, would suppose that this project has impact at national level, thereby saving cost and provide a fast payback.

Once this project is implemented and evaluated, it could be made extensible to the rest of basics subjects and even extended to other degrees, especially in those subjects in which the agenda is not susceptible to significant changes.

The teaching material that is generated will be placed in the virtual campus, available to all students, so they can access it in any moment, either during the course of the class or after the them. Also, it allows the option of using multiple multimedia devices for downloading and viewing: desktop computers or laptops, tablets, smartphones, etc.

This project can be extensible to other levels of education which require teaching in SSL. It can be useful for partnerships with People with Hearing Disability, for the performance of on-line courses in SSL about issues demanded by its partners.

In the search of information for the development of this article, a large quantity of instructional videos about teaching support were found, but in any case these were teaching SSL.

REFERENCES

1. Fuertes, J. L.; González, Á. L.; Mariscal, G.; & Ruiz, C.: Herramientas de Apoyo a la Educación de Personas Sordas en la Universidad Española. *Enseñanza*, *430*(45), 01. (2005).
2. Jáudenes, C.: Accesibilidad de las personas sordas a la comunicación, a la información y al conocimiento. *Accesibilidad a los medios audiovisuales para personas con discapacidad*, 43-51. (2007).

3. Parra, D. J. L.; Infante, G. R.: Tecnología de la Información y Comunicación aplicada al alumnado con discapacidad: un acercamiento docente. *Revista Iberoamericana de Educación, ISSN*, 1681-2653. (2009).

4. Ortiz, I. D. L. R. R.: Comunicar a través del silencio: las posibilidades de la lengua de signos española (Vol. 5). Universidad de Sevilla. (2005).

5. BOE, 24 october 2007, Law 27/2007, of 23 october

6. Viera-Santana, J.G.; Hernández-Haddad, J.C.; Rodríguez-Esparragón, D.; Castillo-Ortíz,J.: Interactive Application In Spanish Sign Language For A Public Transport Environment. *11th International Conference on Cognition and Exploratory Learning in Digital Age (CELDA 2014).* (2014).

7. Corsado, S.: Flash MX animación (Los principios de la animación tradicional adaptados a Flash). Ed. Anaya Multimedia, (2003).

MOODLE E-LEARNING SYSTEM AND STUDENTS' PERFORMANCE IN HIGHER EDUCATION: THE CASE OF PUBLIC ADMINISTRATION PROGRAMMES

Lan Umek, Damijana Keržič, Nina Tomaževič and Aleksander Aristovnik
University of Ljubljana, Faculty of Administration
Gosarjeva 5, SI-1000 Ljubljana, Slovenia

ABSTRACT

The use of information and communication technologies (ICT) and therefore e-learning is becoming an ever more frequently used teaching and learning technique at all levels of education. In higher education, it completely or partially substitutes the classical teaching methods. It provides richer resources than the traditional classroom and overcomes its limitations (time and space). In some cases, it has proved to be very effective. Some authors, however, also point out that e-learning requires highly self-regulated and independent students or their e-learning performance may be low. The purpose of the paper is to analyse how introduction of the e-learning system Moodle as part of the teaching process is related with students' performance, i.e. the average grade and the average number of admissions to the exams. We also examined the same relationship among different groups of students (based on selected individual socio-demographic factors). The study included a member of the University of Ljubljana (Faculty of Administration) with public administration programmes as our sample in the period from 2008 till 2014. The results of the analysis (using a t-test) show a significant improvement in performance (a higher average grade and lower average number of admissions) at the different (faculty-, student- and course-) levels after introducing the Moodle e-learning platform. The data show that the greatest improvement is seen among students with lower high school grades. The results can serve as important guidelines for university management when further investigating how to enhance students' performance on different levels when employing modern ICT solutions in the teaching process.

KEYWORDS

e-learning, Moodle, blended learning, students' performance, higher education, public administration programme

1. INTRODUCTION

In recent years, e-learning has been becoming increasingly interesting for society and educational institutions because it supports the concept of lifelong learning and since knowledge is becoming more and more important. This increases the demand for various educational forms and means. Different education programmes around the world cater to this increased demand and offer new forms of education that are frequently supported by information-communication technology (ICT) (Sulčič and Lesjak, 2009). Moreover, technological advances have revolutionized teaching and learning processes (Aristovnik, 2012). Fry (2001), for instance, notes that the emergence of new technologies, the rapid expiration of knowledge and training, the necessity of just-in-time information delivery, and the need for more cost-effective teaching methods have transformed teaching-learning practices.

In comparison to traditional classroom instruction, the major advantages of e-learning are reducing geographical barriers as well as travel and programme overhead costs. The access becomes more flexible, from anywhere and usually at any time – essentially, it allows participants to collapse time and space (Cole, 2000) – however, the learning materials must be designed properly to engage the learner and promote learning. On the other hand, there are also many problems that make e-learning ineffective. Many students drop out of online courses due to a lack of motivation, instructional design-related factors and learning style mismatch, time conflicts with other commitments, organizational support and follow-up on completion (Wang et al., 2003). Other problems connected with e-learning are the absence of significant differences in acquired knowledge and the unsuccessfulness of e-learning projects (Sulčič and Lesjak, 2009).

The effectiveness of e-learning systems has been an important subject of research in the last few decades. The opinions on the effectiveness of e-learning are many and very different. There are also many factors that influence the effectiveness of e-learning, with some being connected with technology/technics and others with people. Upadhyaya and Mallik (2013) claim that each issue of the effectiveness of e-learning cannot be treated as a standalone topic – either as a technical matter or as a people issue. E-learning involves interaction between people and processes, meaning that has to be treated as a socio-technical system rather than a social system considering only the people aspect (e.g. students, teachers and other stakeholders) or a technical system only considering the standards and processes aspect (e.g. course content, technology, Learning Management System (LMS), content management tools). E-learning is a complex process that depends not only on these aspects in isolation, but also the interaction among them.

The purpose of the paper is to analyse how the introduction of the Moodle e-learning system as part of the teaching process is related to students' performance in the public administration programmes, measured as the average grade and the average number of admissions to the exams for each course. We also examined the same relationship among different groups of students (based on gender, country region, high school grades) and courses (year of study, study programme, chair (faculty's organizational unit) in which the course is conducted). The study included data for the period from 2008 till 2014. The paper explains how introduction of the Moodle e-learning system increased the students' performance on the faculty level and discusses the variances among the different subgroups.

The paper is structured as follows: first, a brief literature review about e-learning and its impact on students' performance is presented. Second, we review the empirical methodology and describe the data. The third section outlines the empirical results and the discussion. The final section provides some concluding remarks, limitations and directions for future work.

2. LITERATURE REVIEW

Since e-learning has been an important and ever more frequently used teaching technique in the past decades, there are also many studies on its impact on students' performance. Delivering instructions that can produce equal or even better outcomes than face-to-face learning systems is one of the main goals of introducing ICT into the study process (Saba, 2012). But besides the many advantages of this type of study, there are also many disadvantages which can reduce the positive impact of modern ICT tools on students' performance. Moreover, in the e-learning process there are also many specific factors involved that are not directly connected with ICT but importantly influence the students' performance, sometimes also in a negative way.

Sulčič and Lesjak (2009) claim that, although ICT represents a fundamental material condition for e-learning, it does not have a statistically significant influence on the effectiveness of e-learning. Similarly, Russell (2001) discovered no statistically significant differences between classical and online learning. Different authors report varying attrition rates, e.g. from as high as 70%–80% (Dagger and Wade, 2004, Flood, 2002) to 20%–50% (Frankola, 2001; Diaz, 2002). These attrition rates can even be higher (between 10%–20%) than for traditional face-to-face education (Carr, 2000). When measuring students' performance also with other measures, Novo-Corti, Varela-Candamio and Ramil-Diaz (2013) report an increase in the performance of students (grades and qualifications) when using the mixed technology of e-learning in Moodle and face-to-face lectures.

According to Ally (2004), the teaching strategies as well as testing and assessment methods are much more important than the use of ICT in education. Students' non-participation in the learning process plays an important role in high dropout rates in online learning (Dagger and Wade, 2004). It is therefore very important to determine which approaches might increase student engagement (Tyler-Smith, 2006).

The review of the previous studies raises the dilemma of the validity of such comparisons since the statistics on retention and drop outs can be incomparable, unreliable and/or misleading (Hall, 2001; Haverilla, 2009; Saba, 2012; Wang, Foucar-Szocki, Griffin, 2003). Researchers acknowledge that the reasons for attrition are many and complex and that there are no simple solutions (Berge and Huang, 2004).

The same is true for students' performance, measured as average grades and the average number of admissions to the exams. There are many factors that influence students' performance, such as (Chien, 2012; Haverila and Barkhi, 2009; Kim and Kim, 2013; Saba, 2012; Upadhyaya and Mallik, 2013; Yukselturk and Burut, 2007): learner characteristics (demographic factors, prior e-learning experience, ability and interest,

motivation, self-regulation), supporting systems (organizational aspects – e.g. structure and institutional arrangements; people aspects – e.g. motivation, training, other stakeholders) and e-learning system (quality of contents, tasks (instructor factors), technology – e.g. system reliability, user interface).

It can be deduced from the reviewed literature that there is a huge research gap concerning the contributions of socio-demographic factors of students involved in an e-learning system to their academic performance. Nevertheless, a few researchers have focused on selected socio-demographic aspects of e-learning, such as Berge and Huang (2004), Yukselturk (2005) and Park and Choi (2009). In general, however, individual factors (i.e. socio-demographic, e.g. age, gender, education etc.) seem to have little influence on student performance. Indeed, Willging and Johnson (2004) claimed that external factors such as family issues, lack of organizational support, and workload are the crucial factors affecting students' performance in an e-learning system (also see Park, 2007). Nevertheless, in our study we tried to fill above-mentioned research gap and highlight the importance of a selected socio-demographic background on (full-time) students' performance in the Moodle environment in public administration programmes at the University of Ljubljana.

3. MOODLE: E-LEARNING PLATFORM AT THE FACULTY OF ADMINISTRATION (UNIVERSITY OF LJUBLJANA)

The open-source learning management system Moodle is already widespread in all segments of education, from primary schools to universities. It is free, flexible, customizable and basically contains many standard features which make it popular. It is available in more than 100 languages. Today, more than 54,000 active sites are registered from 225 countries, with millions of users (Moodle, 2015). Kareal and Klema (2006) compared particular features of some open-source e-learning systems and found that Moodle is one of the most adaptable, which is an essential part of effective education as they pointed out, and mots user-friendly learning systems among all the compared ones. Chen et al. (2011) studied the implementation of a Moodle course as an extension of a classical learning process at a university and found that for students "the Moodle e-learning platform is easy to use and provides a good communication tool, discussion area, group space, workspace, and makes learning more interesting".

The Faculty of Administration (FA) is part of the University of Ljubljana, Slovenia, that develops administrative science through research and education as well as integration into Slovenian and international practice. The FA offers two undergraduate study programmes – the University Study Programme in Public sector governance (US) and the Higher Education Professional Study Programme in Administration (PS) – and one joint undergraduate University Study Programme in Administrative Information Science (UI) together with the Faculty of Computer and Information Science. The undergraduate study programme (1st cycle) lasts 3 years (six semesters). Both undergraduate study programmes of the FA, the First Cycle Professional Study Programme in Administration and the First Cycle University Study Programme in Public Sector Governance, meet the high quality standards defined by the European Association for Public Administration Accreditation (EAPAA). The FA also offers the continuation of study in seven postgraduate programmes. The study programme is interdisciplinary, combining administrative, legal, economic as well as organizational and ICT courses. Consequently, the Faculty is organized in three chairs: the Chair of Economics and Public Sector Management, the Chair of the Administrative-Legal Area and the Chair of Organization and Informatics.

The FA began with blended learning in 2005 with eCampus, a payable platform for e-learning. By blended learning we mean the current use of the term, namely "combining Internet and digital media with established classroom forms that require the physical co-presence of teacher and students" (Friesen, 2012). After three years of use, the learning platform was replaced with the open-source Moodle platform, mainly due to the user-friendly environment and cost benefits.

At the beginning, the traditional teaching techniques were combined with an e-classroom on the basis of the voluntary decision of lecturers themselves. In the 2010/11 academic year, introduction of the Moodle e-learning system as part of the teaching process became mandatory for all courses in the first year of undergraduate study, namely 20 to 30 percent of the traditional face-to-face learning process was implemented in Moodle. In the next year, blended learning was implemented in the second year of study and in the 2012/13 academic year all undergraduate study courses had their own e-classroom in Moodle.

At the same time as implementing this combined method of learning, the rules (e-learning policies) on the quality of e-classrooms were determined. At the end of each semester, a consultant reviews the e-classrooms for e-studies and assesses them regarding their compliance with these rules. The quality assurance of the pedagogical work in e-classrooms in accordance with the defined rules is thus regularly monitored and necessary improvements are made.

4. EMPIRICAL RESEARCH

4.1 Methodology and Data

In our study we analysed the performance of undergraduate students in two study programmes at the FA– the university (US) and the higher education professional study programme (PS), in the period between the 2008/09 and 2013/14 academic years. We only included the compulsory courses for full-time students in our survey since the e-classroom for elective courses was completely mandatory. For each academic year, we surveyed all compulsory courses and checked what proportion of their realization (lectures, practical exercises) was held in Moodle. Using preliminary analyses, we defined that a course can be understood as (also) executed in Moodle if at least 1/5 of its realization is held in an e-classroom (i.e. a minimum 3 weeks in a semester of 15 weeks).

The purpose of the research was to find out if the introduction of the blended learning with support of the Moodle platform had increased the students' performance. We analysed and compared two indicators of students' performance, namely students' average grades and average required admissions to pass an exam in the years 'with Moodle' with the (previous) years without it. In the Slovenian higher education system, the grading scale ranges from 1 (minimum) to 10 (maximum) with 6 as a minimum passing grade. For our analysis, we used Student's t-test for two independent samples. Table 1 shows the number of students enrolled in both programmes in each academic year between 2008/2009 and 2013/2014, where "Moodle – NO" means years with only face-to-face classrooms and "Moodle – YES" years with blended learning. Notice that in the last academic year all the courses are treated as courses with Moodle since it was mandatory for lecturers to have an e-classroom in Moodle. On the contrary, in the first two years (2008/09, 2009/10) there are no courses treated as courses with Moodle. In the interim period, we have both types of courses: face-to-face and blended classroom. It is therefore possible that the same students were selected for both the "Moodle – NO" and "Moodle – YES" samples since they attended both types of courses. Notice that we only analysed obligatory courses so the students could not choose to be assigned to the "Moodle – NO" and "Moodle – YES" samples since they had to follow the lecturers' decision.

Table 1. Students enrolled in each academic year – in study years of both programmes (PS – Professional Study Programme and US – University Study Programme)

Academic year		Moodle – NO			Moodle – YES		
		1st	2nd	3rd	1st	2nd	3rd
2008/09	PS	213	0	0	0	0	0
	US	278	0	0	0	0	0
2009/10	PS	114	0	0	0	0	0
	US	208	210	0	0	0	0
2010/11	PS	157	0	96	133	0	0
	US	163	191	138	148	175	0
2011/12	PS	119	0	0	156	0	89
	US	108	140	147	109	0	0
2012/13	PS	0	0	0	133	0	65
	US	92	103	131	0	0	0
2013/14	PS	0	0	0	110	0	67
	US	0	0	0	93	80	82

Source: Survey, 2014

As explained in the above literature review section, students' performance is influenced by many factors. We decided to eliminate the impact of (1) the fluctuation of lecturers and (2) different generations of students. Therefore, we only analysed courses where the same lecturer conducted a course without Moodle and later with it, both for at least two consequent years. This means we excluded all courses where the lecturer was changed. We also excluded courses where only one generation used Moodle or only one generation did not use it. Our original data table was therefore reduced to only 14 compulsory courses.

4.2 Empirical Results

On the faculty level, the introduction of Moodle is related to a significantly increased student performance. The average grade rose from 6.98 to 7.11 (Table 2), making the difference of 0.13 points highly significant (p-value: 2.71E-7). The decrease in the average number of admissions needed for the exams is even stronger (Table 3) – it went down from 1.73 admissions (Moodle – NO) to 1.30 (Moodle – YES). The difference of – 0.43 is even more significant (p-value: 7.26E-86).

Although the introduction of the Moodle platform at the faculty level showed a significant improvement, we assumed there might still be subgroups of students or courses where the improvement is not significant. For a more detailed analysis, we collected additional data on courses and students (factors). We added data about the study programme (US/PS), the year of study (1st, 2nd, 3rd) and the chair (organizational unit at the Faculty) to which a lecturer belongs. From the students' enrolment form we extracted data on the students' gender and the region of Slovenia where they were born. We only considered two 'regions' – "Central Slovenia" where the faculty is located – and all other regions in Slovenia as one region ("Other Slovenian regions"). In addition, we took the students' high school final grade into account (four categories).

Table 2. Average grades for years with Moodle (Moodle – YES) and years without it (Moodle – NO) among different factors (study programme, year of study, chair of lecturer; gender, region and high school final grade) with differences and corresponding p-values (Sig.)

	Moodle				
	NO	YES	Difference	Sig.	
Programme					
University Study Programme	6.99	7.12	0.13	3.18E-06	***
Professional Study Programme	6.93	7.08	0.15	2.09E-03	
Year of study					
1st	7.09	7.20	0.11	6.80E-04	*
2nd	6.82	6.99	0.17	4.06E-05	***
3rd	6.89	6.94	0.05	2.40E-01	
Chair					
Economics and Public Sector Management	6.79	7.06	0.28	4.88E-15	***
Administrative-Legal Area	7.24	7.37	0.13	1.10E-02	
Organization and Informatics	6.91	6.96	0.05	1.69E-01	
Gender					
Male	6.86	7.00	0.14	1.79E-03	
Female	7.01	7.15	0.13	6.21E-06	***
Region					
Central Slovenia	6.92	7.10	0.17	8.35E-07	***
Other Slovenian regions	7.03	7.13	0.10	3.17E-03	
High school final grade					
sufficient (2)	6.89	7.01	0.12	1.46E-05	***
good (3)	7.11	7.17	0.06	1.61E-01	
very good (4)	7.41	7.45	0.04	3.43E-01	
excellent (5)	7.61	7.61	0.00	5.01E-01	
Together (at the faculty level)	**6.98**	**7.11**	**0.13**	**2.71E-07**	***

Difference is significant at the following levels: 0.1 (*), 0.05 (**), 0.01 (***)
Source: Survey, 2014

For each factor we calculated the average grade and the average number of admissions to the exams for all of their levels separately for the years with Moodle and the years without it. In Table 2 and Table 3 we report the averages and differences with corresponding p-values calculated with an independent samples t-test. We corrected the p-values with a Bonferroni correction and marked the significant ones with stars. The data in Table 2 indicate a highly significant increase in the average grade among the majority of categories.

The biggest increase in the average grade belongs to the courses in the Chair of Economics and Public Sector Management. The average grade rose from 6.79 to 7.06, with the difference of 0.28 points being highly significant (p-value: 4.88E-15). We also discovered highly significant increases for students from Central Slovenia (increase from 6.92 to 7.10, p-value: 8.35E-7), students from the University programme (from 6.99 to 7.12, p-value: 3.18E-60), female students (from 7.01 to 7.15, p-value: 6.21E-6), students with high school grades 2 out of 5 (from 6.89 to 7.01, p-value: 1.46E-5) and students in the 2nd year of study in both study programmes (from 6.82 to 6.99, p-value: 4.06E-5). In the other subgroups, the increase in the average grade is not significant. On the other hand, it is interesting that the average grade went up in all subgroups with the only exception of students with an excellent high school background (grade 5 out of 5). We found at least one subgroup with a highly significant increase in the average grade for each factor (programme, year, chair, gender, region, high school grades) which helps us identity where the implementation of Moodle seems to play an important role in achieving high students' average grades.

Table 3 shows a highly significant decrease in the average number of admissions to the exams among all categories. A slight exception is the factor 'high school final grade'.

Table 3. Average number of admission for years with Moodle (Moodle – YES) and years without it (Moodle – NO) among different factors (study programme, year of study, chair of lecturer; gender, region and high school final grade) with differences and corresponding p-values (Sig.)

	Moodle				
	NO	YES	Difference	Sig.	
Programme					
University Study Programme	1.76	1.32	-0.44	3.40E-61	***
Professional Study Programme	1.58	1.23	-0.35	9.16E-21	***
Year of study					
1st	1.72	1.20	-0.52	1.05E-75	***
2nd	1.76	1.43	-0.33	2.63E-15	***
3rd	1.66	1.44	-0.22	2.37E-04	***
Chair					
Economics and Public Sector Management	1.76	1.27	-0.49	8.16E-58	***
Administrative-Legal Area	1.43	1.25	-0.17	7.17E-07	***
Organization and Informatics	2.02	1.42	-0.60	4.44E-28	***
Gender					
Male	1.78	1.32	-0.45	6.13E-23	***
Female	1.71	1.29	-0.43	1.90E-65	***
Region					
Central Slovenia	1.75	1.32	-0.44	2.81E-43	***
Other Slovenian regions	1.70	1.27	-0.43	3.21E-41	***
High school final grade					
sufficient (2)	1.80	1.32	-0.47	1.17E-63	***
good (3)	1.60	1.28	-0.32	4.20E-13	***
very good (4)	1.40	1.21	-0.19	5.89E-04	*
excellent (5)	1.43	1.13	-0.30	2.32E-03	
Together (at the faculty level)	**1.73**	**1.30**	**-0.43**	**7.62E-86**	***

Difference is significant at the following levels: 0.1 (*), 0.05 (**), 0.01 (***)
Source: Survey, 2014

Students with an excellent (grade 5 out of 5) and very good (grade 4 out of 5) high school background saw a decreased average number of admissions. The drops from 1.43 to 1.13 (excellent students) and from 1.40 to 1.21 (very good students) are, however, too small to be significant. We can see that those students with a better high school background (grades) need fewer admissions than the students with lower high school grades. It is, however, encouraging that the Moodle environment helped students with a lower high school background reduce the average number of their admissions. Students with sufficiently high school grades (grade 2 out of 5) decreased the average number of admissions from 1.80 to 1.32. Although the decrease is significant for all factors, the data in Table 3 show a very significant decrease in the average number of admissions for the 1st year of study (from 1.72 to 1.20 with p-value: 1.05E-75) and female students (from 1.71 to 1.29 with p-value: 1.90E-75). We can also find highly significant differences in the University Programme and courses from the Chair of Economics and Public Sector Management.

5. CONCLUSION

The results of our study indicate that the implementation of an e-learning system (Moodle) at the Faculty of Administration, University of Ljubljana is related to a statistically significant increase in students' performance, measured as the average grade and the average number of admissions to the exams. We demonstrated that the courses from the Chair of Economics and Public Sector Management, female students and students with a lower high school background benefitted more from the work in the Moodle environment than the other groups of studied entities. Based on our empirical results, we can also conclude that almost all subgroups of courses and students reduced the average number of admissions to the exams and increased the average grades after the Moodle platform was introduced. Interestingly, the only subgroup of students which did not benefit much is the group of students with the highest grades from high school.

The main limitation of the research is the limited data set (i.e. the reduction of the number of courses analysed due to the lecturers' fluctuation and different generations of students). Besides that, we did not take into account other individual factors (e.g. motivation) and external factors (e.g. contents quality, previous trainings in Moodle, instructor factors, technological characteristics of the Moodle platform). These factors should be the subject of our further research in the near future. Moreover, future research could also broaden the scope of the current study, which was restricted to the public administration programme. Finally, additional studies should seek to analyse the data from different study programmes in order to increase the validity of results for the entire University of Ljubljana. To conclude, the study results can still serve as important background material when deciding on the future development of e-learning at the Faculty of Administration as well as on the introduction of e-learning platforms at other faculties within the University of Ljubljana. The empirical results pointed out the main challenge: how to use the Moodle platform to increase the grades of students with the best high school backgrounds and therefore to increase the graduates' capabilities to solve challenges in public administration.

REFERENCES

Ally, M., 2004. Foundations of Educational Theory for Online Learning. In Anderson, T. and Elloumi (Eds.), *Theory and Practice of Online Learning*. pp. 3-31. Athabasca University.

Aristovnik, A., 2012. The impact of ICT on educational performance and its efficiency in selected EU and OECD countries: a non-parametric analysis, *The Turkish Online Journal of Educational Technology*, Vol. 11, No. 3, pp. 144-152.

Berge, Z. and Huang, Y., 2004. A Model for Sustainable Student Retention: A Holistic Perspective on the Student Dropout Problem with Special Attention to e-Learning. *DEOSNEWS*, Vol. 13, No. 5. Retrieved 23.2.2015 from http://www.ed.psu.edu/acsde/deos/deosnews/deosnews13_5.pdf

Carr, S., 2000. As distance education comes of age, the challenge is keeping the students. *The Chronicle of Higher Education*, Vol. 23. Retrieved 23.2.2015 from http://chronicle.com/free/v46/i23/23a00101.htm

Chien, T.C., 2012. Computer self-efficacy and factors influencing e-learning effectiveness. *European Journal of Training and Development*. Vol. 36, No. 7, pp. 670-686.

Liao, C.-W et al., (2011). Perspectives of university students on cooperative learning by Moodle. *International Journal of Digital Content Technology and its Applications*, Vol. 5, No. 6. Retrieved 23.2.2015 from http://www.aicit.org/jdcta/ppl/22_%20JDCTA_June-26.pdf

Cole, R.A., 2000. *Issues in Web-based pedagogy: A critical primer.* Westport, CT: Greenwood Press.

Dagger, D., and Wade, V.P., 2004. *Evaluation of Adaptive Course Construction Toolkit (ACCT).* Retrieved 2.3.2015 from http://wwwis.win.tue.nl/~acristea/AAAEH05/papers/6-a3eh_daggerd IOS_ format_v1.1.pdf

Diaz, D.P., 2002. Online drop rates revisited. *The Technology Source.* May-June. Retrieved 16.2.2015 from http://technologysource.org/article/online_drop_rates_revisited/

Flood, J., 2002. Read all about it: online learning facing 80% attrition rates. *TOJDE*, Vol. 3, No. 2. Retrieved 15.2.2015 from http://tojde.anadolu.edu.tr/tojde6/articles/jim2.htm

Frankola, K., 2001. Why online learners dropout. *Workforce*, pp. 53-63. Retrieved 15.2.2015 from http://www.workforce.com/articles/why-online-learners-drop-out

Friesen, N., 2012. *Report: Defining Blended Learning.* Retrieved 12.02.2015 from http://learningspaces.org/papers/Defining_Blended_Learning_NF.pdf

Fry, K., 2001. E-learning markets and providers: some issues and prospects. *Education + Training*, Vol. 43, No. 4/5, pp. 233-239.

Hall, J., 2001. *Retention and Wastage in FE and HE, Scottish Council for Research in Education.* Retrieved 26.2.2015 from http: http://www.ulster.ac.uk/star/resources/retention%20and%20wastage_hall.pdf

Haverila, M. and Barkhi, R., 2009. The influence of experience, ability and interest on e-learning effectiveness. *European Journal of Open, Distance and e-Learning,* Vol. 1. Retrieved 18.2.2015 from http://files.eric.ed.gov/fulltext/EJ911761.pdf

Kareal, F. and Klema, J. 2006. Adaptivity in e-learning. *Current Developments in Technology-Assisted Education. Current Developments in Technology-Assisted Education*, pp. 260-264. Retrieved 18.2.2015 from http://karlovi.cz/filip/adaptivity_in_e-learning.pdf

Kim, J.K. and Kim, D.J., 2013. Meta-analysis on relations between e-learning research trends and effectiveness of learning. *International Journal of Smart Home*, Vol. 7, No. 6, pp. 35-48.

Moodle, 2015. Moodle.org. Retrieved 3.3.2015 from https://moodle.org/

Novo-Corti, I. et al., 2013. E-learning and face to face mixed methodology: Evaluating effectiveness of e-learning and perceived satisfaction for a microeconomic course using the Moodle platform. *Computers in Human Behavior*, Vol. 29, pp. 410-415.

Park, J., 2007. Factors related to learner dropout in online learning. In Nafukho, F. M., Chermack, T. H., & Graham, C. M. (Eds.) *Proceedings of the 2007 Academy of Human Resource Development Annual Conference* (pp. 25-1–25-8). Indianapolis, IN: AHRD.

Park, J.-H. and Choi, H.J., 2009. Factors influencing adult learners' decision to drop out or persist in online learning. *Educational Technology & Society*, Vol. 12, No. 4, pp. 207-217.

Russell, T.L., 2001. *The No Significant Difference Phenomenon: A Comparative Research Annotated Bibliography on Technology for Distance Education.* IDECC.

Saba, T., 2012. Implications of E-learning systems and self-efficiency on students' outcomes: a model approach. *Human-centric Computing and Information Sciences*, Vol. 2, No. 6, pp. 1-11.

Sulčič, V. and Lesjak, D., 2009. E-learning and study effectiveness. *Journal of Computer Information Systems*, Vol. 49, No. 3, pp. 40-47.

Tyler-Smith, K., 2006. Early attrition among first time eLearners: A review of factors that contribute to drop-out, withdrawal and non-completion rates of adult learners undertaking elearning programs. *Journal of Online Learning and Teaching.* Retrieved 28.2.2015 from http://jolt.merlot.org/vol2no2/tyler-smith.htm

Upadhyaya, K.T. and Mallik, D., 2013. E-Learning as a socio-technical system: An insight into factors influencing its effectiveness. *Business Perspectives and Research*, Vol. 2, No. 1, pp. 1-12.

Wang, G. et al., 2003 *Departure, Abandonment, and Dropout of E-learning: Dilemma and Solutions.* James Madison University.

Willging, P. A. and Johnson, S. D., 2004. Factors that influence students' decision to drop out of online courses. *Journal of Asynchronous Learning Network,* Vol. 8, No. 4, pp. 105-118.

Yukselturk, E., 2005. Online information technologies certificate program. *Turkish Online Journal of Distance Education.* Vol. 6, No. 1. Retrieved 4.3.2015 from http://tojde.anadolu.edu.tr/tojde17/pdf/erman.pdf

Yukselturk, E. and Bulut, S., 2007. Predictors for student success in an online course. *Educational Technology & Society*, Vol. 10, No. 2, pp. 71-83.

CADA DÍA SPANISH:
AN ANALYSIS OF CONFIDENCE AND MOTIVATION
IN A SOCIAL LEARNING LANGUAGE MOOC

Michael Henry[1] and Diana Marrs[2]

[1]*eMentor – University of Missouri, University of Missouri, Kansas City*
[2]*Academic Program Development, University of Kansas*

ABSTRACT

Student performance in a Connectivist Massive Open Online Course (cMOOC), featuring daily synchronous web meetings was analyzed to explore the possibility of increased participant motivation and confidence. Participant survey data and course performance data were compiled, analyzed, and interpreted for 1256 individuals who completed a pre-course survey and 54 selected individuals who completed the post-course survey and met the sample criteria. This qualitative study adds to the overall understanding of social learning in a blended cMOOC environment. Results suggest that Daily Online Task-based Social (DOTS) Learning in large-scale web meetings may increase an individual's language learning confidence and personal motivation.

KEYWORDS

Online Learning, Foreign Language Instruction, Pedagogy.

1. INTRODUCTION

Massively Open Online Courses are criticized due to the "Retention Problem," (Koller, Ng, Do, Chen, 2013) demonstrating high numbers of participants in an online MOOC may not promote successful learning outcomes. Efforts to provide a more accurate picture of student success have included categorizing participants as "Passive participants, Active participants or Community participants," (Milligan, Allison, Margaryan, 2013). In addition, participants in MOOCs often report feeling "isolated and alone" which may reduce motivation and confidence, (Bischoff, 2000). In an attempt to increase the number of students completing online programs, different designs have been suggested, including social learning opportunities, blended asynchronous and synchronous interactions in a connectivist environment or cMOOC, (Siemens, 2005).

To help explore these issues further, a Spanish Language cMOOC called "Cada Día Spanish" was offered through the Canvas Network, for eight weeks in the fourth quarter of 2014. The online course was a demonstration of how daily synchronous meetings could be applied to a cMOOC, for language learning. Over 1700 participants signed up for the course. Study participants were selected based on criteria, described below, and resulting in 121 participants self-identified as active participants and 54 individuals selected as study participants. Our intention was to explore ways to increase personal motivation and confidence, with the assumption that language skill may improve as a result. This study explores two specific questions:

- Does participant motivation improve through daily, online, task-based, social learning?
- Will participants demonstrate increased language learning confidence in this cMOOC?

The qualitative study seeks to determine factors contributing to language learning success (confidence and motivation), rather than providing a comprehensive language learning program.

2. CADA DÍA SPANISH – cMOOC DEMONSTRATION PROJECT

The design team reviewed various cMOOC models (Siemens, 2005; Littlejohn & Margaryan, 2013) prior to the development of a design framework for the Cada Día Spanish cMOOC. A review of literature focused on significant indicators for student success and how social presence and Socialcultural Theory (SCT) affects student outcomes, (Ellis, 2003; Lantolf & Thorne, 2006). Some of these same benefits of teacher confirmation and social presence may transfer to technically sophisticated online social, instructor-led and synchronous learning environments. There are three themes we explored in the development of the Cada Día experimental cMOOC: Connectivist MOOCs, Social Learning, and Task-based language learning.

2.1 Connectivist MOOCs

In the connectivist MOOCs, or cMOOC model, learners take a greater role in "shaping their learning experiences than in traditional online learning, while facilitators focus on fostering a space for learning connections to occur," (Milligan, Littlejohn & Margaryan, 2013). cMOOCs focus on knowledge creation and generation rather than "knowledge duplication" (Siemens, 2012). Participant learners are asked to identify individualized learning goals in a self-directed environment. Students are provided a framework to respond to various activities at their own pace.

In a connectivist learning environment, the teacher assumes the role of facilitator, and guides students through feedback and encouragement. Although the facilitators are not responsible for imparting information, their role to direct students to find, analyze and share knowledge is critically important. However, massive courses make individualize instruction difficult, and synchronous online meetings have provided a method of maximizing facilitator to student interaction, (Henry, 2011). The cMOOC design removes the traditional "Instructor or Teacher" role and strives "to integrate instructional strategies that connect learners with each other in meaningful and authentic ways," (Stewart, 2013), which will hopefully reduce feelings of isolation and loneliness.

2.2 Social Learning

Sociocognitive theorists describe social learning as an interactive group process in which learners actively construct knowledge and then build upon that knowledge through the exchange of ideas with others. The Social Learning model relies on the interaction of three important techniques: social presence, teaching presence, and cognitive presence, (Garrison, Anderson, & Archer, 2000).

2.2.1 Social Presence

Social presence, in an online learning environment via computer-mediated communication (CMC) represents the degree of awareness of the other person in a communication interaction. If there is no "awareness" of another student or facilitator, the individual will feel alone. Several studies have observed that there is increased social interaction when the instructor "has not forgotten the importance of the human touch" (Pacansky-Brock, 2014).

2.2.2 Teaching Presence

Teaching presence is an understanding of the presence of an instructional path, designed by a facilitator, teacher or designer. This presence may be observed in videos, activities and communications from the facilitators. Teaching presence is strengthened through daily email correspondence, and synchronous web meetings.

2.2.3 Cognitive Presence

The third element, cognitive presence, is "the extent to which the participants in . . . a community of inquiry are able to construct meaning through sustained communication" (Garrison et al., p. 89). Online Learning environments that are instructor-led, combined with synchronous web conferencing may be able to take full advantage of the interaction between social presence, teacher presence and cognitive presence.

2.3 Task-based Language Learning

Task-based language learning (TBLL), also task-based language teaching (TBLT) or task-based instruction (TBI) employs the use of common language exchanges, (Ellis, 2003; Hismanoglu & Hismanoglu, 2011.). A key component of TBL includes a shift from teacher-produced material to student-produced material. Students are asked to share learning experiences, rather than the teacher directing learning experiences. Since conjugations, vocabulary and grammatical syntax may be easily found online, facilitators guide students through the task framework, and challenge them to improve their responses (Stroud, 2013). The language facilitators do not teach, rather they encourage student to student feedback and peer support.

Participants are encouraged to help each other revise and improve their responses to the task-based problems. Some have suggested that the approach is not pedagogy, but "paragogy," relating to peer production environments (Corneli & Danof, 2011) including the co-creation of ad-hoc spaces for dialogue and support. Facilitators provide quality criteria for knowledge creation and generation. The notion of Learner Generated Content (Perez-Mateo, Maina, Guitert, & Romero, 2011) is associated with learners' productions in Web 2.0 and networked environments. This type of social learning experience facilitates informed but personal views on topics and how they contribute to knowledge construction.

2.4 Cada Día cMOOC Course Design

The Cada Día demonstration project cMOOC was designed to address weaknesses identified in other MOOC models, such as participant isolation and loss of personal motivation. The experiment was designed to improve individual motivation and confidence through Daily, Online, Task-based, Social or "DOTS" (Henry, 2011) language learning, with daily online synchronous web meetings. The language learning tasks in the Cada Día Spanish cMOOC were authentic activities that a friend may share with another friend. They were simple activities, with opportunities for increasingly sophisticated responses. Participants were invited to share their activity in a synchronous web meeting. These activities are included below and in figure 1:

- Identify a song in the target language and share the lyrics.
- Identify a word and share a sentence with the word.
- Identify a short story and read the story.
- Identify a verb, conjugation and sentences using the verb.
- Identify a conversation tip, and share the communication strategy
- Compose a short description of a trip you have taken or would like to take
- Compose a short description of your family and friends.

These activities were posted in the Canvas Learning Management System, for asynchronous review and revision. Participants were invited to share their activity in a synchronous web meeting. Synchronous web meetings were held at Noon EDT UTC-4 hours. Over the eight week program offering, there were 40 weekday meetings and two special Saturday meetings.

Figure 1. Cada Día Spanish cMOOC task-based activities. These activities were posted in the Canvas LMS, then participants were invited to share the activities with native language facilitators in a synchronous web meeting

2.5 Qualitative Study Method

Qualitative analysis of individual participant motivation and confidence levels was observed using participation data in the eight week cMOOC, and through pre-course and post-course feedback comments. Motivation was observed through increased activity, as well as self-reporting levels of personal confidence. The methods for observing increase (or decrease) in personal motivation included end of activity personal assessment and survey, attendance at the synchronous daily web meetings and a willingness to volunteer to present activities in the web meetings.

2.5.1 Participant Surveys

- **Pre-Course Survey** - "Welcome to Canvas Network" - Survey. Administered online to enrolled cMOOC participants. 10 quantitative questions and 2 text response questions. (N=298).
- **Post-Course Satisfaction Survey** - User Experience Survey. Administered online to enrolled cMOOC participants. 10 quantitative questions and 2 text response questions. (N=54).
- **Activity Assessments and Survey** - These surveys appeared after the participant completed an activity. They included a total of six questions: Four questions, related to motivation and confidence and two randomly selected language skill assessment questions. The post-activity assessment was administered online in Spanish with English translations.

2.5.2 Study Sample

The qualitative study sample was determined by selecting participants who completed all surveys and who participated actively in the cMOOC for the entire eight-week period. The course was offered through the Canvas Network and advertised through social media, Google Adwords and Facebook. Over 1700 participants signed up for the online class and expressed an interest in the daily web meetings. From this initial pool, 1256 completed the pre-course assessment and survey. Participants were asked to self-identify as an "Observer, Active Participant, or Passive Participant." Only self-identified "Active Participants" were included in the qualitative study. Passive Participants were not interviewed or surveyed, since participation is critical in the analysis of increased or decreased confidence and motivation.

We were fortunate to have a large group of willing participants, however many only submitted one or two activities. From the enrolled participants, only a small number participated to the extent we would categorize as "Active Participants."

Table 1. Cada Día Spanish cMOOC Participant Activity

Activity Category	Submission
Total Asynchronous Tasks Posted	919
Total Task Assessment Responses	684
Total Synchronous Participants*	321
Total Synchronous Presenters*	118

These represent unique participants, who would have likely participated in more than one activity.

In addition to selecting participants who completed survey responses, we looked at participant online learning activity. We did not include time as a metric of learning activity. It has been suggested in other studies that the length of time studying a language would likely improve skill, as well as confidence (Vesselinov and Grego, 2012), but in an online environment, it is difficult to measure active time. Study time is difficult to document based solely on the time a participant started an activity, until the participant finished an activity, since they would likely be reading and studying outside of the application as well. Therefore we measured participant's learning activity based on completed activities, rather than time spent in the online learning environment.

The participants identified for further qualitative analysis were selected based on these criteria:

- Completed all study surveys
- Willingness to participate in the qualitative study
- Identified as an "Active Participant"
- Completed all seven learning activities
- Participated in at least ten web meetings
- Presented an activity in at least one web meeting
- At least 18 years of age
- Native English language speaker

This selection process resulted in a total of 54 participants to be analyzed for patterns of engagement and self-reporting. We were interested in how the active participants perceived gained or lost confidence and motivation over the eight-week program.

Table 2. Cada Día Spanish cMOOC Demonstration Project Participants

Participants	Number
Total cMOOC Participants	1703
Total Asynchronous Participants	647
Total Synchronous Participants	321
Self-Identified "Active Participants"	118
Study Participants selected	54

3. RESULTS

3.1 Participant Confidence and Personal Motivation

Does the cMOOC format, coupled with daily web meetings for participant presentation increase confidence and personal motivation? For the purposes of this study, we defined "Participant Motivation" as the change in the number of asynchronous actions such as activity submissions, assessment responses, and synchronous actions through web meeting attendance and web meeting presentation(s). After participant data was stripped of personal identification, each response was weighted based on the level of confidence indicated. For example, "I am not confident" was weighted 1 and "I am very confident" was weighted as a 10, using a

Likert Scale. We asked participants to self-report "hours studying each week," although we did not track actual online hours of activity. We also looked at actual participant "Activity," which reflected weekly activity submissions and participation in synchronous events over the eight week program offering. A specific individual (coded by participant number) was compared for each activity survey response. Individual responses were plotted on Figure 2, showing the general trend individual confidence and motivation over the entire experience.

Table 3. Motivation Survey Response Weighting

Question	Weighting
Q7: 0 to 1 hour	[1]
Q8: 1 to 3 hours	[2]
Q9: 3 to 5 hours	[5]
Q10: 5 to 10 hours	[8]
Q11: More than 10 hours	[10]
Q12: I am not confident	[1]
Q13: I am a little confident	[2]
Q14: I am more confident	[8]
Q15: I am very confident	[10]
Q16: I want to speak fluent Spanish	[10]
Q17: I want to speak Spanish well.	[8]
Q18: I want to speak a little Spanish	[5]
Q19: I am just observing	[1]
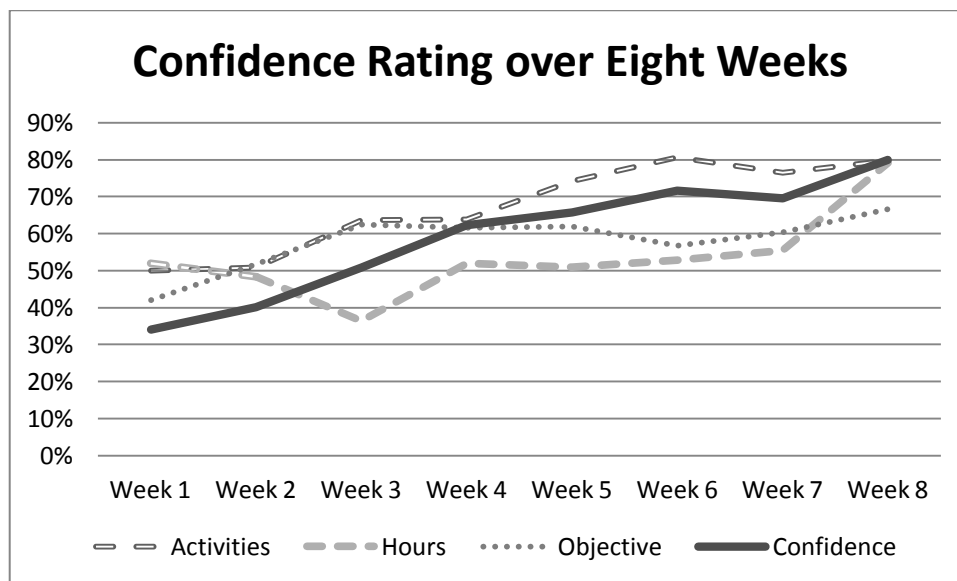
Figure 2. Confidence Rating Over Eight Week Period

3.2 Selected Participant Feedback and Comments

- **Participant 166852** Volunteering was helpful for me to get rid of my fear of speaking in Spanish. I learned better from the activities I shared.
- **Participant 170799** I feel the only way to learn something like a foreign language is to immerse yourself. When you're not exposed to Spanish speakers regularly, this is the next best thing.
- **Participant 201085** I volunteered because it was a great way to practice the language, and interact with others as well. I know basic Spanish, I mostly needed help speaking the language.

- **Participant 172152** The feedback for my mistakes was immediate and really upped my learning curve.
- **Participant 168080** I was able to choose the level of my participation, meaning if a question was too difficult for me to answer, I could try a more simplistic answer and, thus, still participate.
- **Participant 151464** I had an opportunity to learn from the feedback given to more advanced students.
- **Participant 192840** The expertise of the Facilitators staged an obviously "safe" place to make mistakes. Something most of the other students mentioned to me as being one of the things they appreciated most.
- **Participant 121560** Humor was included, which created a more enjoyable and memorable experience.
- **Participant 184261** I liked the mild, almost passive way I learned new things. It was a refreshing departure from the traditional teacher-lectures-students approach.
- **Participant 209679** This course has been both fun and interesting. The Live Meeting and conversing with students all over the world is inspiring. Learning another language is helpful in so many ways both personally and professionally. It opens new windows to the world and in so offers new perspectives to a person's life.
- **Participant 197501** Through this course I am much more motivated to learn than before. The activities have helped me a lot improve my level of proficiency.
- **Participant 183102** It has given me more confidence and expanded my ability to understand spoken Spanish. I have also learned to write sentences in Spanish extemporaneously.

4. CONCLUSION

Our intention was to determine if the cMOOC format, coupled with daily web meetings for participant presentation, would lead to an increase in motivation and confidence. The participant commentary indicates that the cMOOC format did improve motivation and confidence, as defined in this study. However, the responses were largely anecdotal and the data results were restricted to participants with high engagement. Further study is needed to demonstrate relationships between social online meetings, increased language skill, perceptions of confidence, and persistence of motivation. Research questions related specifically to this study could include:

- Does individual goal identification improve motivation or language learning outcomes?
- Does participation in live meetings increase participation in other online programs, (such as Duolingo, Busuu, WeSpeke, SpanishDict, etc.)
- Does the existance of synchronous opportunities in a cMOOC increase retention?

A recommendation resulting from this study is to encourage daily, social interactions through language learning tasks shared with facilitators and participants in web meetings. Other studies have found that students who lack motivation or confidence in their study of Spanish, often "studied very irregularly, e.g. a few hours in the beginning of the study followed by long periods of inactivity," (Vesselinov and Grego, 2012). If motivation and confidence can be increased through daily social task-based learning, it would follow that language comprehension may increase as well. The approach used here, daily large-scale web meetings, using structured task-based activities, may increase social engagement and motivation to reach individual language learning goals.

REFERENCES

Bischoff, A. (2000). The elements of effective online teaching: Overcoming the barriers of success. In K. W. White & B. H. Weight (Eds.), The online teaching guide: A handbook of attitudes, strategies, and techniques for the virtual classroom (pp. 57-72). Boston: Allyn and Bacon

Corneli, J. and Danof, C. J., (2011) Paragogy. In S. Hellmann, P. Frischmuth, S. Auer, & D. Dietrich Editors. Proceedings of the 6th Open Knowledge Conference. Paper presented at OKCon 2011: Open Knowledge Conference, Berlin, Germany. Retrieved from: http://ceur-ws.org/Vol-739/paper_5.pdf

Ellis, R. (2003). Task-based Language Learning and Teaching. Oxford, New York: Oxford Applied Linguistics. ISBN 0-19-442159-7.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. The Internet and Higher Education 2 (2-3), 87-105.

Henry, M. (2011). Webinars: Interactive Strategies to Increase Social Presence. 27th Annual Conference on Digital Teaching and Learning. Board of Regents University of Wisconsin System. Online: http://www.uwex.edu/disted/conference/Resource_library/proceedings/45243_2011.pdf

Hismanoglu, Murat & Hismanoglu, Sibel. (2011). Task-based language teaching: what every EFL teacher should do. Procedia Socil and Behavioral Sciences, 15, 46-52. http://www.academia.edu/5606483/Task-based_language_teaching

Koller, D., Ng, A., Do, C., & Chen, Z. (2013). Retention and intention in massive open online courses: In depth. Educause Review. Retrieved from http://www.educause.edu/ero/article/retention-and-intention-massive-open-online-courses-depth-0.

Lantolf, J. P., & Thorne, S. L. (2006). The zone of proximal development. *Sociocultural Theory and the genesis of second language development* (pp. 263-290). Oxford, NY: Oxford University Press.

Milligan, C., Littlejohn, A., & Margaryan, A. (2013). Patterns of Engagement in Connectivist MOOCs. Journal of Online Learning and Teaching, 9(2). Retrieved from http://jolt.merlot.org/vol9no2/milligan_0613.htm

Pacansky-Brock, M. (2014). Learning out loud: Increasing voluntary voice comments in online classes. In P. R. Lowenthal, C. S. York, & J. C. Richardson (Eds.), Online learning: Common misconceptions, benefits and challenges (pp. 99-114). Hauppauge, NY: Nova Science Publishers.

Pérez-Mateo, M., Maina, M.F., Guitert, M. & Romero, M., (2011). Learner generated content: quality criteria in online collaborative learning. European Journal of Open, Distance and E-Learning. Special issue. Retrieved from: http://www.eurodl.org/materials/special/2011/Perez-Mateo_et_al.pdf

Russo, T.C., Campbell, S., Henry, M.P., & Kosinar, P. (1999). An Online Graduate Class in Communication Technology: Outcomes and Lessons Learned. Electronic Journal of Communication, 9. http://www.cios.org/www/ejc/v9n199.htm#Cours

Siemens, G. (2005). Connectivism: A learning theory for the digital age. International Journal of Instructional Technology and Distance Learning, 2(1), 3-10. Retrieved from http://www.itdl.org/Journal/Jan_05/article01.htm

Siemens, G. (2012). MOOCs are really a platform [Web log post]. Retrieved from

http://www.elearnspace.org/blog/2012/07/25/moocs-are-really-a-platform

Stewart, B. (2013). Massiveness openness = new literacies of participation. Journal of Online Learning and Teaching, 9 (2), 228-238. Retrieved from http://jolt.merlot.org/vol9no2/stewart_bonnie_0613.htm

Vesselinov, R. and Grego, J. (2012). Duolingo Effectiveness Study - Final Report. Duolingo. Online: http://static.duolingo.com/s3/DuolingoReport_Final.pdf

Links to readings for full articles. Please delete after accessing.

http://www.academia.edu/3695958/Lantolf_J._and_Thorne_S._L._2007_._Sociocultural_Theory_and_Second_Language_Learning._In._B._van_Patten_and_J._Williams_eds._Theories_in_Second_Language_Acquisition_pp._201-224_._Mahwah_NJ_Lawrence_Erlbaum

http://www.academia.edu/5606483/Task-based_language_teaching

http://www.ingedewaard.net/papers/connectivism/2005_siemens_ALearningTheoryForTheDigitalAge.pdf

CREATING GAMES AS AUTHENTIC LEARNING
IN THE INFORMATION TECHNOLOGY CLASSROOM

Mark Frydenberg
Computer Information Systems Department
Bentley University
Waltham, Massachusetts, USA

ABSTRACT

Teaching students to create computer games has become a common practice in both K-12 and tertiary education to introducing programming concepts, increasing student engagement, and recruiting majors and minors in technology fields. This study describes a project where first-year college students in an introductory technology concepts course use a visual game creation tool to develop original games to play on their computers and mobile devices. The paper argues that the process of making an original computer game develops digital literacy skills and provides an authentic learning experience as students collaborate to create, publish, and deploy interactive games that they can play on their computers and mobile devices.

KEYWORDS

Game Development, Digital Literacy, Authentic Learning.

1. INTRODUCTION

Many educators have turned to game development as a way to engage students with programming and technology concepts. Creating games to play on computers and mobile devices requires specifying rules of play, creating multimedia, posting the files for distribution on multiple channels, and navigating operating system features. This paper contends that completing these tasks allows students to demonstrate many digital literacy proficiencies and provides an authentic learning experience.

1.1 Digital Literacy

The need for today's students to be digitally literate is growing, and educational organizations worldwide have responded with new curricula to teach digital literacy skills. In the United Kingdom, the Department of Education has teamed up with Microsoft to produce a National Curriculum Guide for K-12 students outlining learning goals. Throughout their education, this curriculum provides opportunities for students to apply principles and concepts of computer science, including abstraction, logic, algorithms, and data representation; to analyze problems computationally; to evaluate and apply information technology, and become responsible, confident, and creators of information and communication technology.(Department of Education, 2014) In the United States, a National Science Foundation Grant has sponsored the development of new curricula for a higher education advanced placement computer science principles course to encourage computational thinking and problem solving skills. (College Board, 2015) The course, to launch in, 2016 will "introduce students to creative aspects of programming, using abstractions and algorithms, working with large data sets, understandings of the Internet and issues of cybersecurity, and impacts of computing that affect different populations."

The National Computing Curriculum identifies pathways to digital literacy through a student's understanding of algorithms, programming and development, data and representation, hardware and processing, communication and networks, and information technology. (Department of Education, UK, 2014) Teaching students to create their own computer games has become a popular approach to introducing programming concepts to introductory computer science and technology students. (Mohammed & Mohan,

2010), (Guzdial, 2015), (Bayliss, 2009). (Elliott, 2007). From an instructional perspective, creating games offers opportunities for teaching programming and software development skills on many levels. Games are engaging, allow students to learn by playing, and enable students to turn their ideas into real-world applications. In addition to promoting algorithmic thinking and problem solving, creating their own games presents students with opportunities to be creative, and demonstrate their proficiency as able participants in a world based on digital literacy skills.

1.2 Authentic Learning

Authentic learning pedagogy enables students to engage in realistic tasks using real-life resources and tools, and offers opportunities for students to learn while taking on the roles of professionals dealing with actual problems that arise. (Herrington, 2003). (Herrington, Parker, & Boase-Jelinek, 2014) Authentic learning environments have real-world relevance, are not well-defined, and require investigation of a task over a period of time, and from different perspectives. They encourage collaboration and reflection, and span several subject areas. Authentic activities integrate with each other such that they reflect real world assessment, and allow competing solutions with a diversity of outcomes. They "engage learners in the work of professionals" (Elliott, 2007, p. 34). The instructor fashioned a game creation exercise and contest for students to learn about software development, and required students to publish their games on two different distribution channels, each with its own set of rules and standards. The adaptation of industry-standard procedures as a classroom exercise provides a new way to engage students in authentic learning as they build digital literacy skills and complete the tasks necessary to create and share their games with the world.

1.3 Research Questions

This study shares preliminary results after offering a game development experience to beginning information technology students. Academic goals of the exercise were to provide an authentic learning experience that enabled students to apply digital literacy concepts and skills, and empower t to create computer games that they can play on their own devices.

The study addresses the following research questions:

- Will students with little or no previous experience in developing software succeed in creating games?
- How does creating and deploying games provide for authentic learning as students develop and apply digital literacy skills?

2. CREATING GAMES TO DEVELOP DIGITAL LITERACY SKILLS

This study introduced students to the use of Construct 2 (Scirra.com, 2014), a gaming development tool that enables users to create advanced 2-D games without the use of any programming language. Construct 2's game creator allows users to export their games as web apps by generating HTML5, CSS3, and JavaScript files, and also to generate native app packages for Windows Phone, iOS, and Android, that can be published on the Windows, Apple, and Google Play app stores and marketplaces.

Suitable for beginners who have little or no experience developing software applications, Construct 2 enables students immediately to take on the role of game developers. They design backgrounds, layouts, and objects (characters, platforms, bullets, sounds, and so on) to be used in the game, and specify their properties and interactions during game play. Figure 1 shows the properties of a player object in a 2-D platform game.

Construct 2 uses an event-driven syntax to describe the interactions between these objects. As shown in Figure 2, a rule describes an end-of-game scenario: "When the player collides with the red dot object (Sprite 9), destroy the player and set Lives back to 4 (because the game is over)." The developer would specify similar rules for game play based on input from arrow keys, touch, or tapping buttons on the screen.

A game must pass several rigorous tests before an app store will accept it for publication. The developer must specify the game's orientation (portrait or landscape), test the game in an emulator to ensure it functions correctly on a variety of devices and screen sizes, register the game with the app store by finding an available

name, provide a series of screenshots and icons at different sizes, package all of the necessary files app, and upload them to the store. Students found this process to be quite complicated, though none of the individual steps involved were complicated on their own.
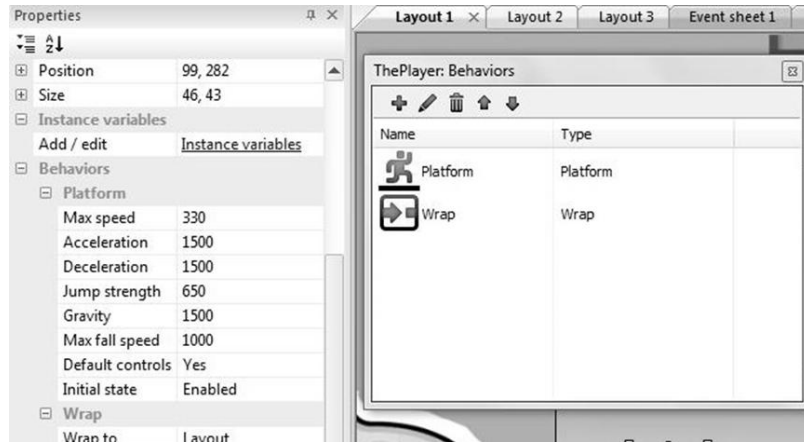
Figure 1. Specifying properties and behaviours of the Player object.
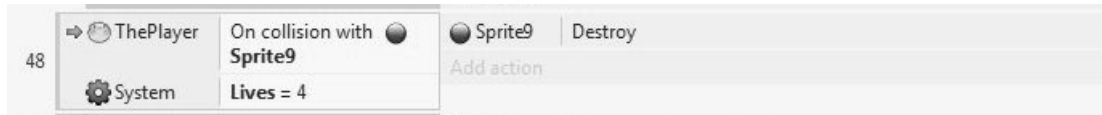
Figure 2. Describing a rule in Construct 2.

Figure 3 shows a student's game published to the Windows Store.
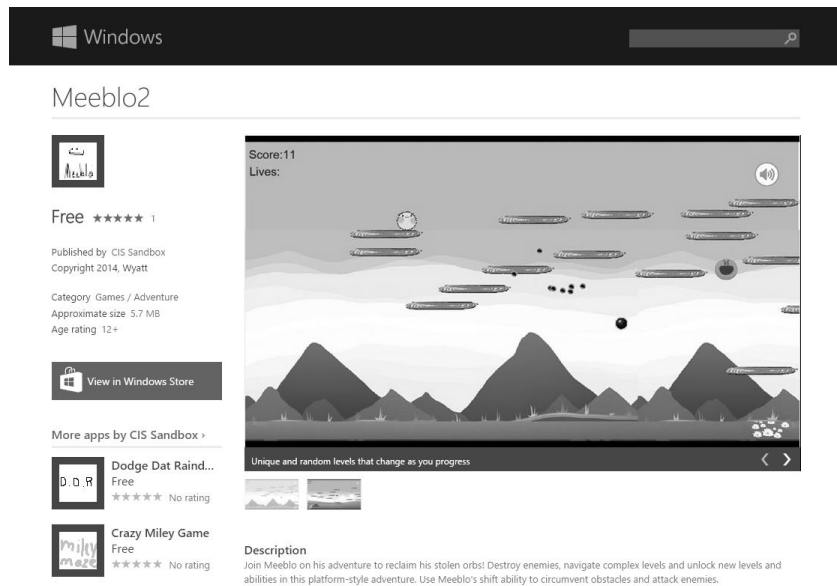
Figure 3. A student's game published to the Windows Store.

When preparing an app for the store, the developer may specify pricing information if the app were to be offered for sale (for the sake of this assignment, students could not sell their apps, as doing so would require additional complexities related to setting up merchant accounts); identify an age-appropriate rating, and supply a complete description and game play notes for game testers.

These real-world tasks required to submit a game for publication demonstrate a student's basic digital literacy skills. Students must be adept at interacting with files, creating graphics, converting files from one type to another, and using web-based tools to accomplish a sophisticated task. Completing these steps also gives students additional appreciation of how apps, such as the ones they download routinely to their devices, are published and deployed via an app store.

3. METHODS

This section presents the research context, data, analysis, and discussion.

3.1 Context

The research context was a required course for first year introductory technology students. The study took place in three sections of IT 101 (Introduction to Information Technology and Computing Concepts), an introductory IT course required of all first year students at Bentley University, a business university in the United States. IT 101 teaches digital literacy skills and covers information technology topics, including making use of laptops, productivity and application software, the World Wide Web, computer components and mobile devices, developing web pages with HTML, operating systems, the Internet, image and video formats, and wireless networking. Three academically different sections of the course taught by two different instructors participated in the project.

- An Honors section, for students enrolled in the honors program, chosen because of their high scholastic abilities,
- An Accelerated section, offered to students who self-selected to be this section because of their interest in technology, and
- A standard section open to all students.

Each section met twice a week for 75 minutes each session. Microsoft sponsored the gaming project and provided an academic technology evangelist to lead the training sessions in class. The same Microsoft academic evangelist facilitated the Construct 2 trainings to students in all three sections, and the instructors assisted students during the demonstrations and exercises in their classrooms.

Students installed Construct 2 on their laptops prior to the training. Teaching students to use the software in the classroom required significant support from the Microsoft evangelists who created classroom resources as well as trained tutors to assist students in developing and deploying their games outside of class.

At the first training, students followed a printed tutorial as the presenter demonstrated each step to create a simple 2-D shooter or platform game. Game elements included identifying a player, shooter, layouts, user interface elements for keyboard and touch input, detecting collisions of objects, and creating and destroying objects. These elements are common to many 2-D games.

The second session showed how to include advanced features, such as adding music, keeping score, and transitioning between different layouts for a start screen and a game over screen. Students also learned how to package their games for deployment to the web and to the Windows Store.

For their assignments, students could create their own original game, or adapt the game they worked on in class and add new features such as sound, score keeping, and end-of-game logic. They could work individually or collaborate with a partner in designing and developing their games, but students had to create their own individual games (which could be similar) for this assignment.

Because Microsoft sponsored this gaming training and contest, and because an academic license through Microsoft DreamSpark allows students to publish apps to the Microsoft Windows store without the need to purchase a developers license, this project instructed students to publish their games to the Windows store. (Apple and Android developers must pay an annual license fee to publish apps in those app stores.)

A Microsoft evangelist, tutors in a university computer lab, and students who had taken the course during a previous semester were available to help the current cohort of students with their games during additional "studio time" sessions outside of class. As an additional incentive, Microsoft donated prizes to be awarded to the winners at a games party at the end of the project.

Upon the due date, tutors and former students played and reviewed all of the games from all of the students in the current semester, evaluating them on playability and originality, and whether a game met a

checklist of required features. From these reviews, the top 7 games were announced. All students then were invited to a games party where they could play all of the games and vote for their favourite ones. The winners were announced, and prizes awarded.

3.2 Data and Analysis

57 of 85 students (37 male, 15 female, 5 prefer not to say or unanswered) from three sections of IT 101 voluntarily participated in an online survey within two weeks after the gaming assignment ended, to share their feedback about the experience.

Of the 57 responses, 44 were complete and used for this analysis. The remaining 13 students did not answer all of the survey questions used in this study.

Results show that these students use their computers and devices to accomplish daily tasks: 34% of their time online is spent for homework, learning or professional reasons, 14% keeping up with news, 20% of their time is spent communicating or on social networks, 22% of their time they use the web for entertainment including music, videos, and games, and 9% of their time is spent online shopping, banking, or other business tasks.

Despite their being tech savvy, 83% responded that they had not created software applications of any kind prior to the game assignment. 17% of respondents had created software applications in high school, including simple Java, Visual Basic, or C# programs, web pages developed in HTML, CSS, and JavaScript, and games using Flash or other game creation tools. None of the students had used Construct 2 previously. These results suggest that creating games to play on their computers and mobile devices was a new experience for most of the students, and certainly, deploying them to two platforms was new for all of the students.

3.3 Results and Discussion

As shown in Figure 4, survey results suggest that the gaming assignment instilled confidence, captured interest, provided authentic skills in writing programs and apps, and allowed students to reflect on their successful results.
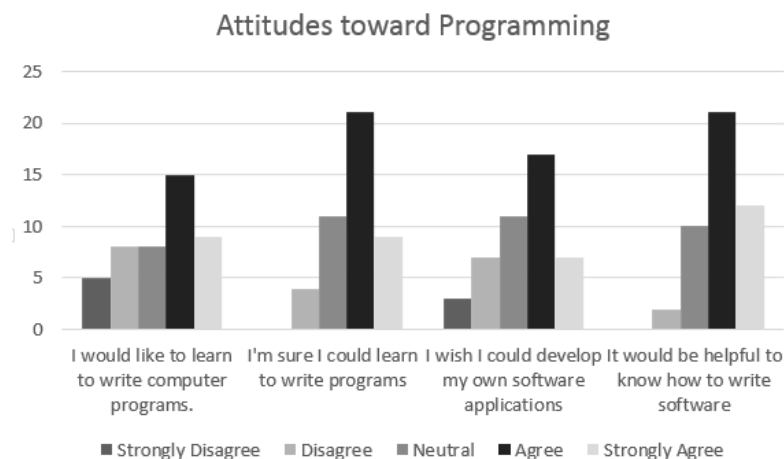
Figure 4. Student attitudes toward programming and creating software.

Said one student, "Games can be easier to make then one thinks." Several student comments reflected the sentiments that "game development is a lot of hard work but it is very rewarding to see a finished project after putting many hours of development into it. I learned to have a final vision but also think step-by-step to make that vision come to reality." Other students got lucky in the process of creating their games: "if you miswrite part of a code, a function you did not expect occurs…You gotta go with the flow if something unexpected works."

3.3.1 Game Development as Authentic Learning

"An authentic, challenging task is the starting point. Authentic tasks are completed for reasons beyond earning a grade. Students also see the activity as worthwhile in its own right." (Means & Olson, 1994, p. 15) The survey asked students their opinions of the gaming assignment as an authentic learning experience.

"Authentic learning requires students to reflect on their experiences and draw conclusions from their findings." (Herrington, 2003). In their reflections, many students remarked that the assignment was "real", gave them a taste of building apps, developed and applied their IT 101 skills, and most were pleased with the games the created, as results suggest in Figure 5.

Attitudes toward Game Development Assignment
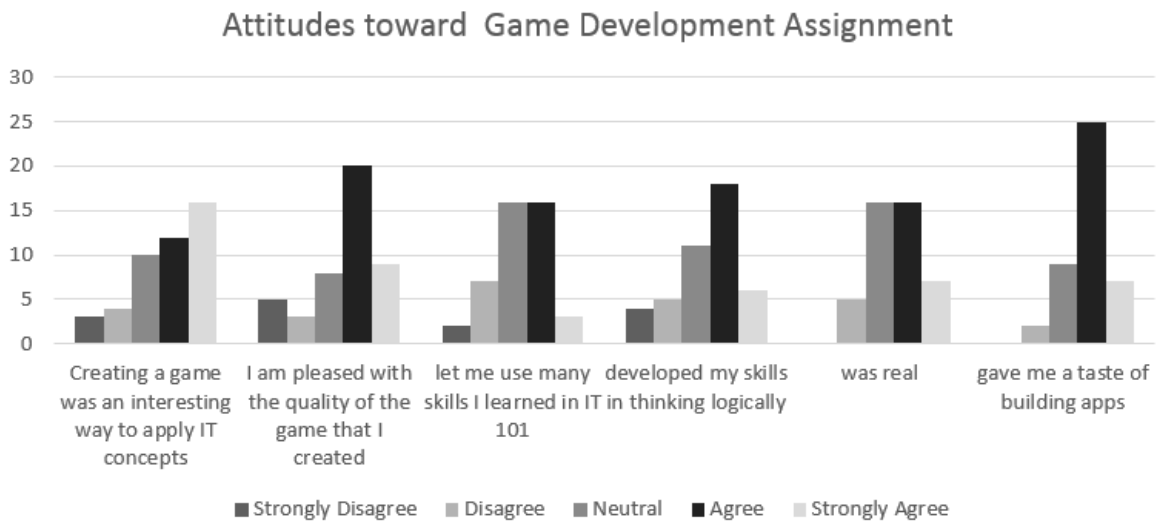
Figure 5. Attitudes toward game development assignment as authentic learning

Results were mixed as to whether students found the experience authentic based on the survey aspects above. Of those who were not neutral in their responses, most agreed or strongly agreed that it gave them a taste of building apps and made them want to learn more about programming. In an open-ended response, students commented that they learned to use Construct 2 and Brackets (an HTML editor), and how to upload their games to the Microsoft store. They learned "to do in depth research on a topic and how to make my own game," that solving problems by walking through them are the best methods to solve computer issues," and one claimed that the assignment allowed the student to "implement higher thinking and creativity into an IT aspect." Another student remarked, "The IT field is a lot harder than it look to be from the outside - but in the end you've always got an opportunity to create something beautiful." For many students, creating a game was the most technically complex task they had ever completed.

Table 1 summarizes ten characteristics of authentic learning environments (Herrington, 2003), and describes how each is manifest in the Gaming Assignment.

Table 1. Authentic Learning Characteristics as Evident in the Gaming Assignment

Authentic Learning Characteristic	As Evident in the Gaming Assignment
Problem has real-world relevance	Students create a game that runs as a web app or a Windows app. Students see the relevance of creating software that runs on their computer or mobile device. The exercise mirrors the requirements of a real-world activity.
Problem is open-ended	Students have the flexibility to use the tools they know in order to design their games, and must apply the concepts learned during the classroom trainings or perform research to find additional tutorials or examples on which to base their own games. Students must ascertain the effectiveness of their choices as they try to implement their own ideas to modify existing games or create new ones.

Task to be investigated over a sustained period of time	The gaming assignment runs over a period of four weeks, so students have time to learn basics, explore alternative solutions, get support from tutors and peers, and realize the trajectory of their progress. The project is divided into smaller, manageable steps that allow students to reach these milestones.
Allow for exploring a task from different perspectives	Students involved in the project are in their first year of college, many have not done any programming or development before. Students with a more technical acumen were able to add complexities; others looked at specific tasks or features such as adding score keeping capabilities, and were able to apply the same steps they did in class example to their own games.
Provide for Collaboration	While students were required to create their own games, they were encouraged to work in pairs to share ideas, and review each other's work. This proved to be effective as students were able to support each other in their learning, show each other how to accomplish various tasks that they remembered that their partners did not. Students used appropriate online collaboration tools to share screens, graphics, or other files with each other.
Provide an opportunity to reflect on the experience	The goal of the exercise was to learn about creating software by developing an actual game, and then deploy it to two different distribution channels. By developing, debugging, and playing their games they reflect on the logic and scenarios they implemented, and how the steps they specified produce the desired game play. By playing their games and showing them to others, students had an opportunity to talk about their work, and reflect on ways that they might want to improve it in future revisions.
Seamlessly integrate with assessment	Not only the instructor determines the quality of a student's game; an independent evaluation takes place through the process of submitting the game to the Windows store. Each step in the submission process requires that the correct files are in place, and descriptions and documentation follow specifications. Microsoft testers play each game prior to accepting it on the store, testing for touch input and other features. Games accepted to the store received an automatic 'A' because they passed these stringent requirements. Grades for this assignment considered the playability, difficulty, and originality of their games, along with the status of their game's acceptance on the Microsoft store.
Create polished products in their own right	The games that students created were completely functioning software apps that they could run on their computers and mobile devices. Many featured touch input, music, score keeping, animations, and other characteristics found in real games. Not only did students create games, they had to deploy their games correctly so others could access them on their devices.
Allow competing solutions and a diversity of outcomes	While all students completed the same in-class training, the games they created were all different. Even variations on the same in-class example generated a variety of results and outcomes. A games contest gave added incentive to produce a high quality final product.

4. CONCLUSION

This study presents preliminary results based on one semester's implementation of a gaming project.

Future research will aggregate survey results over a period of several semesters to further study how the process of creating and deploying games for play on computers and mobile devices encourages digital literacy skills and impacts student learning.

Initial findings suggest that students found the gaming assignment offers an opportunity for students with no prior programming skills to create software within a controlled and supportive environment. It allows them to demonstrate their understanding of coding principles, including identifying objects and interactions, and that creating software requires a developer to specify exact instructions for the computer to follow.

Students learned to represent different types of data and information (scores, sounds, characters in their games) in a digital context; and to design games for multiple devices and input sources, from touch to keyboard. The assignment provides students an opportunity to reflect upon their games and consider enhancements for future revisions. They also must consider ethical implications (suitability of content, amount of violence in games, and use of open-source sounds and graphics) when building their games. The exercise allowed students to experience the role of a game developer and at the same time, create apps for their computers and mobile devices.

ACKNOWLEDGEMENT

REFERENCES

Bayliss, J.D., 2009. Using Games in Introductory Courses: Tips from the trenches. *ACM SIGCSE Bulletin - SIGCSE '09*, pp.337-41.

College Board, 2015. *Computer Science Principles*. [Online] Available at: http://apcsprinciples.org/ [Accessed 21 February 2015].

Department of Education, UK, 2014. *Quick Start: A CPD Toolkit for Secondary Teachers*. [Online] Department for Education Available at: http://www.quickstartcomputing.org/ [Accessed 21 February 2015].

Department of Education, 2014. *Computing programmes of study: key stages 1 and 2*. [Online] Available at: http://www.quickstartcomputing.org/secondary/Resources/section2/Computing%20programmes%20of%20study%20 Key%20Stages%201%20and%202.pdf [Accessed 21 February 2015].

Elliott, C., 2007. Action Research: Authentic Learning Transorms Student and Teacher Success. *Journal of Authentic Learning*, 4(1), pp.34-42.

Guzdial, M., 2015. What's the best way to teach computer science to beginners? *Communications of the ACM*, 58(2), pp.12-13.

Herrington, J., Oliver, R. & Reeves, T.C., 2003. Patterns of engagement in authentic online learning environments. *Australian Journal of Educational Technology*, 19(1), pp.59-71.

Herrington, J., Parker, J. & Boase-Jelinek, D., 2014. Connected authentic learning: Reflection and intentional learning. *Australian Journal of Education*, pp.1-13.

Herrington, J., Reeves, T., Oliver, R. & Woo, Y., 2004. Designing authentic activities in web-based courses. *Journal of Computing in Higher Education*, 16(1), pp.3-29.

Means, B. & Olson, K., 1994. The link between technology and authentic learning. *Educational Leadership*, 51(7), p.15.

Mohammed, P. & Mohan, P., 2010. Combining Digital Games with Culture: A Novel Approach towards Boosting Student Interest and Skill Development in Computer Science Programming. In *2010 Second International Conference on Mobile, Hybrid, and On-Line Learning*., 2010. IEEE Computer Society.

Scirra.com, 2014. *Construct 2*. [Online] Available at: http://scirra.com/construct2

ASSISTING TUTORS TO UTILIZE WEB 2.0 TOOLS IN EDUCATION

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

ABSTRACT

Over the last decade, web has changed the way that educational procedures are delivered to students and has brought innovative learning technologies and possibilities that were not available before. The Web has evolved to a worldwide platform for collaboration, sharing and innovation, constituting what is called Web 2.0. Social media are an emerging part of Web 2.0 and have great potential to be used in education. The efficient integration of social media and Web 2.0 tools in educational systems and courses' curriculum mainly depends on tutors' abilities and experiences. However, in many cases, tutors are not familiar with social media and with many useful Web 2.0 tools and so fail in utilizing them into their courses. In this paper, we present an educational system that aims to assist teachers to develop e-Learning 2.0 knowledge and skills and thus turn them from just in-class trainers to skilled e-tutors. We present the educational courses and the learning approaches followed to assist tutors in applying web 2.0 tools and the social media in their courses for the best benefit of the students' learning. The educational system provides courses and learning material, and assists the tutor to learn how to utilize social media and web 2.0 tools in classroom or in distance learning with the aim to organize, monitor and share learning content, attract students' attention with entertaining activities and motivate them to become more active and collaborate in educational activities. The evaluation study conducted reports very promising results.

1. INTRODUCTION

The advert of the web has changed completely the way that eLearning and educational procedures are delivered to students and have brought new innovative learning technologies and possibilities. Web 2.0 technologies are becoming very popular in the everyday lives of students and as a result, teachers and education designers have begun to explore their use in formal education. The growth of Web 2.0 and the rising of social media have transformed the way that people communicate and collaborate and have the potential to enhance the learning efficiency of the educational systems and eLearning procedures (Bennett et al 2012). Indeed, social media platforms can become important disruptive technologies for building cutting edge models of management education (Thomas et al 2012). In this line, the emergence of web 2.0 has led to a new concept known as eLearning 2.0 referring to the use of the social media and the technologies of Web 2.0 in the relatively unchanged institutional framework that characterizes education (Keats et al. 2007) (Lwoga 2012). When applied in education area, Web 2.0 technologies emphasize on students' active participation, the student-centered generation of content and collaboration and seem to fit very well with the kinds of creative and critical activities associated with all levels of education, with the ways that we know students learn through exposure to multiple perspectives, and with the communication and teamwork skills wanted for students to develop (Bennett et al 2012). So, the incorporation and utilization of web 2.0 technologies in education is vital.

When incorporating any kind of media into courses' curriculum, educators should consider the construct of the course, the technologies used and the pedagogical approaches followed to design and deliver the desired learning activities (Blaschke 2014). While eLearning constitutes a commonplace form of education, the web tools and applications that are used are mainly first generation web tools rather that second

generation, WEB 2.0 tools (Connolly et. al 2011). A reason for this is the tutors' and students' perceived complexity of the tools and the lack of training for using them properly. The tutors in many cases are not familiar with the trending social media services and the available web 2.0 tools and fail in utilizing them into their courses. It is well pointed that tutors need to constantly update their knowledge and capabilities regarding the utilization of new technologies in education. However, in many cases, the lack of tutors training and familiarity with the new web technologies prevent their educational utilization and development. Indeed, in many cases tutors are not familiar with the new web 2.0 technologies and are not aware of what they offer and how they can be utilized in education for the best benefit of their students' learning.

In order to assist tutors gain skills on the new Web 2.0 technologies we have designed and developed an educational system and created various courses and training scenarios. The system aims to broaden the e-skills and competencies of teachers, trainers and tutors and help them to develop adequate online training practices for effective distant tutoring activities at the workplace and on the go without time and distance barriers. In this paper, we initially present the educational system developed, the courses designed and the educational scenarios formulated that aim to help the tutors get familiar with various social media and web 2.0 technologies and platforms and utilize them in the courses they teach. The online courses are designed to assist tutors in applying social media tools and techniques in education and also learn how they can integrate the social media in their courses' curriculum. The utilization of social media could enhance the interaction between the tutor and the students and also the communication between the students who have the opportunity to create, share and exchange information and ideas in virtual communities and networks. Then, we present the evaluation study conducted and the results gathered regarding the tutors and students experiences, their thoughts and opinions.

The structure of the rest of the article is as follows: In next Section, background topics on social media and web 2.0 are discussed and related works are presented. In Section 3, we describe the content and the methodologies of the online course developed, the topics it covers and the social technologies involved. In Section 4, the evaluation study conducted is presented and the results gathered are discussed. Finally, Section 5 concludes the article and draws directions for future work.

2. BACKGROUND TOPICS AND RELATED WORK

Web 2.0 technologies and tools have been used with great success in the e-Learning field and can be utilized to improve the efficiency of the learning for the best benefit of the students. There are many definitions regarding the term and the concepts of Web 2.0 which is defined as the social use of the Web which allows people to collaborate, to get actively involved in creating content, to generate knowledge and to share information online (Grosseck et al 2009). Over the past few years, the integration of social media and web 2.0 technologies in educational systems has attracted a lot of interest. A recent overview of good and widely used approaches can be found in (Moran et al 2011) (Tess 2013). Several studies (Venkateshet al 2014) (Churchill 2009) (Laird 2014) point out the important role that web 2.0 technologies can play in educational systems and in the e-learning area in order to assist tutors to enhance the efficiency of their courses' learning activities, engage and motivate students and improve the communication and cooperation among students and their tutors. Various studies (Holotescu 2015) (Huang et al 2014) examine the way that web 2.0 can assist students in learning and support the development of their skills and competencies and also enable drive broader pedagogical approaches and decision making with the aim to improve educational material and learning procedures. In the work presented in (Ebner et al 2010), authors present a research study that was carried in an Austrian University regarding the use of microblogging platforms in Higher Education. The authors indicate that microblogging should be seen and handled as a completely new form of communication that can support informal learning beyond the classrooms. Authors in (Hung et al. 2010) explore how social networking technologies can be used to supplement face to face courses and provide a mean of enhancing the students' sense of community and promote classroom communities of practice in the context of higher education. The authors indicate that the majority of the participants in their experimental study developed a strong feeling of social connectedness and expressed favorable feelings regarding their learning experiences in the courses where social networks were used as a supporting tool. A study made by Callaghan (Callaghan et al 2012) shows the potential of social network integration into course curriculum. The authors point the critical role of the teacher in engaging effective online learning in social networks and indicate that the

quality of teacher-student relationships, the extent to which a 'learning' rather than 'social' attitude was established, and the online presence that the teacher exerted in the social network facilitate more successful student learning. In the study presented in (Arnold et al 2010), authors indicate that social networks can extend the community originally formed in a physical classroom into an online social network community. The online environment could provide students and teachers the ability to publicly post and read each other's work, modeling approaches to the assignments and various opportunities to provide feedback. Authors in the work presented in (Roblyer et al 2010) study the integration and the utilization of the Facebook platform in the education field. Authors present how students could communicate and cooperate formulating virtual classes and indicate that students are open to the possibility of using Facebook and similar technologies to support classwork. Finally, authors in (Grosseck et al 2009) examine the potential of the Twitter network in the educational field. The authors describe its capabilities and present various ways it can be utilized by the tutors in their courses. The work indicates that Twitter can be very useful and assistive for both tutors' teaching and students' learning enhancing their communication and cooperation.Researches and educators indicate the important role that social media can play in the educational field for assisting the tutors in teaching and students in learning for the best benefit of their learning progress. It is well pointed that teachers should have a strong knowledge and understanding of the way that social networks function, what each social network offers and how they can be utilized and integrated into the courses they teach.

3. WEB 2.0 TECHNOLOGIES AND USING SOCIAL MEDIA

In this section we present the educational system developed and the courses designed to assist tutors in learning how to use social media and web 2.0 technologies in education. The educational system offers tutors various functionalities. Initially, tutors register to the system. During registration, personal information such as name, age, sex, years of previous employment, discipline, school and specialty are required. After subscription the tutor can, at any time, enter the system and assess his account and then select and study the available courses.

The system provides tutors a series of online courses that assist them to learn how to use web 2.0 technologies and social media in education and also assist them to develop online courses and enhance their teaching. In general, the platform provides tutors with courses covering the utilization of the new generation technologies in education. The courses are organized into categories and each category consists of a series of courses. Three main categories of courses are available covering the domain of application of social media in education, presentation of web 2.0 technologies and the e-Learning practices in classroom and in distance education. A part of the categories of the online courses provided by the platform is illustrated in Figure 1.
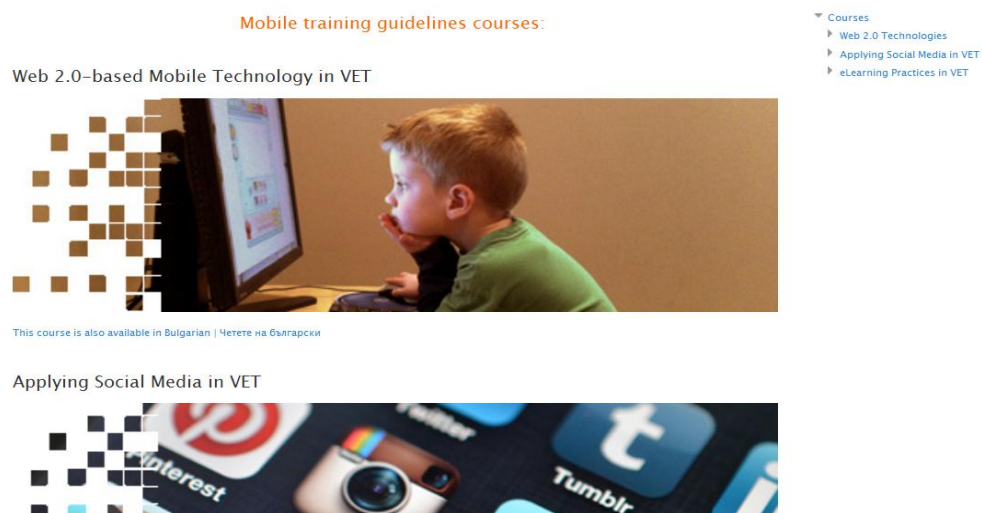
Figure 1. A part of the main categories of the courses

Each category consists of a number of courses. A basic course regarding the use of social media in education is the "Applying Social Media in VET".This course after an initial introduction to social media provides detailed, step-by-step instructions to use some of the most representative social media tools for education. The social media tools covered are Wikispaces, PrimaryPad, Twitter, TodaysMeet, Facebook, Edmondo and Pinterest. Some of these are very popular tools that the educators may already be familiar with (Facebook, Twitter) while others are not popular, but are very useful and easy to learn tools (PrimaryPad, TodaysMeet) that can be used in the classroom or in distance education. Each presentation/chapter has an introduction and instructions of how to use the tool and also a section with ideas, guidelines and scenarios to follow for the tool presented. The contents of the course are illustrated in Figure 2.
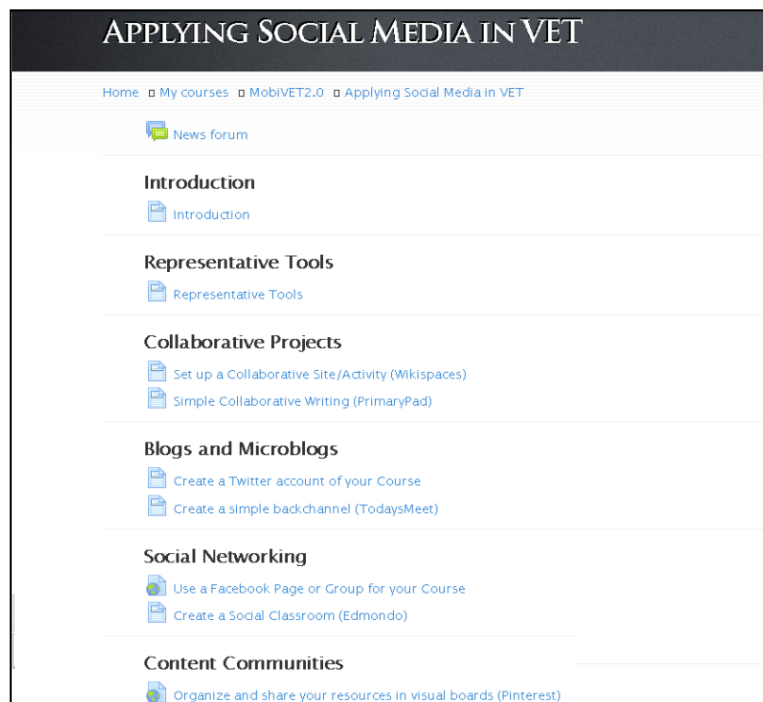
Figure 2. Contents of the course "Applying Social Media in VET"

The course provides an introduction to the social media and to the technologies it involves. It also provides a simple categorization of the basic types of Social Media Tools. Furthermore, it describes the benefits for both students and educators of applying social media in education and especially in distant learning. For each type of Social media tools (Collaborative, Blogs and Microblogs, Content Communities, Social Networking, Virtual Social Worlds, Virtual Game Worlds) it refers to specific tools that are popular or useful for education. For each tool there is a small introduction about what it is and what kind of functions it offers. It focuses on free and open source software that is either popular, so educators and students are probably already familiar with, or simple and easy to use in classroom. The platform also provides the capability for the trainers to create an online course using the Web2.0 technologies. It provides guidelines for designing and developing an e-Learning course for instructional designers and trainers who are new to the development of online learning resources and it addresses the design, development and delivery activities which are specific to e-Learning. The tutors can access the educational system anytime, select the courses they would like to take and study the material of each course on their own pace. Finally, while studying the courses, the tutors can utilize the tools they study into their own courses and help their students to explore and use them.

124

4. EVALUATION

The evaluation study had the purpose to evaluate the teachers' overview about the utility of didactical aspects of the system and the courses designed. It aims to provide an insight of tutors' feelings regarding the utilization of web 2.0 technologies into their courses. The evaluation was conducted during the school year 2014/15 and the participants were 11 tutors from Greek schools from different categories of schools and education levels.

The primary descriptive analysis indicates that the respondents are distributed by gender with ratios of 27% male and 73% female respectively. Also, regarding the respondents' age, it can be observed that 73% of teachers are over 40 years old as illustrated in Figure 3.
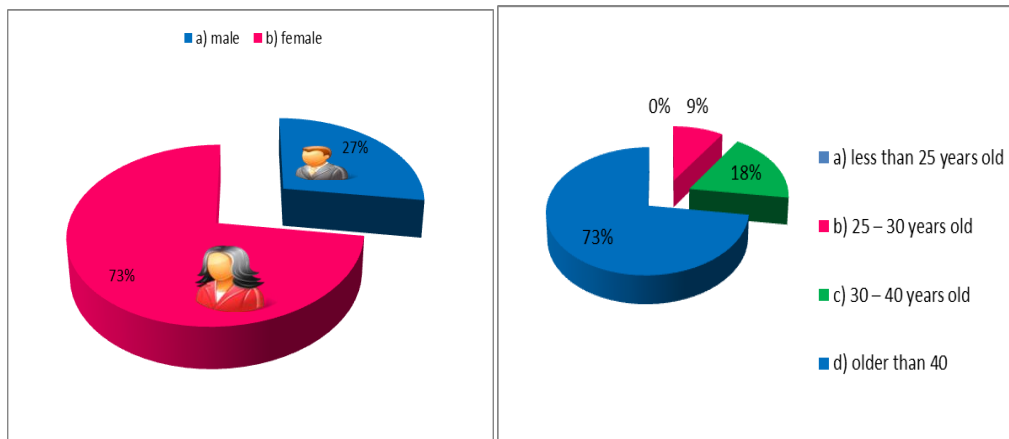
Figure 3. Tutors gender and age.

In addition, the distribution of the educational levels of the tutors' organizations is illustrated in Figure 4. The results showed that most of the tutors were teaching in secondary or vocational schools.
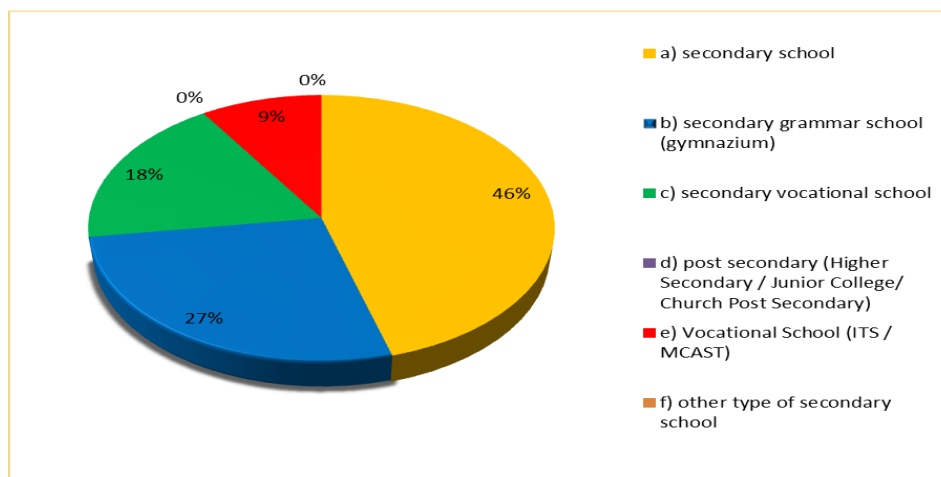
Figure 4. Distribution of the educational levels of organizations

The system provides online courses that the trainers studied and used into their courses. Presented in Figure 5 are the courses that tutors studied and utilized and the most studied courses were the "Applying Social Media" and "Web 2.0 based Mobile Technologies". Both of these courses present technologies and tools that could be useful for all trainers regardless of their domain. Most of the other courses offer good practices regarding specific domains and as expected fewer trainers were inclined to use them.
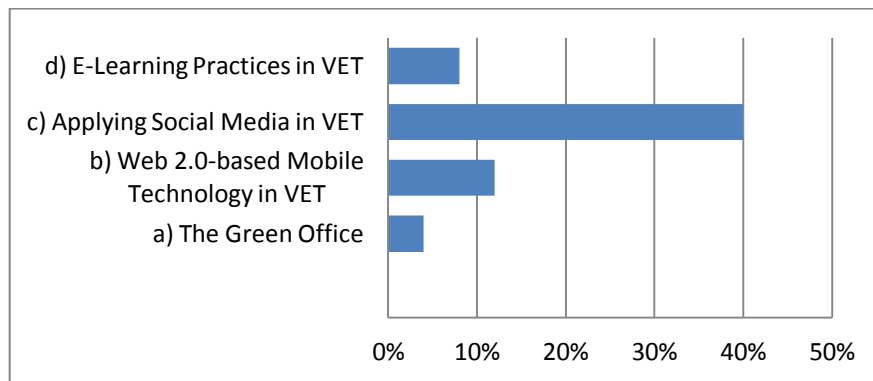
Figure 5.Courses attended by the tutors

After tutors had studied the courses, they were asked to apply the practices and the learning activities they learned in their courses. They were also asked to integrate and use web 2.0 tools they find interesting and fit to the nature of their courses. Then, all trainers were asked to complete an online questionnaire which consisted of questions indicating their experiences of using social media in their lesson and evaluating the quality of the online courses. The questionnaire consisted of 10 questions. Questions 1-8 were based on a Likert (Likert 1932) scale (1: not at all/not good, 5: very much/very good) (see Table 1). Remaining questions 9-10 were of open type and concerned strong and weak points or problems using the platform.

Table 1. Analysis of the tutors' questionnaires

Q	Questions	Answers (%)				
		1	2	3	4	5
1	Did you find the online courses interesting?	0	9.1	18.2	18.2	54.5
2	How much did the online courses assist you to utilize Web2.0 Technologies into your courses?	0	0	27.2	36.4	36.4
3	How much did the online courses assist you to use the social media in classroom?	0	18.2	18.2	18.2	45.5
4	How would you rate the quality of the context of online courses?	0	0	27.3	18.2	54.5
5	How would you rate the quality of the multimedia of online courses?	0	9.1	18.2	18.2	54.5
6	How appropriate did you find the length of the course/courses?	0	0	9.1	45.5	45.5
7	How would you rate the quality of the learning material in general?	0	0	9.1	45.5	45.5
8	Would you suggest the online courses to other trainers?	0	0	0	45.5	54.5

The questionnaire results show that the tutors gave very positive responses. More specifically, tutors' answers show that they found the system and the courses very helpful in learning how to utilize web 2.0 technologies and social media in education. They also found the courses to be well structured and designed and the educational context to be of high quality. Finally, tutors indicate that they will definitely suggest the system and the courses to other tutors.

For the second part of the evaluation study, tutors asked their students regarding their experience of using web 2.0 tools and social media in the courses. The purpose of the study was to examine the students' thoughts regarding the efficiency and the effectiveness of web 2.0 tools and social media in the classroom and in distance learning. In this part of the study, the participants were 100 students. The fields of the studies that the tutors teach and students participated in were among others: theoretical studies in sciences as engineering, Physics, Economics and Business Administration and Mathematics. The questionnaire given to the students consisted of 5 questions which were based on a three point Likert-scale (strongly agree, neutral, disagree). The results collected are presented in Table 2.

Table 2. Analysis of the questionnaires that students filled in

Questions	Agree/ strongly agree	Neutral	Disagree / strongly disagree
	%	%	%
1 The use of social media can enhance my learning interest.	84	12	4
2 The use of social media can enhance my learning motivation.	85	10	5
	70	20	10
3 The online course helped me learn more effectively.	72	22	6
4 The social media helped me to better communicate and cooperate with my fellow students.	75	20	5
5 Would you suggest the web 2.0 tools to be used by the next year's class?	82	17	1

The results indicate that the students enjoyed and had a positive feeling regarding the use of web 2.0 tools and social media in education. It is very encouraging that a very high percentage of the students (approximately 85%) claimed that social media increased their learning interest and motivation. Students also indicated that the communication with their fellow students and their cooperation was better and that they were able to cooperate in a more direct way. Finally, most of the students (82%) would definitely suggest next year's class to utilize the web 2.0 tools and the social media.

5. CONCLUSION

Social media and web 2.0 tools are important technologies that can enhance the learning capabilities of educational procedures both in classroom and in distance education. A vital aspect of the effective utilization of the social media and web 2.0 tools into courses and students' training activities in both formal and informal learning is the tutor's experiences and skills. However, research studies indicate that in many cases tutors are not familiar of the new web 2.0 technologies and are not aware of what they offer and how they can be utilized in education for the best benefit of the students' learning. So, in this paper, we present an educational system and courses designed to assist tutors in learning how to utilize the capabilities offered by the Web 2.0 technologies and the social media and understand what each tool can offer and how they can be integrated in educational activities and in their courses in both classroom and distance education learning. The utilization of social media and Web 2.0 tools could enhance the interaction between the tutor and the students and also the communication between the students who have the opportunity to create, share, exchange and collaborate on information and ideas in virtual communities and networks. The evaluation study reports very encouraging results. Findings indicate that possible pitfalls of tutors or even students being unfamiliar with the Web 2.0 tools and technologies and the lack of institutional support can be easily overcome.

As future work we plan to make a bigger scale evaluation of the educational system's capabilities and furthermore extend the learning scenarios and the educational activities offered to the tutors during the designed courses. Furthermore, we plan to extend the system so that tutors that utilize web 2.0 tools into their courses, to be able to report and illustrate good practices and share their experiences and their students' feelings with the educational community and with other tutors, stakeholders and institutions on local, national and international level. Exploring this direction is a key aspect of our future work.

REFERENCES

Arnold, N., & Paulus, T., 2010. Using a social networking site for experiential learning: Appropriating, lurking, modeling and community building. *The Internet and Higher Education*, 13(4), pp. 188-196.

Bennett, S., Bishop, A., Dalgarno, B., Waycott, J., & Kennedy, G. , 2012 .Implementing Web 2.0 technologies in higher education: A collective case study. *Computers & Education*, 59(2), pp.524-534.

Blaschke, L. M. 2014. Using social media to engage and develop the online learner in self-determined learning. *Research in Learning Technology*, 22.

Callaghan, N., & Bower, M. 2012 .Learning through social networking sites–the critical role of the teacher. Educational Media International, 49(1), 1-17.

Connolly, T. M., Hainey, T., Baxter, G., Stansfield, M. H., Gould, C., Tsvetkova, N., .&Dimitrova, N. 2011.Web 2.0 education: An evaluation of a large-scale european pilot. In *Next Generation Web Services Practices (NWeSP), 2011 7th International Conference on*, pp. 511-516.

Churchill, D. (2009). Educational applications of Web 2.0: Using blogs to support teaching and learning. *British journal of educational technology*, *40*(1), pp. 179-183.

Ebner, M., Lienhardt, C., Rohs, M., & Meyer, I. (2010). Microblogs in Higher Education–A chance to facilitate informal and process-oriented learning?. *Computers & Education*, 55(1), pp. 92-100.

Grosseck, G., & Holotescu, C. 2009. Can we use twitter for educational activities?. In Proceedings of the 4th *International Scientific Conference: eLearning and Software for Education*, Bucharest, Romania 2011

Holotescu, C. 2015. Emerging Technologies in Education.Conceiving and Building a Microblogging Platform for Formal and Informal Learning (Doctoral dissertation, PhD Thesis, UPT Romania).

Huang, W. H. D., Hood, D. W., &Yoo, S. J. 2014. Motivational support in Web 2.0 learning environments: a regression analysis based on the integrative theory of motivation, volition and performance. *Innovations in Education and Teaching International*, 51(6), pp. 631-641.

Hung, H. T., & Yuen, S. C. Y., 2010.Educational use of social networking technology in higher education. *Teaching in higher education*, 15(6), pp. 703-714.

Keats, D.W. & Schmidt, J.P., 2007, The genesis and emergence of education 3.0 in higher education and its potential for Africa , First Monday, Vol. 12 No. 3.

Laird, T., 2014.Using social media in education for classroom teaching, student learning, and educator professional development.Master's Thesis, Kingston, Ontario Canada.

Likert, R.., 1932A technique for the measurement of attitudes. *Archives of psychology*

Lwoga, E. 2012. Making learning and Web 2.0 technologies work for higher learning institutions in Africa. *Campus-Wide Information Systems*, *29*(2), pp. 90-107.

Moran, M., Seaman, J., & Tinti-Kane, H. 2011. Teaching, Learning, and Sharing: How Today's Higher Education Faculty Use Social Media. *BabsonSurveyResearchGroup*.

Roblyer, M. D., McDaniel, M., Webb, M., Herman, J., & Witty, J. V. 2010. Findings on Facebook in higher education: A comparison of college faculty and student uses and perceptions of social networking sites. *The Internet and Higher Education*, 13(3), pp. 134-140.

Tess, P. A. (2013). The role of social media in higher education classes (real and virtual)–A literature review.Computers in Human Behavior, 29(5), A60-A68.

Thomas, M., & Thomas, H., 2012.Using new social media and Web 2.0 technologies in business school teaching and learning.*Journal of Management Development*, *31*(4), pp. 358-367.

Venkatesh, V., Croteau, A. M., &Rabah, J. 2014.Perceptions of effectiveness of instructional uses of technology in higher education in an era of Web 2.0.In *System Sciences (HICSS), 2014 47th Hawaii International Conference on* pp. 110-119.IEEE.

Wang, X., Love, P., Klinc, R., Kim, M. J., & Davis, P. R. (2012).Integration of E–learning 2.0 with Web 2.0.*Journal of Information Technology in Construction (ITcon)*, *17*, pp. 387-396.

Short Papers

EVALUATING STUDENTS' PROGRAMMING SKILL BEHAVIOUR AND PERSONALIZING THEIR COMPUTER LEARNING ENVIRONMENT USING "THE HOUR OF CODE" PARADIGM

Nikolaos Mallios and Michael Gr. Vassilakopoulos
Dept. of Electrical & Computer Engineering,
University of Thessaly,
Volos,Greece

ABSTRACT

One of the most intriguing objectives when teaching computer science in mid-adolescence high school students is attracting and mainly maintaining their concentration within the limits of the class. A number of theories have been proposed and numerous methodologies have been applied, aiming to assist in the implementation of a personalized learning environment that approaches these objectives. In this paper, an empirical study is performed with the support of the "Hour of Code" initiative which took place for a second consecutive year at the end of previous year. The initiative was presented to a number of high-school students as a motivation for teaching computer programming to them. An evaluation of the students' programming skills is attempted with the aid of a questionnaire and a simple personalization framework is presented in order to adapt to the students' personal needs.

KEYWORDS

Teaching programming, evaluation, Hour of Code, personalization framework, adaptation

1. INTRODUCTION

School as a learning organization [9] but primarily as a social environment [1] and the educator as carrier and imparter of knowledge are daily facing many challenges in their attempt to shape the "school of the future", where knowledge is not only statically presented but transferred as part of a dynamically and evolving procedure. Within such an environment computer science plays one of the most important roles. Computer science depicts not only as a static and tiresome lesson, but also as a continuously effort to present and transfer useful knowledge and moreover assist students in their quest for critical evaluation of the information presented.

Teaching computer science to high school students clearly should be enlisted to Bruner's pedagogical paradigm for constructivist learning approach where students are encouraged to enrich what they learn from the tutor with previous acquired knowledge from their past, in order to formulate new ideas or concepts [2]. Combining this educational procedure with Piaget's model for cognitive learning where students are taught something, think about it and then try to express it in their own words [8], lead to a hybrid teaching model for computer science in classroom.

Moreover, computational thinking theory as introduced by S. Papert [7] and later presented by J. Wing [11], advocate that algorithmic thinking is a fundamental skill which everyone can realize (and not only computer scientists). In addition, J. Wing argued for the significance of bringing computational thinking in other aspects of life.

Within this educational environment, bringing computer science and teaching programming lessons to high school students not only encourage their way of understanding through computational thinking and cognitive learning, but also promotes their personal skills and influence them in an alternative way of acquiring and using the knowledge learned.

All of these aspects described above are widely recognized and were included and applied in an innovative idea which took place worldwide during the 2nd week of December (8-14 Dec. 2014) which was named "Hour of Code" [12]. The "Hour Of Code" initiative firstly introduced in the United States of America, as an opportunity for mid-adolescence students to be taught "just one hour of code". The campaign was quickly spread all over the world and moreover promoted from numerous powerful and influential people, including the president of the United States, founders of big IT companies and other individuals from sports and arts. The success of the initiative was significant and students throughout the world were taught and enjoyed an hour of code for a consecutive year.

In the remainder of this paper, the "Hour of Code" initiative is briefly described in section 2 and the three-step teaching methodology which we applied in section 3. Furthermore a short evaluation of the students understanding of simple programming concepts with the aim of an additional example is given in section 4, along with a questionnaire filled by each student. Finally, we extend our previous work [6] by proposing a simple framework which aims to help us personalize the computer learning environment for each student and adapt our teaching methodology to their specific skills and needs.

2. THE HOUR OF CODE

2.1 Description of "The Hour of Code" Initiative

The most significant objective of the "Hour of Code" initiative as this is presented by the originators of the idea is to bring closer all students to computer science and programming, through the presentation and accomplishment of the "one hour of code" paradigm. The idea initially originated in the United States of America from an non-profit organization (code.org) which then turned into a public charity.

The significant importance of the initiative and the successful results which were obtained, are demonstrated by the numbers presented in the first page of their website. Namely, almost 5.2 billion lines of code have been written till today and more than 100 million students have learned at least one hour of code. The campaign of the initiative, as well as the programming examples which are presented, have been endorsed by great personalities of all the important aspects of social life. Moreover, even the president of the United States supported actively the project and encourages every student to actively participate and complete at least an hour of code because "…learning these skills isn't just important for your future, it's important for our country's future.."[10]. All these factors demonstrate the noteworthy significance of the initiative and exhibit many of the reasons which made the DG connect European Commission to organize a similar event within the boundaries of the European Union during the 3rd week of October 2014 with excessive success.

3. TEACHING METHODOLOGY

3.1 Methodology of Teaching "Hour of Code" in the Classroom

Within this context and the "Hour of Code" as the triggering event, we decided to actively participate in the initiative and teach the very first tutorial of the webpage to 3 different classes of high-school students aged 14-17 years old. Most of the students had no previous experience in the field of computer programming (with the exception of a few of them who having been learning computer algorithms as part of a course in their curriculum) and mainly live in rural neighborhoods.

The approach of teaching the computer programming hour is briefly explained in the 3 steps which follow and important characteristics are highlighted throughout this description.

3.1.1 Introduction – Explaining the Importance

The initial teaching approach which was selected in order to evenly introduce the importance of computer science (and more generally computers) to the students, was a 3-minute brief introduction on the recent innovations on the computer science field (tablets, touch-screens, mobile devices) and the numerous

applications which nowadays all of us are daily using. In addition the students were encouraged to imagine their parents' life 30 years ago in the decade of 80's when the presence and use of computers were insignificant.

3.1.2 Career Opportunities in the Computer Science Field

Following the initial approach presented to the students for the context of computer science, another step which introduced career opportunities in the CS field was presented. A brief discussion in the form of questions-answers took place with the students showing a lot of curiosity for the working conditions and mainly the annual salary of professions relating to computers. A very short demonstration was made with pictures taken from the web which illustrated the new offices of Apple Inc., Google and Facebook. Students were excited to learn the middle IT computer annual salaries and the benefits which arise when working for a big IT company.

At this point a short video from the "Hour of Code" webpage was showed, where a number of personalities analyzed the importance of computer science and programming. Students were impressed to learn that a considerable number of the top-100 wealthiest people on earth are working in the IT industry.

3.1.3 Demonstrating the 20 Steps Example

The most important step of the teaching methodology followed was the demonstration to each class of the first example of the webpage with 20 steps. This example was carefully chosen from the organizers of the initiative to include the basic steps of programming, conditions (if-statements) and loops (repeat and repeat-until statements).

Students enjoyed the demonstration (in a single PC with the image projected to a board) and the main reasons for this success were the simplicity of the examples (cartoon characters were chosen for the 20 steps) and the built-in video explanations of each group of paradigms from well-recognized celebrities.

After the first few steps, each of the three classes was able to solve the additional steps roughly effortless and most of the students found the solutions to each step relatively quickly. The very last steps of the examples were more difficult and a few number of the students lost their attention throughout the whole hour.

4. EVALUATION OF THE INITIATIVE FROM THE STUDENTS

In order to evaluate the student's perceptive of the programming patterns presented and their basic programming skills and potential programming talents, we performed a two phase evaluation approach.

Initially, another example (Lightbot) of the initiative was given for each student to complete alone (without the educator's assistance) during another teaching hour of the Computer Science course (one pc per student).

The purpose of this phase was for the educator to quietly evaluate the student's progress in the puzzle, for the proper usage of condition statements and loops. The example was more difficult than the one presented and a significant amount of the students did not accomplish it (till the end). All these results and the overall progress of each student separately, were recorded in an independently designed evaluation sheet.

For the second phase of the evaluation, a specifically designed questionnaire was given to each student (in all 3 classes) with a few questions. The purpose of the questionnaire was for the student to evaluate the initiative, record their experiences in programming and their interest in computer science. Among the questions, one was specifically chosen to ask for their opinion of the initiative and give an estimate of their level of understanding of the programming patterns presented (all of them, many, few and not-at-all). The results obtained from this question are presented in Table I.

Table 1. Level of understanding (according to students opinion)

Understanding of each step	Number of students (49)			Percentage
	1st class (age 15)	2nd class (age 16)	3nd class (age 17)	
All	5	6	3	28,57%
Many of them	13	6	7	53,06%
Few of them	4		4	16,33%
None	1			2,04%

Another noteworthy fact which was inferred from the questionnaire given was the wide acceptance of computer science among the students and their motivation for a future career in the IT field. Almost 3 out of 4 students envision a profession in the computer science field (according to their understanding of computer science). Among them, there subsist a few which yearn for the hardware industry and few of them in the computer programming field (Table II below).

Table 2. Possible future career in the IT industry

Career in the IT field	Number of students (49)			Percentage
	1st class (age 15)	2nd class (age 16)	3nd class (age 17)	
Yes	12	9	6	55,1%
No	11	3	8	44,9%

5. PERSONALIZING THE COURSE – ADAPTING TO EACH INDIVIDUAL CLASSROOM REQUIREMENTS

The assessment performed and the results obtained from both the evaluation sheet and the questionnaire given, motivated as to start designing a personalized system in order to improve the quality of teaching programming to these students and adapt our methods to their specific needs.

Our goal was to personalize the learning environment for each individual and provide personalized material and exercises for the course of computer studies in high school.

The necessity for a personalized education environment has been pointed out in numerous cases both in the past [4] as well as nowadays [3], [5]. The principal advantage for a personalized approach from a student's perceptive is the ability to create an adapted learning environment with personalized notes and exercises which will guide the student to learn at its' own pace. Therefore, our approach was to firstly design and in a later phase implement, a simple personalized learning environment in order to provide our students an enhanced learning experience. The implementation of our system is still in a premature phase; consequently we present here snippets of the initial design.

In the first phase of our design of this personalized teaching environment, a simple user profile was created for each student. The profile comprised of basic characteristics for each student (name, age, gender) and two other fields (scienceedu and understand). Both of these fields were given with a decimal numeric score (0 to 1) which was obtained from the evaluation phase earlier described. The sciencedu field illustrate the student's tendency to math/science and the understand field our estimate evaluation of the student's understanding of programming.

In the next phase, we are planning to create personalized material and small tests for three categories of computer programming. The material should be carefully chosen to illustrate specific components of programming, for three categories (beginners, intermediate and advanced) and adapt to each student's requirements.

The main idea of this design is to support each student by assessing his/her skills and automatically placing them in one of the three categories. This classification will be based on the evaluation results obtained by the given questionnaire combined with the user profile's numerical fields.

Finally, a simple automated system will be designed and implemented in order to generate and present personalized material according to the age/gender of the student and ranking of the student. The proposed personalized system could initially perform a basic preliminary test for each student. The results obtained could identify potential weakness and errors that a student has and automatically generate the appropriate material which a student should study.

This simple framework is in the process of design and implementation and any further results obtained should be tested in an experimental environment within the classroom.

6. CONCLUSIONS AND FUTURE WORK

Evaluating teaching performance and students' learning behavior and skills are very challenging tasks which require effort and time. The opportunity to teach and assess students' programming skills was given with the "Hour of Code" initiative. In this paper, a brief description of the initiative was given, along with the teaching methodology which was followed.

The evaluation of the students' learning behavior and the interest they expressed, motivated us with the idea to adapt our methodology and teach computer programming according to their specific needs. Therefore, a simple personalized framework is under design and implementation which aim to provide a personalized learning environment for the computer programming education.

The work presented is an ongoing project with a number of open questions and challenging ideas. The framework presented just finished the implementation phase and a number of ongoing questions acquired our attention. The design is simple, but will provide us with enough material to teach for the remainder of the semester.

Therefore, a new framework will encapsulate all those concepts and a design of an adaptive and personalized learning management system will assist instructors of algorithmic and programming courses.

REFERENCES

[1] Boocock, S. S. (1973). The school as a social environment for learning: Social organization and micro-social process in education. *Sociology of Education*, 15-50.

[2] Bruner, J. (1996). *The Culture of Education,* Cambridge, MA: Harvard University Press.

[3] Fancsali, Stephen E., and Steven Ritter. "Context personalization, preferences, and performance in an intelligent tutoring system for middle school mathematics." *Proceedins of the Fourth International Conference on Learning Analytics and Knowledge*. ACM, 2014

[4] Fok A.W.P. and H.H.S. Ip, "Personalized education: An exploratory study of learning pedagogies in relation to personalization technologies." *Advances in Web-Based Learning–ICWL 2004*. Springer Berlin Heidelberg, 2004, 407-415.

[5] Halstead-Nussloch Richard, Jon Preston, and Han Reichgelt. 2014. Improving student success through personalization and customization. *Proceedings of the 15th Annual Conference on Information technology education (SIGITE '14)*. ACM, New York, NY, USA, 77-80.

[6] Mallios Nikolaos,"Hour of Code: Presentation of the Initiative and assessment reports", *PEKAP 2014 (in Greek)*

[7] Papert Seymour, An Exploration in the Space of Mathematics Educations, *International Journal of Computers for Mathematical Learning*,1(1):95–123, 1996

[8] Piaget J.,The Equilibrium of Cognitive Structures, *The Central Problem in Cognitive Development 1985*, University of Chicago Press, Chicago, Illinois

[9] Silins H., Mulford B., (2002) "Schools as learning organisations: The case for system, teacher and student learning", *Journal of Educational Administration*, Vol. 40 Iss: 5, pp.425 – 446

[10] Stephenson C., Bulding Student Interest in Computing, *CSTA ACM Communications*

[11] Wing Jeannette, *Computational thinking, Communications* ACM 49, 3 (March 2006), 33-35

[12] www.code.org, Last accessed 15 Feb 2015

USING IMMERSIVE VIRTUAL REALITY FOR ELECTRICAL SUBSTATION TRAINING

Eduardo H. Tanaka[1], Juliana A. Paludo[1], Carlúcio S. Cordeiro[1], Leonardo R. Domingues[1], Edgar V. Gadbem[1] and Adriana Euflausino[2]

Eldorado Research Institute[1], CPFL[2], Campinas, SP, Brazil

ABSTRACT

Usually, distribution electricians are called upon to solve technical problems found in electrical substations. In this project, we apply problem-based learning to a training program for electricians, with the help of a virtual reality environment that simulates a real substation. Using this virtual substation, users may safely practice maneuvers with varying degrees of complexity. To improve the user's sense of immersion, interactive devices such as the Oculus Rift virtual reality headset are going to be adopted. The project's stakeholders had a good impression of the device and believe that the proposed methodology will improve the training and effect positively the electricians' performance, reducing accidents inside the substation area and decreasing the time required to reestablish the power supply after a failure.

KEYWORDS

Electrical Simulation, Immersive Virtual Reality, Interactive Devices, Problem-Based Learning, Training Staff.

1. INTRODUCTION

The electric power system consists of power generation, transmission and distribution networks, and load consumption. The power generation is the origin of the electrical energy. A transmission network is composed by high-voltage power lines, which drive electric power from a generation station to a load center area, as they are usually far apart for long distances. A distribution system has medium and low voltage networks and conducts electrical energy from the transmission system to industrial, commercial and residential loads. These sections of the electric power system are linked by electric substations. Their function is to reduce or increase voltage levels in order to supply correctly each section of the system, thereby establishing a connection between the power generation and the transmission system on the one hand, and the transmission and distribution systems on the other (Massachusetts Institute of Technology, 2011).

A substation has the electrical and protection equipment necessary to transform power with safety and efficiency and offer an adequate power quality to the customers of the distribution system. A substation comprises transformers, regulators, circuit breakers, disconnectors, monitoring equipment, protection relays, electrical buses, and others (Blume, 2007). Since this facility is a fundamental section of the electrical system, it is very important to maintain its proper operation. Thus, if there is a problem in the substation after an electrical fault in its area, the site must be repaired as soon as possible. As a result, the customers would not have their energy supply interrupted for a long period and damages to the power grid or equipment of customers could be avoided. Electricians allowed to work in substations are the professionals who will respond in most events of technical problems in distribution substations in a local electric utility.

In order to obtain the best performance of the electricians, electric companies must offer an efficient training to guide them properly. Therefore, the project in this paper proposes an improvement of electricians' training program by including a problem-based learning methodology within an application of virtual reality (VR) in the current training program of the utility. A virtual substation, as much realistic as possible, with all its equipment has been developed to give electricians the opportunity to safely operate the equipment and execute basic and emergence maneuvers.

2. RELATED WORK

2.1 Immersive Virtual Reality in Education and Training

Adopting a VR environment for education and training can be very attractive for several reasons. First, as it does not involve security risks that may exist in the real world, users can freely explore the environment without harming themselves, their colleagues or even damaging the environment. Second, users can try to perform tasks and solve the proposed problems how many times they require, without the pressure of a classroom full of colleagues (Patel et al, 2006) or even a formal evaluation. Thus, this kind of environment encourages the user to conduct his/her learning at his/her own pace, with no risks (Mikropoulos et al, 1997). Given these characteristics, VR environments have been developed for different trainings (Grabowski and Jankowski, 2015; Sacks et al, 2013; Ausburn and Ausburn, 2004).

A VR environment is not only capable of representing and simulating real or fictional environments, but also making users feel like they are physically present in those places (Ausburn and Ausburn, 2004). In order to be more effective and let the users focus only on the tasks that must be performed, the VR environment must be immersive. Usually, immersion can be achieved by covering the whole field of vision of the user with a Head Mounted Display (HMD).

2.2 Electrical Simulators

Electrical simulators are useful to help professionals to understand ordinary and emergence operations that he/she will face in a work daily basis. One example of electrical simulator is STOP (Silva, 2011). In STOP, users interact with single-line diagrams of electrical systems, simulating faults in the systems and setting relays, circuit breakers, transformers and other equipment. However, as the only way to interact with the systems is through the diagrams, users do not have a realistic experience of manipulating the equipment.

Other simulators offer a more realistic experience, such as Virtual Substation and Furnas 02 (Silva, 2012). Both simulators aims to train new technicians to control and/or operate an electrical substation or a power plant, so that the facilities were modeled in 3D in order to look like a real substation and power plant. In fact, it is possible to interact with most of the equipment through joysticks and VR glasses, but the look and feel of these simulators is not as realistic as the project presented in this paper demands.

It is not common to find substation simulators that use immersive VR to give the users a good impression of how a real substation is and, more important, how to operate the real equipment in a maintenance or emergency maneuver. A virtual electric substation does not replace a real one, although it is a valuable resource for training purposes, as a real substation may not be available for trainings. Even if it is available, several actions that are commonly performed in electric substations involves risks to the electricians, who may suffer injuries if performing unsecured maneuvers or lacking personal protective equipment, and to customers, who may face a blackout if a maneuver is wrongly done by the electricians.

3. MATERIALS AND METHODS

Nowadays, the training program of the electrical utility consists of theoretical and practical lessons. However, these practical lessons allow electricians to have only a very restricted contact with real substations so that it is nearly impossible to practice maneuvers during the training program. Therefore, a virtual substation designed as a VR environment will be a valuable tool to complement and improve the training program. Besides that, as the emergency calls in the electrical substation do not occur very often, the virtual substation will allow electricians to periodically practice and keep their skills sharp and proficient.

To deliver the required realism, a real substation should be represented in the VR environment, containing accurate 3D models of all equipment and simulating the exact behavior of them. Moreover, as immersion is a must-have, HMD support is also required. To fulfill these requirements, the Unreal Engine (Epic Games, 2015) was chosen, as it can render high quality graphics, is compatible with HMD and has a very active and supportive community. In addition, the selected HMD for this project was Oculus Rift (Oculus, 2015), as it is one of the most promising technologies available at the time that this paper was written, with a reasonable

support and rich online documentation. As the HMD covers the user's field of vision, using a keyboard and a mouse could be a bit clumsy. Gesture-based user interfaces could provide a more natural interaction with the VR environment and are still under analysis by the authors.

The behavior of the virtual substation was modeled by discrete event simulation, as its operations can be represented as a defined sequence of processes. Then, this virtual substation can be seen as a learning environment where instructors will select a specific issue that is avoiding the substation to work properly whereas students will have to investigate and isolate or solve that problem to fix the substation. In other words, students can learn by themselves in the environment while practicing to solve problems that may occur on real substations, as the Problem-Based Learning pedagogy recommends (Hmelo-Silver, 2004). This kind of methodology is characterized as an active learning, which was chosen because it is more attractive and effective for experienced professionals (Bonwell and Eison, 1991).

To evaluate the performance of the student while restoring the substation, some criteria will be considered: proper usage of the personal protective equipment, completed tasks, correct interaction with the equipment to find the problem and a solution. Additionally, this assessment will be presented to instructors and students as a final score, similar to video games, enhancing the experience of the users and their motivations.

4. PRELIMINARY RESULTS

Although this is a work in progress project, it does have a few valuable results. At the time that this paper was written, about half of the 3D models of the equipment were designed and integrated into the VR environment. Figure 1 shows some of the models already included in the VR environment.

Figure 1. 3D models for low voltage circuit breaker and disconnector (left) and details of an existing panel (right)

To validate the behavior of the substation and the discrete event simulation, an emergency maneuver was implemented in the VR environment. In this emergency maneuver, part of the substation was turned off due to a short circuit, which means that customers were facing a blackout. Then, an electrician in the substation should identify the root cause of the short circuit, isolate it, and try to turn the substation on again – and all of these tasks should be performed by interacting with the substation's equipment. To manipulate the equipment, the user can work with the Oculus Rift and a joystick or an ordinary monitor, keyboard and mouse.

An informal evaluation of the VR environment and the emergency maneuver selected was done with technicians and instructors from the local electric utility. As there were some 3D placeholders in the environment instead of models of the real equipment, some stakeholders were not able to envision the substation correctly, indicating that the placeholders are not easy to understand. Therefore, the design of the 3D models was re-prioritized and became a high priority task for the development and graphics teams. Despite this issue, the stakeholders were able to point a few pros of using the proposed VR environment:

- Improved electrician qualification, resulting on improved performance when some maneuvers are required in a substation;
- Reduced time to re-establish energy after a blackout, given that electricians will be able to successfully conclude more emergency maneuvers in a shorter time than nowadays;
- Reduced accident rate in substations, as electricians will be able to practice good safety practices when performing the maneuvers in the VR environment.

The pros indicate the potential of this project to benefit both the electricians and the society as a whole since the substation issues that cause blackout may be quickly repaired due to a better qualification.

5. CONCLUSION

This paper presented the project of a virtual substation being developed as an immersive VR environment, which offers a safe training area and represents accurately the behavior and operation of the system modeled. The proposed environment should at least partially suppress the current lack of practice of electricians in real substations, enabling them to explore the virtual substation and practice basic and emergency maneuvers, applying all concepts learned in theory classes with safety and without external pressure. An improvement on the electricians' performance is also expected, in the form of reduced accident rates and shorter time to re-establish the energy supply.

In the informal evaluation with the stakeholders, it was noticed that they expected a 3D scenario designed before the beginning of the maneuvers' simulation, exposing that having a realistic environment can call more attention than a simulation case without external features. Nevertheless, they were positive with the project's progress and with the immersive sense given by the use of the Oculus Rift. Other interactive devices (for instance, those with motion detection) are under analysis to improve the experience in the VR environment.

ACKNOWLEDGEMENT

REFERENCES

Ausburn, L. J. and Ausburn, F. B., 2004. Desktop virtual reality: A powerful new technology for teaching and research in industrial teacher education. *Journal of Industrial Teacher Education*, vol. 41, n. 4, p. 33-58, 2004.

Blume, S. W., 2007. *Electric Power System Basics: For the Nonelectrical Professional*. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.

Bonwell, C. C. and Eison, J. A., 1991. *Active Learning: Creating Excitement in the Classroom*. George Washington University, School of Education and Human Development.

Epic Games, 2015. Unreal Engine. https://www.unrealengine.com/. Accessed March 2, 2015.

Grabowski, A. and Jankowski, J, 2015. Virtual Reality-based pilot training for underground coal miners. *Safety Science*, vol. 72, p. 310-314, February 2015.

Hmelo-Silver, C. E., 2004. Problem-based learning: What and how do students learn? *Educational Psychology Review* 16.3, p. 235-266. 2004.

Massachusetts Institute of Technology. 2011. *The future of the Electric Grid: an interdisciplinary MIT study*. Cambridge, Massachusetts, USA.

Mikropoulos, T. et al, 1997. Virtual realities in environmental education: The project LAKE. *Education and Information Technologies*, vol. 2, p. 131-142, 1997.

Oculus, 2015. Oculus Rift. https://www.oculus.com/. Accessed March 2, 2015.

Patel, K. et al, 2006. The effects of fully immersive virtual reality on the learning of physical tasks. *PRESENCE 2006: The 9th Annual International Workshop on Presence*, Cleveland, Ohio, USA, Aug. 2006. 24 – 26.

Sacks, R. et al, 2013. Construction safety training using immersive virtual reality. *Construction Management and Economics*, vol. 31, n. 9, p. 1005-1017, July 2013.

Silva, C. H. C., 2011. *Desenvolvimento de um laboratório virtual para capacitação tecnológica a distância em proteção de sistemas elétricos*, Master dissertation, Universidade Federal do Ceará. Fortaleza.

Silva, R. C., 2012. *Virtual Substation: Um sistema de Realidade Virtual para treinamento de operadores de subestações elétricas*, Master dissertation, Universidade Federal de Uberlândia, Uberlândia.

GOAL SETTING, DECISION-MAKING SKILLS AND ACADEMIC PERFORMANCE OF UNDERGRADUATE DISTANCE LEARNERS: IMPLICATIONS FOR RETENTION AND SUPPORT SERVICES

Professor Nebath Tanglang and Aminu Kazeem Ibrahim. Ph. D.
National Open University of Nigeria, Lagos, 14/16 Victoria Island, Lagos

ABSTRACT

The study adopted an Ex-post facto research design. Randomization sampling technique was used to select 346 undergraduate distance learners and the learners were grouped into four, High and Low Goal setter learners and High and Low Decision-making skills learners. The instruments for data collection were Undergraduate Academic Goal Setting Scale (UAGSS), Undergraduate Decision-making Skills Scale (UADMSS) and Semester Examination Course Result Grades in four courses. The instruments were validated with face and content validity and a test re-test administered after three weeks. The obtained alpha value were 0.77 and 0.84 while, Semester Examination Course Result Grades for the four courses that formed the academic performance (Use of English and Communication skills 1, Use of English and Communication skills 11, History and Philosophy of Science and the Good Study Guides) were moderated by External examiners appointed by the Senate of the University. t – test for unequal samples and Pearson Moment Correlation Coefficient statistical method were used to analyse the data. The findings indicated statistically significant difference between high and low goal setter undergraduate distance learners academic performance (t = 4.01 < 0.000), statistically significant difference between high and low decision – making skills undergraduate distance learners academic performance (t = -3.35.93 < 0.001), statistically significant positive relationship between high goal setter undergraduate distance learners and high decision-making skills undergraduate distance learners academic performance (0.297<0.000) and statistically significant negative relationship between low goal setter undergraduate distance learners and low decision-making skills undergraduate distance learners academic performance (-0.307< 0.000). Recommendations were made towards learners' retention and provision of support services.

KEYWORDS

Goal setting, Decision-making skills, Academic performance, Retention and Support services.

1. INTRODUCTION

Setting achievable goals are vital to human success and achievements in life. Executing a set of achievable goals will automatically depend on a foundation of taking effective decision towards actualization of the set goals. Since goals contribute to success, it must also influence students' academic performance particularly in distance education. When learning goals are formulated by learners, it must be carried out with efficient decision-making skills (Aminu &Gali, 2012). Education and Counselling psychologists believed that learning to formulate goals and developing efficient decision-making skills are some of the basic training that should be inculcated in learners, if there must be successful academic records (Shertzer & Stone, 1976; Saka, 2006; Sambo, 2008 and Aminu & Gali, 2012). Setting attainable goals, determines the success of any activity, engagement or commitment. When goals are clearly mapped out, it must be accompanied with efficient decision-making skills so as to ensure it achievable implementation (Mind tools, 2014). Students' academic performance in learning tasks and exercises like any other worthwhile activities must therefore be planned and properly guided. Distance learners all over the world are characterized by different engagements and commitments at a given time, as most of them combine work and study together (Ipaye,2003). Assisting distance learners set achievable goals as well as develop efficient decision-making skills is crucial toward meeting up with the increasing demand for distance related academic programmes all over the world. Distance learners need to work towards the achievement of these formulated goals regularly at the beginning

of the programme, during and at the end of the programme, if the learner wants to get the most out of them. Learners that set realistic goals can be more motivated than those learners that set unachievable goals (Ipaye, 2003). Setting realistic goals have been traced to effective motivation. For example, Locke & Latham's theory, 1960's (cited in Mind Tools, 2014) showed that clear goals and appropriate feedback motivate individual. For undergraduate distance learners in open and distance education to set realistic goals, Locke and Latham (1990) outlined five principles of goal setting that need to be examined. The five principles outlined by Locke and Latham (1990) that were researched to improve individual chances of success are: Clarity, Challenge, Commitment, Feedback and task complexity. The researchers' view was that, the application of these principles to learners will improve academic performance. Undergraduate distance learners in open and distance education and institutions may find these principles difficult to understand comprehend or apply due to their numerous engagements combined with learning at a distance. Apart from having a set of realistic goals as a distance learner, the other related and intervening variable is the learner's decision-making skills (Aminu &Gali, 2012). Learner decision-making skills are vital in carrying out set goals. For distance learners to develop effective decision-making skills needed for goal setting, the learner must learn to take the following stages of decision-making: Efficient evaluation of problems, list of possible solutions in term of merits and demerits, application of the most appropriate solution, acceptance of the outcomes and acting upon the outcomes (Shertzer & Stone, 1976; Okon, 1983; Denger, 1986; Saka, 2006; Sambo, 2008; Aminu & Gali, 2012). According to Mind Tools (2014) stages involved in making efficient decision are: Establishing a positive decision-making environment, generating potential solutions, Evaluating alternatives, Deciding, Checking the decision, Communicating and Implementing.

Assisting learners to effectively set realistic and achievable goals and developing in the learner efficient decision-making skills is one of the roles of distance learning institutions, particularly in the National Open University of Nigeria (Ipaye, 2003). The convention that learners must set goals and make rational decisions that will enhance their academic performance have generated different but related studies (Tanglang & Aminu, 2014;Joo, Bong & Choi 2000; Chan, Yum, Ran, Jegede & Taplin 1999). In another study, Roblyer (1999) worked on factors that motivate community college and virtually high school students to choose online or traditional course formats. The findings indicated that for students who choose distance learning, control over face and timing of learning was more important; for students who choose face-to-face (FTF) course interaction with instructor and students was paramount. Cheners, Hu, & Garcia (2001), Pajares & Kranzler (2002), McIsaac, & Gurawerdena (1996) discovers that self-efficacy was related both to academic performance (r=38) and to persistence (r=34). Michael (2013) examined the evidence for the effectiveness of active learning. It defines the common forms of active learning most relevant for engineering faculty and critically examined the core element of each method and found that there is broad but uneven support for the core elements of active, collaborative, cooperative and problem-based learning. Examining these findings, none have specifically investigated goal setting and decision-making skills in relation to academic performance of undergraduate distance learners. The need to assist the distance learners to set realistic and achievable goals and acquire appropriate decision-making skills related to the demand of distance learning and education becomes necessary.

1.1 Statement of the Problem

The negative trend in the completion rate of learners in distance education programme when compared with general enrolment prompted this research study, cited in Tanglang &Aminu (2014). Many of learners don't realize the importance of setting goals that will guide their learning activities, learning style and other activities that they combined with learning before and during the programme. From the researchers experience while interacting with undergraduate distance learners, many of these learners who were able to set realistic and attainable goals still lack the appropriate decision-making skills to carry out the set goals. Based on this, goal setting, decision-making skills and academic performance of undergraduate distance learners are been investigated in an attempt to draw implications for distance learners retention and support services.

1.2 Research Hypothesis

The following null-hypothesis was formulated for the study:

i. There is no significant difference between the academic performances of High and low goal setter distance learners, ii. There is no significant difference between the academic performances of High and low decision-making skill distance learners, iii. There is no significant relationship between the academic performance of High goal setter and high decision-making skill distance learners, iv. There is no significant relationship between the academic performance of Low goal setter and low decision-making skill distance learners.

2. METHODOLOGY

2.1 Research Design

Ex-post factor research design was adopted for the study.

2.2 Population, Sample and Sampling Technique

The population consisted of an estimated Three thousand (3,000) One hundred levels undergraduate distance learners of the National Open University of Nigeria Lagos Study Centre (NOUN: Academic office, 2014). Three hundred and forty-six (346) One hundred level undergraduate distance learners were randomly sampled.

2.3 Data Collection Instruments

Data collection instruments consisted of Undergraduate Academic Goal Setting Scale (UAGSS), Undergraduate Academic Decision-making Skills Scale (UADMSS) and End of semester examination course result grades in the four core compulsory courses. The Undergraduate Academic Goal Setting Scale and Undergraduate Academic Decision-making Skills Scale were modified scales designed by Mind Tools (2014), a web-based programme for training individuals on how to develop realistic goals and make effective / good decisions. The modified UADMS scale was first used by Tanglang &Aminu (2014). The UAGS scale consisted of eighteen statements on a format of Not at all with score of 5, rarely with score of 4, sometimes with score of 3, often with score of 2 and Very often with score of 1. The UADMS scale also consisted of eighteen statements on a format of Not at all with score of 1, Rarely with score of 2, Sometimes with score of 3, Often with score of 4 and very often with score of 5 on which the samples responded by honestly ticking the type that best describe their levels of goal setting and decision-making skills. The UAGS scale followed the five principles (clarity, challenge, commitment, feedback and task complexity) required for improved personal goal setting (Lock and Latham in Mind Tools, 2014). The statements on the scale were designed to measure: A). Preparing to set goals B). Forming goals C). Motivation D). Achieving Goals. The UADMS scale on the other hand, measures the following skills that were theoretically believed to form good /effective decision-making skills of individuals. Shertzer and Stone (1976); Okon (2003); Denga (1986); Saka (2008); Sambo (2010); Aminu, and Gali (2012); Mind Tools (2014) and Tanglang and Aminu (2014): A) Establishing a Positive Decision-Making Environment B) Generating Potential Solutions, C) Evaluating Alternatives D) Deciding, E) Checking the Decision f) Communicating and Implementing. Undergraduate learner with score range of 18 to 66 were interpreted as Low goal setters and low decision- making skill learners, while undergraduate distance learners with score range of 67 to 90 were interpreted as High goal setters and high decision-making skill learners. The interpretations served as basis for grouping the samples with One hundred and fifty-five High goal setters, One hundred and ninety-one Low goal setters, One hundred and forty-seven High decision-making skills learners and One hundred and ninety-nine Low decision-making skill leaners. The mean age was 20.31.

2.4 Validation of the Research Instruments

The Psychometric properties of UAGSS and UADMSS were established through face and content validity on a pilot study that involved 50 Undergraduate distance learners of the university's study centre in Kano. A test re-test conducted after three weeks of the first administration gives coefficient alpha values of 0.712 for UAGSS and 0.831 for the UADMSS. For the individual statements that measure the processes in setting realistic and achievable goals, the following Cronbach alpha reliability estimates were obtained: A). Preparing to set goals = 0.79. B). Forming goals = 0.67. C). Motivation = 0.68. D). Achieving Goals = 0.63. Individual statements that measures the processes involved in effective decision making, the following Cronbach alpha reliability estimates were obtained: A) Establishing a positive decision-making environment = 0.77. B) Generating potential solutions = 0.71. C) Evaluating alternatives = 0.77, D) Deciding = 0.81, E) Checking the decision = 0.80, F) Communicating and implementing = 0.799. The alpha values for each item on the two scales indicated their suitability for the study. While, the validation of the 2013/2014 semester examination for the four core-compulsory courses of the academic performance were established by External Examiners in the subject areas appointed by the Senate of the National Open University of Nigeria.

2.5 Administration and Collection of Research Instruments

The researchers were personally involved in the administration of the research instruments and also collected and compiled the required academic performance course grade scores of the samples.

2.6 Methods of Data Analysis

t-test for unequal samples was used to analyse the significant differences between high and low goal setters and high and low decision-making skill learners' academic performance while, Pearson Products Moment Correlation Coefficient method was used to analyse the significant relationships between High goal setters and high decision-making skills learners academic performance and also for the analysis of low goal setters and low decision-making skills learners academic performance.

2.7 Results

The results of the study are hereby presented in table 1 and 2. The interpretation of each result follows the tables:

Table 1 contained the analysis of hypotheses 1 and 2 which states that: There is no significant difference between the academic performances of High and low goal setter distance learners and that; there is no significant difference between the academic performances of High and low decision-making skill distance learners.

Table 1. t – test Analysis of Significant Difference between the Academic Performances of High and Low goal setter Distance Learners and Significant Difference between the Academic Performances of High and Low Decision-making skill Distance Learners

Variables	N	Mean	SD	t-value	P-Value
High Goal Setter Learners	155	8.40	1.63	4.01	0.000
Low Goal Setter Learners	191	7.78	1.02		
High Decision-making Skills Learners	147	7.71	1.23	-3.35	0.001
Low Decision-making Skills Learners	199	3.20	1.44		

Table 1 shows significant differences between the academic performances of High and Low goal setter distance learners and also significant difference between the academic performances of High and Low decision-making skills distance learners.

Table 2 contained hypothesis 3 and 4 which states that there is no significant relationship between the academic performances of High goal setters and high decision-making skill distance learners and that there is no significant relationship between the academic performances of Low goal setters and low decision-making skill distance learners.

Table 2. Relationship between the Academic Performances of High Goal Setters and High Decision-making Skill distance learners and Relationship between the Academic Performances of Low Goal Setters and Low Decision-making Skill Distance Learners

Variables	N	r –value	Sig. (2-tailed)
High Goal Setter Learners			
High Decision-making Skills Learners	302	0.297	0.000
Low Goal Setter Learners			
Low Decision-making Skills Learners	390	-0.307	0.000

Table 2 shows significant positive relationship between the academic performances of high goal setter distance leaners and high decision-making skill distance learners' and also significant negative relationship between the academic performances of low goal setter s and low decision-making skill distance learners.

2.8 Discussions

The significant connection between goals setting and decision-making skills as displayed in the academic performance can be linked to what was alluded to by Tanglang &Aminu (2014) that learner decision-making skills are vital in carrying out stated goals. The findings supported Joo, Bong & Choi (2000) that student's self-efficacy for self-regulated learning positively related to his / her academic self-efficacy, strategy use, and internet self-efficacy. Cheners, Hu &Garcia (2001) was also supported by these findings which showed that self-efficacy was related both to academic performance and to persistence. In a similar context, Pajares & Kranzler (2002) on the study of direct effect of mathematics self-efficacy on mathematics performance discovered strong effect of general mental ability, this shows an interplay of self-efficacy as one of the variables of goal setting and effective decision-making skills.Similarlly, the findings supported McIsaac, & Gurawerdena (1996) that a combination of cognitive style, personality characteristics and self-expectations is asserted to be able to predict the achievement in distance education.

2.9 Implications for Learners' Retention and Support Services

The unit for learner support services in open and distance learning institutions can be used to train distance learners on setting goals and developing effective decision-making skills. First, student counsellors must first prove to the learners, the roles played by setting achievable goals and how effective decision -making skills compliment the achievement of set goals and their influence on better academic performance. Second, student counsellors can map out the components involved in goal settings and decision-making skills based on their theoretical foundations. Third, the components can be developed into steps and provided in a module to be followed in developing the skills needed for appropriate goal settings and effective decision-making skills for learners. Fourth, the student counsellors can assist learners on how the module can be acquired to arrive at setting their various goals and decision-making.

3. CONCLUSION

The findings of this study proved the advantage of goal setting and decision-making skills on academic performance of undergraduate distance learners. The study was limited to undergraduate distance learners therefore, there is the need for study that will compare goal setting and academic performance of open and distance learners with that of conventional institutions.

ACKNOWLEDGEMENT

REFERENCES

Aminu, K. I. and Gali, S. 2012. *Guidance and Counselling in Schools: Theories and Practices*. Albarka Publishing Company, Kano, Nigeria.

Chan, M. S.C. et al, 1999. *Locus of Control and Metacognition in Open and Distance Learning: A Comparative Study of Low and High Achievers.* Paper Presented at the 13th Annual Conference of the Asian Association of Open Universities. The Central Radio and TV University. Beijing, China.

Cheners, M. M. et al, 2001. *Academic self-efficacy and First-year College Students Performance and Adjustment.* Educational Psychology, p. 55. Available: http:www.itdl.org/journal/htm

Denga, D. L. 1986. *Guidance and Counseling in Non-school Setting*. Savanna Publishers Limited, Jos, Nigeria.

Ipaye, B. 2007. *Strategies for Sustainable Learners Support Services in Developing Nations*. National Open University of Nigeria, Lagos, Nigeria.

Joo, Y. J. et al, 2000. *Self-efficacy for Self-regulated Learning, Academic Self-efficacy and Internet Self-efficacy in Web-based Instruction.* Educational Technology Research and Development, Vol. 48 No. 2, pp. 5-7. Available, http:/www.emory.edu/EDUCATION/mfp/efftalk.html

Locke, E. A. and Latham, G. P. 1990. *A Theory of Goal Setting and Task Performance.* Englewood Cliffs, NJ: Prentice Hall.

Mc Isaac, M. S. and Gunawardena, C. N. 1996. *Distance Education.* Machmillian, Jonassen, Ed, New York.

Michael, P. 2013. *Does Active Learning Works?* A Review of the Research Engineering Education. Vol. 93, No. 3, p. 223. Available:http:/www.emory.edu./EDUCATION/mfp/efftalk.html

Mind Tools. February newsletter, 2014. *Making an Effective Decision.* Available:http:/www.mindtools.com/pages/article/newTED-79htm

Mind Tools. August newsletter 346, 2014. *How Good is Your Goal Setting?* Available, http:/www.mindtools.com/pages/article/newTED-79htm

Okon, S. E. 1983. *Guidance for the 6-3-3-4 System of Education. Institute of Education,* Ahmadu Bello University, Zaria, Nigeria.

Pajares, F. 2002. *Self-efficacy Beliefs in Academic Contexts.* Available, http:/www.emory.edu./EDUCATION/mfp/efftalk.html

Roblyer, M. D. 1999. *Is Choice Important in Distance Learning? A Study of Student Motives for Taking Internet-based Courses at the High School and Community College Levels.* Research on Computing in Education, Availableon:http:/www.emory.edu./EDUCATION/mfp/efftalk.html

Sambo, S. 2008. *Understanding Guidance and Counseling.* Ahmadu Bello University, Zaria, Nigeria.

Saka, A. Y. O. 2006. *A Collection of Essay in Guidance and Counselling for Schools.* Debis-co Printing and Press, Kano, Nigeria.

Shertzer, B. and Stone, S. C. 1976. *Fundamentals of Guidance*. Houghton Mifflin Company, Boston, USA.

Tanglang, N. and Aminu, K. I. 2014. *Decision-making Skills and Academic Performance of Distance Education Learners*: Implications for Students Counselors. Available, http:/www.iacsit.org

TRANSFORMATIONS:
MOBILE INTERACTION & LANGUAGE LEARNING

Dr. Fiona Carroll[1], Dr. Rita Kop[2], Dr. Nathan Thomas[1] and Rebecca Dunning[1]

[1]*Department of Computing, Engineering and Science, University of South Wales Pontypridd. Wales. CF37 1DL*
[2]*Dean Faculty of Education, Yorkville University, Yorkville Landing, Suite 102, 100 Woodside Lane, Fredericton, NB E3C 2R9. Canada*

ABSTRACT

Mobile devices and the interactions that these technologies afford have the potential to change the face and nature of education in our schools. Indeed, mobile technological advances are seen to offer better access to educational material and new interactive ways to learn. However, the question arises, as to whether these new technologies are being used to their full 'interactive' potential? In Wales, the Welsh language strategy (2012-2017) is pushing to ensure that the Welsh language can embrace new technologies and use them to support and facilitate it's use by Welsh language learners and speakers. As more and more Welsh schools invest in ipads and handheld devices, it is important that the way these schools use these technologies evolves too. These new technologies (and the new interactions that they provide) need to be closely stitched with the desired learning objectives to ensure value, new meaning and learner engagement is achieved. This paper reports on an initial empirical study into the design of a Welsh Learning application, particularly the alignment of the interaction facilities of the technology and learning material in an attempt to harness the desired learning experience.

1. INTRODUCTION

As more and more schools are investing in mobile technology for learning (i.e. iPads, iPods and other handheld devices etc.), the question arises as to what these devices and the new modes of interactivity that they bring to the classroom will actually mean for education. This paper is focused on the education of the Welsh language, as Wales is currently losing around 2,000-3,000 Welsh speakers every single year (Welsh Language Commissioner, 2012). In fact, 'there are many shortcomings in the teaching and learning of Welsh as a second language' (Lewis, 2012). In terms of technology, there are an ever increasing range of exciting and engaging educational websites and applications out there; however, it seems that there are very few that support the education of the Welsh language (Welsh Government, 2013). Even though many Welsh language schools are moving toward the use of mobile devices, they might not be using the full potential of these devices to fully nurture a deep learning of the language. The aim of this research is to explore how the iPad device can be harnessed to create an interactive, fun, yet meaningful way of learning the Welsh language. Of particular interest is the relationship between *interaction* and *learning* and how these need to be closely aligned and nurtured in the mobile environment to ensure an 'engaging' learning experience is achieved.

2. TRANSFORMATION – AN 'ENGAGED' LEARNING EXPERIENCE

Tablets, mobiles and handheld computers such as the iPad / iPhone are fast becoming the epi-centre of people's lives; they are transforming the ways in which we interact with technology. Most of these smart devices are currently embedded with powerful interaction facilities and programmable sensors such as GPS, gyroscope, microphone, haptic sensors, cameras, accelerometers and so on. In fact, these sensor-enabled devices are influencing all aspects of our social ecosystem, particularly holding huge pedagogical potential

for our educational system (Serrano-Santoyo & Organista-Sandoval, 2010). With sensors and new modes of interactions, these devices are changing the way we interact with the physical world around us; they afford interactions which play an intrinsic role in the learning experience. Indeed, interaction has the potential to draw out the essential quality of a learning object; it can initiate an absorbed interplay of cognitive and non cognitive faculties that in turn can cause what Dewey (1934) describes as a transformation – an 'engaged' learning experience. As Elkind (2009) highlights '[learning] experience is not always independent of our behaviour but rather created by it'. With mobile technologies, learners and educators of today, do not only have the opportunity to explore and reinvent the learning object in new and refreshing ways, but they also have the ability to expand learning through the amplification of social conversations and learning networks.

In an attempt to understand these new opportunities for interactivity and the opportunity for learning, it is equally important to be aware of the concepts inconclusively linked to these new technologies and interactions. Usability, being one of these, can be seen as being a quality attribute that assesses how easy user interfaces are to be used (Nielsen, 2003). From the beginning, the study of how people use technology has played a central role in the development of Human Computer Interactions (HCI), so much so, that the HCI discipline has often been portrayed 'as the study and the practice of usability. It is about understanding and creating software and other technology that people will want to use, will be able to use and will find effective when used' (Carroll, 2001, p. xxvii). However, in terms of interaction and particularly the varied interactions of today, it is now evident that we need to understand the bigger picture and acknowledge that usability is actually made up of several components. Indeed, usability is a collective term for all aspects of an activity's performance. As Löwgren & Stolterman (2004, p.5) describe, the design of computer interactions is more 'the process that is arranged within existing resource constraints to create, shape, and decide all use-oriented qualities (structural, functional, ethical, and aesthetic) of a digital artefact for one or many clients'. It is the shaping of digital artefacts for better user experiences, in terms of both appearance and function; the interaction point is what brings everything together and where new connections of knowledge emerge that hold the potential for greater understanding and learning.

How might we shape new interactions for Welsh language learning? A number of researchers in the field of Learning Technology have chosen to use a Design-Based Research approach (Kelly, 2004; Bannan-Ritland, 2003; Barab & Squire, 2004) to examine and analyze in a systematic way every aspect of a new learning design innovation. The transformation, we discuss, depends on balancing the interaction afforded by the technology (function and appearance) with the learning cues and connections to guide the learner into a sense of flow and engagement in the learning environment. Interactions, particularly those afforded by new mobile technologies (touch screen, sensors etc), have the potential to expose the learner to a number of opportunities for the creation and recreation of new, exciting and 'engaging' learning experiences. The key lies with the learning designer and how well the 'transformation' is designed; how well the interactions, function as well as appearance, are aligned with the learning material.

3. INITIAL STUDY OF THE APPLICATION

This research was undertaken at the University of South Wales to explore how the iPad device and the interactions it affords can enhance the 'Welsh language' learning experience. In Wales, there is a 'need to ensure that the [Welsh] language can embrace new technologies and use them to support and facilitate its use by Welsh speakers of all ages' (Welsh Government, 2011). To build the *Welsh language learning* application, a design-based research approach has been used to ensure that each stage of the development has been considered and addressed as described (Carroll and Kop, 2011). From the start, it was important to think about the appearance and function of the interaction and how this integrates with the learning objectives – to create ideas of what the main features of the application might look like and also how these would function (i.e. what interactions they would afford). Based on the national curriculum of Wales, we decided to focus the *Welsh language learning* application on the area of 'Knowledge and Understanding of the World' and within this to concentrate on three main topics: 'Knowledge of the Home' 'Animals' and 'Weather Observation'. For example, on paper, the *home environment* section of the application aimed to encourage the child's Welsh literacy skills and to reinforce their vocabulary and knowledge of items around the house. This core idea was then expanded through interaction to incorporate more playful experiences. In detail, the learner is presented with the cutaway profile of a house showing four separate rooms full of everyday

household objects. Each room contains objects that have been embedded with touch gesture interactivity and it is the learner's task to visually explore the rooms, touch the objects and in doing so build up his or her Welsh language skills. The key lies in the interaction – driven by the curious exploration – in that each learner needs to be enticed to visually engage with an object and then to physically touch it to trigger a response. For example, on touching the television set, the television switches on and the Welsh pronunciation of the word 'television' is audibly played as well as textually presented. In doing so, the learner is able to familiarize him or herself with the sound, spelling and visual representation of each object in Welsh.

Five local welsh medium nursery/ primary schools (1-5) were approached in order to test the application. Both children (approximately ten learners per class/ school) and teaching staff (approximately one teacher and two teaching assistants per class/ school) were asked to take part in the study; the study was conducted through the medium of Welsh. Observational methods and focus groups were used to evaluate the children's impressions of the *Welsh Language Learning* application. The teaching staff from each school were asked to complete a questionnaire after using and observing the use of the *Welsh Language Learning* application to evaluate its interactivity and potential for learning.

The overall perception from the study was that all children enjoyed using the application, they were all interested and it proved a suitable tool to engage and keep them involved. Generally, all children participated in the activities and enjoyed discussing the application with their peers. The playfulness of the *drag and drop weather* activity and the novelty of the *dressing up an avatar* seemed to be most popular with schools (1)(2)(3) whilst children in schools (4)(5) engaged more in the exploration of the *home environment* section as they found identifying all the items around the house as well as the quiz the more challenging. Some children did slightly struggle with the learning content and children from school (3) were recorded to occasionally use the 'English Help' button for help. Overall, as the focus group discussion highlighted, all children enjoyed and were interested in using the application; in fact, they wanted to use it more. From the questionnaire data, we concluded that teachers from all five schools felt that the children enjoyed, were interested in and had the potential to benefit educationally from using the application. Three out of five teachers thought that the 'weather' section seemed most successful with the children whereas school (2) thought that the home environment section was the more engaging. All teachers agreed that the majority of children were participating as they usually do and were all paying attention (i.e. not easily getting distracted etc). In terms of learning the Welsh language, four out of five of the teachers found that the application was slightly too easy for the target audience (i.e. very few children seemed to need extra guidance). However, when asked to rate what they thought the probability of learning for each child after using this application would be (on a scale of 1-5, 1 being lowest – 5 being highest), teachers from four schools rated the application as a '4' for its potential for learning. The results also indicate that 'learning through play', particularly the playful elements incorporated into the interactions, proved to be an effective way to engage children of such a young age in the 'Welsh language' learning process. In terms of interactivity, all teachers felt that the children enjoyed interacting with the application; in fact, they all felt the need for more interactions to further enhance the child's learning experience.

4. CONCLUSION

This short study has allowed us to identify the learning activities and interactions that the children were most engaged in whilst using the *Welsh Language Learning* application. More importantly, it has given us some insight into why the children were engaged with them (i.e. novel activities, playful interactions and challenging tasks). It is this power to 'engage' learners that emphasizes the importance of interaction to the learning process. In fact, it is this very 'power' that exposes the need to rethink the potential of the interactions that new technologies afford to the learning experience. Indeed, it is the attention to both the visual appearance and function of the interaction that can keep participants in the flow of their activities and consequently enhances their experiences. It is this detailed focus on the interaction that then plays an important role in determining the 'transformation'. As we have seen from this initial study, it was a combination of challenging learning tasks (i.e. appropriately set learning objectives) framed in novel activities that were brought to life through visually and functionally 'playful' interactions that harnessed the learners' engagement and the enhancement of the learning process. Looking ahead, the aim is to explore further iterations of this application with a deeper focus on the visual and functional aspects of the mobile

interaction and its role in the learning experience. Engagement is the key and it is the harnessing of engagement which takes interaction beyond usability and more towards the experiential, introducing many possibilities for new and exciting learning experiences.

REFERENCES

Bannan-Ritland, B. (2003) The Role of Design in Research: The Integrative Learning Design Framework, Educational Researcher, 32, 21-24Carroll, F. & Kop, R. (2011). "A Learning, Research and Development Framework to Design for a Holistic Learning Experience", E-Learning and Digital Media Journal. ISSN 2042-7530.

Barab, S. and Squire, K. (2004) Design-Based Research: Putting a Stake in the Ground, The Journal of the Learning Sciences, 13, 1, pg.1-14

Carroll, J.M. (2001). Human Computer Interaction in the Millennium. New York: ACM Press, Addison-Wesley. p. Xxvii

Carroll, F. & Kop, R. (2011). "A Learning, Research and Development Framework to Design for a Holistic Learning Experience", E-Learning and Digital Media Journal. ISSN 2042-7530.

Dewey, J. (1934). Art as Experience. London: The Berkley Publishing Group.p.22

Elkind, D. (2009). Learning through Play. Available at: http://www.communityplaythings.com/resources/articles/2009/learning-through-play. (18/03/2015)

Löwgren, J. & Stolterman, E. (2004). Thoughtful interaction Design – a Design Perspective on Information Technology. USA: MIT Press.p.5

Kelly, A. (2004) Design Research in Education: Yes, but is it Methodological?The Journal of the Learning Sciences, 13,1,

Lewis, G. (2012). Welsh Second Language in the National Curriculum -the case of teaching Welsh in English-medium schools. p. 2. Available at: http://www.assemblywales.org/paper_3_-_dr_w_gwyn_lewis.pdf (Accessed: 10/7/ 2013)

Nielsen, J. (2003). An introduction to usability. (Online). Available from: http://www.useit.com/alertbox/20030825.html (31/10/2006).

Serrano-Santoyo, A., & Organista-Sandoval, J.(2010). "Challenges and opportunities to support learning with mobile devices"; In Proceedings of the 3rd Mexican Workshop on Human Computer Interaction, Universidad Politécnica de San Luis Potosí,. México, 85-87.

Welsh Government (2011). Written Statement - Welsh Government's Welsh Language Annual Report for 2010 / 11. Available at: http://wales.gov.uk/about/cabinet/cabinetstatements/2011/09decemberwelshlanguagereport/?lang=en (10/7/ 2013)

Welsh Language Commissioner (2012) Data / Statistics. Available at: http://www.Welshlanguagecommissioner.org/English/Assistance/Pages/datastatistics.aspx (10/7/ 2013)

Welsh Government (2013). Welsh-language technology and digital media action plan. Available at: http://wales.gov.uk/topics/welshlanguage/publications/welsh-language-technology-and-digital-media/?lang=en (12/07/2013)

DIGITAL RESOURCE EXCHANGE ABOUT MUSIC (DREAM): PHASE 2 USABILITY TESTING

Rena Upitis[1], Karen Boese[1], Philip C. Abrami[2] and Zaeem Anwar[1]
[1]Queen's University, Kingston, ON Canada
[2]Concordia University, Montreal, QC, Canada

ABSTRACT

The Digital Resource Exchange About Music (DREAM) is a virtual space for exchanging information about digital learning tools. The purpose of the present study was to determine how users responded to DREAM in the first four months after its public release. This study is the second phase of usability research on DREAM, and was conducted to guide future development of the tool. Research questions were designed to determine patterns of use for DREAM, the most popular resources, and gaps in the DREAM resources, in order to guide further design and content development. The primary data sources were site analytics, supplemented by an online survey and feedback from teachers who took part in a DREAM workshop. Results indicated that DREAM is steadily gaining users, and that the tool is effective and satisfying for music teachers as a way of keeping abreast about digital learning tools, especially for resources for ear training and sight reading. The paper concludes with suggestions for design enhancements and ways of broadening the user base.

KEYWORDS

Digital music tools, learning objects repository, music education

1. INTRODUCTION

Digital applications for music education have been growing at an astonishing rate, and these resources are changing the ways people teach, learn, and make music (Burnard, 2007; Partti, 2012; Rainie & Wellman, 2012; Waldron, 2013). While the use of digital tools in classroom music settings has a long history and is well described in the literature (Savage, 2012; Webster, 2012), the use of digital tools in studio music instruction is less prevalent (Upitis & Abrami, 2014). In both instances—classroom music teaching and private studio music instruction— obtaining information easily and swiftly about these new tools is important so that teachers can assess the appropriateness of such tools for their students' needs in a timely fashion. However, teachers are perennially time-starved and are often unable to systematically examine and evaluate the resources that are available. Consequently, classroom teachers often rely on interactions with their colleagues to learn about new technologies (Savage, 2012). But independent music teachers often work in isolation (Feldman, 2010), making these informal discussions about resources more unlikely and certainly less than comprehensive. Thus, a tool that provides a centralized place where independent music teachers can keep abreast about new digital technologies for their field has the potential to assist music teachers considerably. It is this type of tool that was examined in the present study.

The Digital Resource Exchange About Music (DREAM) is one of a suite of four digital tools for music learning. The first tool in the suite, iSCORE, supports students in their path to becoming self-regulated musicians. Two tools that are presently under development include an iOS mobile app for annotating music videos called Notemaker, and another web-based tool called Cadenza, which, like iSCORE, also supports student self-regulation. These tools were designed by a research and development team comprised of members from two universities and a national music conservatory (Upitis, Abrami, Brook, Troop, & Varela, 2012). DREAM was designed by our team to encourage teachers to learn about digital resources related to learning to play a musical instrument following the Western musical tradition, both in classroom and studio settings. DREAM enables teachers to evaluate the resources, to read about other teachers' views of the resources, and to add resources of their own to the digital learning objects repository. In the release version

(DREAM, v. 1.4), over 3,000 high-quality English and French resources were organized into six categories: (a) musical repertoire, (b) ear training and sight-reading, (c) practising, (d) history and theory, (e) creating and composition, and (f) professional resources. All of the entries in DREAM are searchable by title and key words, and users can also filter the resources by instrument, ability level, or platform (e.g., by type of tablet or smartphone). DREAM recommends resources to users based on their prior choices. We characterize DREAM as a Trip Advisor™ for music teachers—but instead of choosing a hotel based on such filters as free parking and breakfast, the teachers choose, for example, musical repertoire, filtering for instrument (e.g., piano) and difficulty level (e.g., advanced). In the four-month period immediately after launching the tool, the resource base grew to nearly 3,500 entries, the bulk of which are in the repertoire category.

In this age of ubiquitous and accessible digital tools, it is essential that DREAM operates in a way that is seamless and efficient for intended users. Even though DREAM is essentially an educational tool, the expectation from users is that it will function as seamlessly and professionally as commercial products, such as the Trip Advisor™ described above. The process of usability testing involves learning from test participants that represent the target audience. These test participants help determine the degree to which the product meets its goals (Rubin & Chisnell, 2008; Yadrich, Fitzgerald, Werkowitch, & Smith, 2012). Rubin and Chisnell (2008) assert that a usable product must be "useful, efficient, effective, satisfying, learnable, and accessible" (p. 4). In a similar vein, Barnum (2011) states that tools should be easy to learn, easy to use, intuitive, and fun. Barnum notes that the International Organization for Standardization (9241-11) defines usability as, "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (p. 11). Rubin and Chisnell embellish this definition of usability by noting that one of the most important aspects of making something usable is the "absence of frustration in using it … [so that] the user can do what he or she wants to do the way he or she expects to be able to do it, without hindrance, hesitation, or questions" (p. 4). The parallel idea in Barnum's (2011) work is the notion that usability should be invisible, that is, the built-in usability of products suits the user so that the user doesn't have to "bend to the will of the product" (p. 1).

Before releasing DREAM to the public, an extensive usability testing protocol for DREAM was designed, and has been reported elsewhere (Upitis, Abrami, Brook, Pickup, & Johnson, 2015). During the first usability study, the DREAM design and contents were modified on the basis of the input of 12 core test participants and designers, a group of 24 classroom music teachers enrolled in a teacher education program, as well as 47 studio music teachers representing eight of the thirteen provinces and territories in Canada. The results of the Phase 1 usability study gave support for the conclusion that DREAM could serve as a centralized place for music teachers to keep abreast about digital technologies, providing a tool that would be valued by music teachers in terms of efficiency and effectiveness. Further, the usability study provided evidence that DREAM would be enjoyable and efficient, so long as the team continued to vet resources, provide reviews, and otherwise ensured that only the highest quality resources would be included.

DREAM (v. 1.4) was released on September 4, 2014 with a single email announcement to approximately 30,000 users through the database of The Royal Conservatory (RCM), a national music conservatory in Canada. Most subscribers to the database are from Canada, although a small number live in the United States, where the RCM also conducts music examinations. Since that time, our data reveal that all new users have joined DREAM primarily by Internet searches and word of mouth. As recommended on the basis of the first usability study, a small team of music teachers has continued to vet new resources from outside users, provide reviews of the most popular resources, and add new resources as required to fill gaps, such as recordings for instruments other than the piano. Further, DREAM has been presented to various teacher organizations both for information and feedback, and several professional publications for independent studio teachers have featured short descriptions of DREAM. Overall, the first four months are best characterized as a "soft launch," that is, a gentle introduction to the tool rather than a strategic marketing plan, the latter of which the developers will undertake after the results of the present study are incorporated in Version 2 of DREAM. Strategic methods for marketing digital tools have been in use for several decades (e.g., Downes & Mui, 2000; Edelman, 2010; Ryan, 2014). While most of these sources examine marketing strategies for businesses, it is clear that an educational digital tool, like DREAM, could be launched using similar strategies, some of which will be explored in the final section of the paper.

Thus, the purpose of the present study was to describe and analyze the first four months of use to guide further development of the tool and to identify strategies for expanding the user base. The research questions for this second phase determined: (a) patterns of use for DREAM (b) which pages and categories were most useful, (c) what gaps were identified by users and developers in terms of DREAM resources, and (d) what features of DREAM require further development to increase user satisfaction.

2. METHOD

2.1 Data Collection

The primary sources of data were the site analytics tracked by Google, as well as by the host server. These site analytics included data on user numbers, page views, countries of origin, new and returning users, and information about the time spent on various parts of the site. There were two secondary sources of data: a focused survey and feedback from music teachers who took part in a workshop on DREAM. The focused survey was targeted to DREAM users through the project website as well as through Facebook. The survey contained one question regarding teachers' use of DREAM to triangulate with the site analytics data regarding which of the six categories of resources were most often accessed. In addition, we asked a series of usability questions, including whether they shared DREAM with their students and colleagues, whether DREAM had changed their teaching, whether the resources were useful, and finally, whether there were any changes that they would make to DREAM in terms of content, function, and design. Feedback from the teachers taking part in the workshop focused on design aspects of DREAM, notably the browse and search functions. In total, 22 teachers provided comment through the survey or workshop.

2.2 Data Analysis

Open-ended questions from the targeted survey and workshop feedback were analysed according to the research questions described above. Descriptive statistics were compiled from the closed-ended survey questions regarding patterns of use. Site analytics were gathered and compared from the two sources to compile a portrait of user information as it pertained to the first four months post-release.

3. RESULTS

3.1 User Characteristics and Patterns of Use

Over the four-month time period from September 4, 2014 to January 4, 2015, DREAM received over 40,000 page views. Nearly a third of the users returned to the site after their initial exposure to the tool, coming back to the site both to access and to contribute content. Over the four months, nearly 5,000 new users accessed DREAM, mostly to view content. Users can view content without creating an account; however, to add content or to comment on resources in the digital repository, an account must be created. Of the new users, only 187 people (4%) created an account. This is not surprising, given that many users will simply use DREAM to locate resources and have resources recommended to them, and not be interested in adding new resources or reviews of their own. Earlier we characterized DREAM as a Trip Advisor™ for music teachers; many people who use Trip Advisor™ to make travel plans never provide a review upon their return.

As can be seen in Table 1, users of DREAM typically spend just over three minutes on the website, browsing six pages on average. This means that they go well beyond the home page, and likely search or browse until they find the resource they are seeking. There is also a difference between new and returning users. New users access approximately three pages, while returning users engage with six or more pages each time. Thus, it appears that users who find DREAM helpful return each time for longer and longer sessions. In addition, this result does not include the time that they may spend learning more about the resources that they locate through DREAM. In the workshop with teachers, we observed that teachers would browse through two or three resources, and, finding one that piqued their interest, they would then leave DREAM and spend time examining the resource they had identified on the webpage dedicated to that particular resource.

Table 1. Overview of site analytics

Measure	
Unique sessions	6,778
Users	4,788
Page views	40,091
Pages visited per session	5.91
Average session duration	03:28 minutes
New users	70.1%
Returning users	29.9%

The site is predominantly accessed via Windows operating systems (45%) followed by iOS mobile devices such as iPhones and iPads (25%), Macintosh computers (19%), and Android mobile devices (8%), with the remainder being accessed through BlackBerry, Linux, Nokia and Windows Phone. The most popular browser is Safari (34%), followed closely by Chrome (30%). Firefox and Internet Explorer combined make up another 25%. Nearly two thirds of the visitors are from Canada (64.78%), with a notable number from other English-speaking countries, such as the United States (13.93%), and the United Kingdom (2.15%). Some users are from other countries in Europe, as well as Hong Kong. The users are predominantly English-speaking (83%); fewer than 2% are currently accessing DREAM in French.

As noted previously, the resources in DREAM are divided into six categories. In descending order of popularity, the resources accessed were (a) musical repertoire, (b) ear training and sight-reading, (c) practising, and (d) theory and history. The remaining two categories, namely, creating/composing and professional resources, were rarely accessed, indicating that these resources were less important to teachers.

These patterns of use correspond to the results of the survey and feedback from the teacher workshop. Every teacher we observed in the workshop, and every survey respondent reported that they used DREAM to find ear training and sight-reading programs and apps. While repertoire had more page views, the number of page views of ear and sight resources is proportionally much higher. Near the end of the four-month period that this study took place, there were 2,964 repertoire resources in DREAM, compared to only 44 ear and sight resources. This means that 85% of the resources were repertoire pages, and a mere 1.25% of the resources related to ear training and sight-reading—yet they were accessed nearly as often as repertoire. Put another way, in terms of the total page views, repertoire accounted for 5.24% of the page views, and the ear and sight resources represented 4.40% of the page views. The importance of the ear and sight resources to teacher pedagogy was also reflected in the open-ended comments on the survey. One teacher noted, "The ear training and sight-reading apps I've located have been particularly handy… I also extolled its virtues in an article about the sight-reading apps!"

3.2 Further Survey and Workshop Results

The site analytics do not give a direct indication of whether the resources recommended by DREAM are useful to users, although certainly the high rate of returning users is an indirect indication of user satisfaction. Consequently, to learn more about usability, survey respondents were asked directly about whether DREAM resources were useful, and every respondent answered "often" or "sometimes", with over 60% selecting "often." The categories of rarely and never were not used. Another indication of user satisfaction from the survey results was that every respondent indicated that they have told colleagues and/or students about DREAM. As to changes in pedagogy, most respondents indicated that it was too soon to tell, although those respondents who indicated that DREAM has improved their teaching commented on the usefulness of ear training and sight-reading apps, repertoire, and instructional videos about learning. One user commented on the importance of peer reviews of the resources.

At this stage in the development of DREAM, it is important to ascertain whether there are design changes that should be incorporated in Version 2. If users have concerns about DREAM, they tend to center on the search function. Some users are confused about the difference between browse and search; others have requested a more sophisticated search function that would enable them to make greater use of DREAM. A few users have suggested that repertoire should support more platforms (DREAM presently supports YouTube, but not, for example, Vimeo).

Other directions for improving the design of DREAM and increasing the resources include working closely with music conservatories worldwide to identify additional resources of both global and local interest. Asian, African, and Middle Eastern music are not well represented in DREAM and this is also a way to enhance the repository. In addition, seldom used and poorly rated resources might eventually be held aside.

Finally, the site analytics indicate that most users access DREAM directly, using the URL to visit the website. The remaining users often find the site using search engines. A small minority of users come from site referrals and social media. These results will guide our strategies for increasing the DREAM user base.

4. CONCLUSION

For a specialized tool for music educators that was launched in a low-key way, the first four months of use of the DREAM tool was impressive. The number of page views, especially for resources in the ear training and sight-reading category, was considerable. Many teachers also accessed the apps and other instructional resources designed to support student practising. This is not surprising, given that teachers often identify that one of the perennial challenges of instrumental music instruction is to guide student practice and to provide scaffolding for students to become proficient sight-readers (e.g., Hallam et al., 2012). The results from the present study, which point so strongly to the importance of these types of sight-reading and practising resources, will help us focus on new content in these categories. Given the results, other design changes would also be prudent, especially with respect to the search and browse functions. We expect that the improvements for the search function in particular will have a positive impact, given that the search pages are accessed much more frequently than the browse function and that teachers have commented on specific ways that the search function could be improved.

The results also indicate there is potential to grow the user base. There are at least three reasons for this conclusion. First, there has been a steady increase in users each month, even without strategic marketing to reach out to more teachers. Second, this organic growth of DREAM includes a substantial group of users (35%) who reside outside of Canada, and therefore are not among those who would have received notification the release of DREAM. Finally, there are clear indications that the tool is efficient, satisfying, and useful to users.

How, then, to grow the user base? While evidence has shown that word of mouth and direct linking have been the most effective ways of expanding the DREAM user base, there is merit in considering other sources of traffic. Search traffic from Google and other websites has accounted for a majority of the site sessions to date. By promoting our search results with the use of Google AdWords, and SEO optimization through smart site linking in reputable and related sources, our target audiences would encounter DREAM more often. There are also web-based music forums that may be worth investigating for promotional value. Having active exposure on these forums might increase referrals through direct links as well as word of mouth. At present, Facebook is our sole provider of social media referrals. Facebook contains targeted ads that can be focused on specific demographics. By setting up these targeted profiles, we can ensure that DREAM exposure increases to music teachers, students, and other interested parties.

Edelman (2010) claims that successful digital marketing has four components, two of which have direct application to DREAM. He argues that marketers must first "engage the consumer throughout an increasingly digital purchase journey" (Edelman, 2010, p. 2). This strategy suggests that continuing to grow the user base, without charge, in the ways discussed above. Over time, adding such features as a donate button and creating a premier version might serve to both increase the user base and generate revenue to maintain and enhance DREAM. Edelman (2010) also stresses that successful marketers continually gather and use digital data to guide their actions, and this we will also continue to do with the aim of refining DREAM and making it available to the widest possible audience.

ACKNOWLEDGEMENTS

REFERENCES

Barnum, C., 2011. *Usability testing essentials: read, set ... test!* Elsevier, London, UK.

Burnard, P., 2007. Reframing creativity and technology: promoting pedagogic change in music education. *Journal of Music Technology and Education*, Vol. 1, No. 1, pp. 196–206.

Downes, L., & Mui, C., 2000. *Unleashing the killer app: Digital strategies for market dominance.* Harvard Business School Press, Cambridge, MA, USA.

DREAM | Digital Resource Exchange About Music (DREAM) - Music Teaching Resources. 2015. *DREAM | Digital Resource Exchange About Music (DREAM) - Music Teaching Resources*. [ONLINE] Available at: http://www.dreammusictool.ca. [Accessed 18 January 2015].

Edelman, D. C., 2010. Four ways to get more value from digital marketing. *Marketing & Sales Practice.* McKinsey & Co., Boston, MA, USA.

Feldman, S., 2010. *RCM: A quantitative investigation of teachers associated with the RCM exam process*. Susan Feldman & Associates, Toronto, ON, Canada.

Hallam, S., Rinta, T., Varvarigou, M., Creech, A., Papageorgi, I., Gomes, T., & Lanipekun, J., 2012. The development of practising strategies in young people. *Psychology of Music,* Vol. 40, No. 5, pp. 652–680.

Partti, H., 2012. Cosmopolitan musicianship under construction. Digital musicians illuminating emerging values in music education. *International Journal of Music Education*. doi: 10.1177/0255761411433727.

Rainie, L., & Wellman, B., 2012. *Networked: The new social operating system*. MIT Press, Cambridge, MA, USA.

Rubin, J., & Chisnell, D., 2008. *Handbook of usability testing: how to plan, design, and conduct effective tests* (2nd ed.). Wiley Publishing, Inc., Indianapolis, IN, USA.

Ryan, D., 2014. *Understanding digital marketing: Marketing strategies for engaging the digital generation.* Kogan Page Limited, London, UK.

Savage, J., 2012. Those who can – play; those who can't – use music tech? How can teachers knock down the walls between music and music technology? In: C. Philpot and G. Spruce, eds. *Debates in music teaching*. London: Routledge, 2012. pp. 169–184.

Trip Advisor. 2015. *Trip Advisor*. [ONLINE] Available at: http://www.tripadvisor.ca/. [Accessed 26 January 15].

Upitis, R., Abrami, P. C., Brook, J., Pickup, D., & Johnson, L. (2015). Digital Resource Exchange About Music (DREAM): Usability testing results. *European Journal of Social and Behavioural Sciences (EJSBS),* Vol. 8, No. 2, ISSN 2301-2218.

Upitis, R. & Abrami, P. C. (2014). Enhancing music learning with digital tools. *Proceedings of the 12th Annual Hawaii International Conference on Arts and Humanities*, ISSN 1541-5899, pp. 267–283.

Upitis, R., Abrami, P. C., Brook, J., Troop, M., & Varela, W. (2012). Learning to play a musical instrument with a digital portfolio tool. *Journal of Instructional Pedagogies*, Vol. 9, No. 1, pp. 1–15.

Waldron, J., 2013. YouTube, fanvids, forums, vlogs and blogs: Informal music learning in a convergent on- and offline music community. *International Journal of Music Education*, Vol. 31, No. 1, pp. 91–105.

Webster, P., 2012. Key research in music technology and music teaching and learning. *Journal of Music, Technology, & Education,* Vol. 4, Nos. 2–3, pp. 115–130.

Yadrich, D. M. et al., 2013. Creating patient and family education web sites: assuring accessibility and usability standards, Computers, Informatics, Nursing, Vol. 30, No. 1, pp. 46–54. doi: 10.1097/NCN.0b013e3182343eac.

RESEARCH SUGGESTIONS IN THE DESIGN
OF A GLOBAL GRADUATE BUSINESS PROGRAM
DELIVERED BY ONLINE LEARNING

Dr. Amy Puderbaugh
Walden University
155 5TH Ave S Ste 100. Minneapolis, MN *55401-2511*

ABSTRACT

The purpose of this paper was to examine the unique areas of concern when establishing an eLearning program in the field of global business. A survey of eLearning and a global management subject matter appears. This paper identifies potential challenges in program design and raises practical concerns for future research.

KEYWORDS

Subject matter course design, distance learning, graduate global business courses, international business program, eLearning, global management competencies

1. INTRODUCTION

Workforces are becoming more global (Remtulla, 2007a) and educational instructions are moving more towards non-traditional learning ("Online enrollment", 2010). Since the use of a delivery method can significantly shape the success of a program, the success of graduates, and the success of an institution's reputation, it is important that the choice delivery method be examined thoroughly. As different programs within an institution have distinct subject matter that needs to be uniquely presented and tailored it is important that the design and delivery of each topic of study is looked at individually.

The purpose of this work was to add to the breadth of research available by examining questions that should be answered in a global business master's program delivered online. The project also calls to attention a large gap that existed in available research material. Information on pedagogy, eLearning, the global realm, and graduate business programs as isolated areas is plentiful. However, finding material that ties these areas together or focuses on the course subject matter is not an easy find.

A global business program may also be known as names such as an international business program, a global management program, or similar title. The program may appear as a solo offering or as a concentration within another field (such as an MBA program with a global business concentration). This paper will not distinguish; it will focus on courses that are solely delivered via an eLearning format.

If there are areas of global business management that cannot be taught via eLearning educational leadership will need to know this. If there are areas that are difficult to teach, educational leadership will need to know what techniques are effective. Limitations need to be examined honestly as there will be ramifications on the success of the program. An institution should also be proactive in this search for information as finding a problem out reactively could mean the problem is widespread and debilitating to the institution.

2. EXAMINING ELEARNING

Rosenberg (2001) defines eLearning as, "the use of internet technologies to deliver a broad array of solutions that enhance knowledge and performance". Rosenberg further states that eLearning is networked, delivered via a computer and standard internet technology and that it is focused on the broadest view of learning.

eLearning is a popular, but smaller segment of the field of distance learning. Distance learning can involve areas such as media tapes or delivery via standard mail. A key to eLearning is the replacement of face-to-face interaction with a hardware interface (Remtulla, 2007b).

A survey by Babson Survey Research Group study revealed, in 2013 online students numbered 7.1 million, a 6.1% increase from the previous year, and the lowest recorded increase in a decade of steady increases. 33.5% of higher education students reported taking at least one online course (Allen & Seaman, 2014).

eLearning can provide students with an opportunity to attend courses without altering their existing schedules, or moving house. Students can pick their most convenient times to study (within some restraints) and have a better chance of maintaining work-life-school balance (Li, 2008). Individuals who do not feel as though they are being developed in the workplace may turn to eLearning at a university for a form of self-development in hopes that it may set them up for a future position.

Desai and Pitre (2009) list several advantages to offering a course online. These include the time flexibility for students, the chance for a school to increase enrollment, the chance for students to have diverse group interactions with students from other cities and countries, possible exposure to unique culture and language, a wider perspective of problem solving, and project variety.

Chau (2010) acknowledges that cost, accessibility and flexibility may be motivations for institutions moving to online learning. However, Chau also proposed that educational institutions are motivated by providing a commodity in current demand in the consumer marketplace.

3. CHALLENGES OF ELEARNING FACILITATION

eLearning is not without challenges. For facilitators there can be isolation, time demands, highly rigid courses, and a lack of traditional student/teacher hierarchy.

One unique challenge of eLearning is a staff that may be external to the university campus. Instructors may feel a sense of isolation from the university or program itself (Magdalena & Mellar, 2009). Instructors may have little vested interest in student success. The understanding of university support areas may be limited. Instructors working on a contract or ad-hoc basis may also be responsible for reporting or fixing the problems found within the course (Magdalena & Mellar, 2009).

Students may also experience isolation. Students did not miss the opportunities for social interaction when taking courses online (Mallory, 2007; Smith & Duus, 2001). However, in a traditional setting students may feel a closer bond to the instructor (Lucas, 1996). Smith and Duus (2001) stress the need for small class sizes due to the intense dialogue interaction that is needed between student and instructor. Smith and Duus (2001) further note that although offering a class online may result in cost savings due to increased opportunity, the small class sizes may make that savings null.

An additional challenge to instructors may be the rigidity of the course. One study found that "the demands for a structured and focused approach to virtual interactivity may be too much of a challenge for some" (Smith & Duus, 2001). Although the course itself may be more rigid than a traditional course, instructors may find the student/teacher hierarchy within the course much less so. A course with open discussion forums may also blur the line between the instructor and peers in interaction. Instructors need to learn how to be leaders in the virtual world and build a sense of community and collaboration. Engaged faculty can help students feel connected (Cook, 2010). However, instructors who move from a traditional course to teaching online may find the time demands much more difficult, as students may expect quick answers to questions at any hour (Cook, 2010; Smith & Duus, 2001). Du-Charme-Hansen and Dupin-Bryant (2005) emphasize the need to build a distance education plan that involves actively building community, facilitating communication, and humanizing the experience. Many of the suggestions have to do with course threads, synchronous chat and engaging in more informal conversation about "how's it is going?". Although an active classroom discussion board is emphasized in the literature the desire for synchronous sessions remains under debate (Cunningham, 2014; Nicholas, 2014).

One study suggested universities focus on course design, instructor selection and instructor involvement, as the delivery method of the course did not have a statistically significant impact on learning (Buhagiar & Potter, 2010). Another case used the example used the social interactive website, Second Life, as an instructional tool to improve faculty engagement and to develop a sense of community among faculty and

students (Sutton, White, Mbizo & Stewart, 2010). Verene (2013) argues that complete learner-instructor and learner-learner engagement cannot take place online due to the lack of genuine, real time dialogue and communication nuances.

4. CONTENT DESIGN FACTORS

There are several factors that should impact how a course is crafted and presented. Among these are course content, pedagogy, the subject matter covered, the learners, and the media to be used.

Edmundson (2009) found that course outcomes affect the course content, pedagogical approaches, and the type of media used. Some courses such as computer courses tend to be culturally neutral. Other areas such as leadership courses were "deeply imbedded with cultural values, ideology, and worldviews" (Edmundson, 2009). As the content was more complex, the pedagogical approaches and media needs become increasingly complex as well. Making the content accessible to a culturally diverse audience may include examination by observation, focus groups, country experts, interculturalists, web interface designers and a close look at the targeted learners (Edmundson, 2009). eLearning courses should be tailored based on the content and the learners unique identity and needs.

Universities may or may not examine the subject matter of a course when deciding whether a class should be offered online. There may be other considerations, such as space concerns, instructor pool, or the need to be geographically diverse to get a wide enough student base. The decision to offer a course online may be solely administrative, yet instructional input will need to be offered. The instructional designs and technology chosen should align with the course goals and pedagogical goals (Cook, 2000). In order for this alignment to take place the specific subject matter area needs to be examined.

5. GLOBAL MANAGEMENT DESIGN

In global management subject matter design, the natural place to look for program outcomes is competencies required by organizations that employ global management professionals. Much of the research focused on competencies needed function as an expatriate employee (Bücker & Poutsma, 2010). However, some competencies discussed were the ability to use social capital and diverse networks in a way that completes work effectively (Makela & Suutari, 2009).

Criticisms of MBA graduates include that they are "ill prepared to deal with complex, multi-layered issues faced by managers in global markets" (Belasen & Rufer, 2007) and that the theoretical courses that they take result in too much emphasis on the quantitative and not enough emphasis on people skills (Sulaiman & Mohezar, 2009). Tay (2001) suggests that courses such as public speaking, conflict resolution, and team work techniques be added to be business school programs in an effort to enhance soft skills of students. Bueno and Tubbs (2004) suggest that the most important global leadership competencies are: communication skills, motivation to learn, flexibility, open-mindedness, respect for others, and sensitivity. These are soft skill areas and may be areas difficult to teach or develop in students.

Over the last thirty years business schools have been forced to react to an AACSB mandate to internationalize their curriculum. Some schools have reacted by merely adding an international business survey course. Others have integrated an international component into existing subject areas such as marketing, accounting or management. Some programs insist on going beyond mandate minimums in program design (Delaunay & Blodgett, 2005).

Some traditional universities are able to take unique advantage of opportunities around them to develop competencies. Others make a conscious effort to create international core community within the university. Suffolk University developed a Global MBA (GMBA) program with the idea that it would tap into opportunities in the vibrant international business community around Boston. The program makes a conscious effort to ensure that a global perspective is always in place within the classroom. One third of the faculty members of the Suffolk University's business school were born in and educated outside of the United States; half of the faculty base has extensive experience in work or education abroad. The University maintains several campuses abroad. Fifteen percent of the students of the school of business come from abroad (Delaunay & Blodgett, 2005). MBA students at Oxford spend six months of their program with

organizations located in other countries (Tay, 2001). Some universities offer a regional world focus when it comes to courses or offer some specializations or seminars abroad (such as finance in Japan) (Delaunay & Blodgett, 2005).

With more business practitioners becoming consultants than in the past, offering a course preparing students for consulting activities may have advantages. Students could learn about consultant communication, research, assessment and relevant business communication (Dallimore & Souza, 2002).

Foreign language requirements may be needed by those who would like to do business in the global arena. Freeman (2001) notes languages are needed for a broader range of job functions than in the past. Freeman also notes that more small firms are taking advantage of international business opportunities than ever. Staff that can communicate effectively is needed.

6. IMPLICATIONS FOR FUTURE RESEARCH

The lack of material available in the design of business curriculum and global business course development makes it possible to suggest areas for future research. Research that makes connections between the topics of adult learning, online delivery, a global business subject matter, and graduate level students is proposed. Programs currently exist that can be examined. Effectiveness can be looked at from a student perspective, administrative perspective, and business perspective.

7. CONCLUSION

Global management and eLearning were both found to be areas of growth. This study was a rare attempt to look at the global management within a graduate eLearning context. The need for further research was evident and some areas of future, specific study proposed. The areas of future examination include administration, instructors and students. Considerations of program validity, reliability and overall evaluation should be considered at the time of program creation.

REFERENCES

Allen, I. E. & Seaman, J. 2014. Grade change: Tracking online learning in the United States. Wellesley, MA: Babson Research Group. Retrieved from http://www.onlinelearningsurvey.com/highered.html

Belasen, A. T., & Rufer, R. 2007. Building a competency-based MBA from the ground up-curriculum design and program delivery. *Academy of Management Annual Meeting Proceedings*, pp 1-6.

Buhagiar, T., & Potter, R.. (2010). To stream or not to stream in a quantitative business course. *Journal of Instructional Pedagogies,* Vol. 3, pp1-6.

Bücker, J., & Poutsma, E. 2010. How to Assess Global Management Competencies: An Investigation of Existing Instruments. *Management Revue,* Vol. 21, No. 3, pp 263-291. doi:10.1688/1861-990.

Bueno, C., & Tubbs, S. L. 2004. Identifying global leadership competencies: An exploratory study. *Journal of American Academy of Business, Cambridge*, Vol. 5, No. 1/2, pp 80-87.

Chau, P. 2010. Online higher education commodity. *Journal of Computing in Higher Education,* Vol. 22, No, 3, pp 177-191.

Cook, K. 2000. Online Professional Communication: Pedagogy, Instructional Design, and Student Preference in Internet-Based Distance Education. *Business Communication Quarterly,* Vol. 63, No. 2, pp 106-110.

Cook, S. 2010, December. E-Learning requires teaching e-Leadership online. *Women in Higher Education, 19*(12), pp 7.

Cunningham, U. 2014. Teaching the Disembodied: Othering and Activity Systems in a Blended Synchronous Learning Situation. *International Review of Research In Open & Distance Learning,* Vol 15., No. 6, pp 33-51.

Dallimore, E. J. & Souza, T. 2002. Consulting Course Design: Theoretical Frameworks and Pedagogical Strategies. *Business Communication Quarterly,* Vol. 65, No. 4, pp 86-113.

Delaunay, C. J., & Blodgett, M. S. 2005. A Global MBA for Tomorrow's Global Business Leaders: Integrating Best Practice with Boston's Locational Advantage. *Journal of Teaching in International Business*, Vol. 17, No. 1/2, pp 125-141. doi:10.1300/J066v17n01_07.

Desai, M. & Pitre, R. 2009. Developing a curriculum for on-line international business degree: An integrated approach using systems and ERP concepts. *Education*, Vol. 130, No. 2, pp 184-194.

DuCharme-Hansen, B. A., & Dupin-Bryant, P. A. 2005. Distance Education Plans: Course Planning for Online Adult Learners. *Techtrends Linking Research And Practice To Improve Learning,*Vol. 49, No. 2, pp 31-39.

Edmundson, A. 2009. Culturally accessible learning: An overdue Global Business Imperative. *T+D*, Vol. 63, No. 4, pp 40-45.

Freeman, J. 2001, May 31. Independent graduate: Recruiters look for graduate communicators There's never been a better time to learn or brush up on a foreign language. *The Independent,* p 2.

Lee, K. 2000. Best e-learning incorporates classroom lessons. *Employee Benefit News*, Vol. 14, No. 11, p 81.

Li, A. 2008, September 27. Universities take leap into world of online learning. *South China Morning Post*, p. 7.

Lucas, A. 1996, March. A virtual business degree. *Sales and Marketing Management,* Vol. 148, No. 3, p 14.

Magdalena J., & Mellar, H. 2009. Factors affecting quality enhancement procedures for e -learning courses. *Quality Assurance in Education,* Vol. 17, No. 3, pp 220-232.

Makela, K., & Suutari, V. 2009. Global careers: a social capital paradox. International Journal of Human Resource Management, Vol 20, No. 5, pp 992-1008. doi:10.1080/095851909028502.

Mallory, C. 2007. Leading distance learning: Possible differences in subjects enrolled in online and traditional instruction. Ph.D. dissertation, University of the Incarnate Word, Texas, USA.

Nicholas, A. J. 2014. Graduate Engagement in Online Management Courses. *Academy Of Business Research Journal*, Vol. 1, pp 18-26.

Online enrollment increases faster than ever. (2010, December). *Women in Higher Education,* Vol. 19, No, 12, p 5.

Remtulla, K. A. 2007a. The knowledge-based economy and e-learning: Critical considerations for the workplace democracy. *Convergence*, Vol. 40, No. 1/2, pp 9-23.

Remtulla, K. A. 2007b. E-learning and the global workforce: Social and cultural implications for workplace adult education and training. In *Linguistic and cultural online communication: Issues in the global age,* ed. K. St. Amant. New York: IGI Global.

Rosenberg, M.J. 2001. *E-learning: strategies for delivering knowledge in the digital era*. New York, USA.

Smith, D. E. & Duus, H. J. 2001. The power of e-learning in international business education. *Journal of Teaching in International Business,* Vol. 13, No. 2, pp 55-72.

Sutton, M., et al.. 2010. Assessment in online programs: Use in strategic planning for faculty/adjunct development and course instruction to improve faculty and student engagement. *International Journal on ELearning,* Vol. 9, No. 1, p 129.

Tay, A. 2001. Management's perception of MBA graduates in Malaysia. *Journal of Management Development*, Vol. 20, No. 3, p 258.

Verene, D. 2013. Does Online Education Rest on a Mistake? *Academic Questions*, Vol 26., No. 3, pp 296-307. doi:10.1007/s12129-013-9367-2.

ELECTRONIC EDUCATION SYSTEM MODEL-2

Fatih Güllü[1], Rein Kuusik[1] and Mart Laanpere[2]

[2]Tallinn University of Technology, Akademia tee 5, Tallinn, 19086, Estonia
[2]Tallinn University, Narva mnt 25, 10120, Tallinn, Estonia

ABSTRACT

In this study we presented new EES Model-2 extended from EES model for more productive implementation in e-learning process design and modelling in higher education. The most updates were related to uppermost Instructional layer. We updated learning processes object of the layer for adaptation of educational process for young and old people, taking into account interests and abilities of students of the different age groups. Important added objects of the uppermost layer are cultural diversity and language. We updated communication object of the Instructional layer and added human and social factor. The methods of study of Instructional layer were updated with selective object "religion". We added to E-paradigm layer an object "combination" that explains by combination of synchronous and asynchronous objects.

Our study has high significance for increase of quality of e-learning in higher education in specific cases. We strongly recommend application of this updated EES Model-2 to support high educational standards of higher education and provide rights of students with different needs and abilities.

KEYWORDS

EES model, EES Model-2, higher education, e-learning

1. INTRODUCTION

Because enabling technologies present many opportunities as well as challenges in the realizing of electronic learning (e-learning), it is imperative that educators and institutions planning to embark on the development of e-learning systems, have a clear and accurate understanding of the capabilities, limitations and influences of these technologies (Cloete, 2000). Creative approaches and competent strategies to manage these limitations at the instructional design, the user levels as well as integration to other systems, need to be established and understood in order to ensure a degree of quality comparable to that of traditional learning. Without the integration of well-established methods and techniques, many of the e-learning efforts may be futile, leaving frustrated facilitators and badly educated students in their make (Cloete, 1999, 2001).

The creation of an e-learning system needs to have a model. The first generation of e-learning system was to manage and measure the learning process, display some kind of learning objects but they didn't deal with reusability and organization. These were the Learning Management System. The second generation electronic learning systems, based on Ismail (2002), has to be able to manage searchable, reusable and platform-independent learning objects. Cloete (2001) has improved the system and developed a layered model for second-generation e-learning systems: Electronic Education System (EES) Model. The aim of the model is to assist the designers of different e-learning settings to plan and implement a specific learning situation, with the focus on the individual requirements and milieu of the learning group (Cloete, 2001). The multilevel EES model contains four layers (Fig. 1, Cloete, 2001).
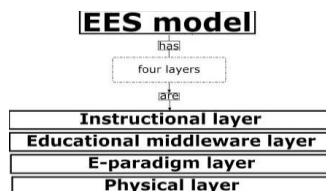

Figure 1. Four-tier model for Electronic Education System (modified after Cloete, 2001)

These layers are strictly separated in their functions and each layer uses the services of the lower level layers (Dulai et al, 2013). The strategic development of e-learning can be carried out either on top-down or bottom-up manner, or as combination of both (Gullu et al, 2014). These approaches were implemented by many universities. Their target is application of the potential of e-learning to enhance teaching and learning. In addition, staff training is seen as essential to successful e-learning but flexible support structures and mechanisms are seen as even more important (MacKeogh and Fox, 2009; Drlik and Skalka, 2011).

The need to update existing EES model raised from the modern issues influenced on educational process in our society. We explored that diversities of age, religion, language, culture are making significant influence on educational process of current generation of students. According to number of studies based on personal interviews and detailed research we found that current students can be older, more religious and with strongly marked commitments to language, culture and nationality (e.g. Stolzenberg et al, 1995; Myers, 1996; Sherkat, 1998; Sherkat, 2007; Terry and Irving, 2010; Cavazos, 2015).

In this study we extended the EES model, explaining in details each layer, and presented new EES Model-2 taking into account described issues.

2. EES MODEL-2 STRUCTURE

The basis for extended EES Model-2 is EES model developed by Cloete (2001). This is a model where can be implemented a top-down and a bottom-up algorithm approaches to design of a strategic model for a particular e-learning situation. Cloete (2001) described in detail implementation of these approaches and basic design of the EES model. In this study we updated some layers adding new elements into the EES Model-2 and described them in detail.

2.1 Instructional Layer (Uppermost)

The purpose of the instructional layer is to serve as a window between the learning process and the underlying strategies necessary to establish the learning environment. The instructional layer is composed of various objects, each containing one or more methods (Cloete, 2001). In our EES Model-2 the Instructional layer consists of intermediate elements, Learning process and Learning environment strategies, and main objects (Fig. 2). The Learning process can be adopted for young and old people, who have different needs and ways for study. The main objects are containing different methods of study (by watching, reading, discovering, observing, listening, doing and cooperative learning). We added religion into the methods of instructional layer as an important object, which can strongly motivate students for seeking of knowledge in countries where religion has big importance (i.e. Turkey, Arabic countries, Malaysia and Indonesia). This element is mentioned as selective due to its specific implementation.

The main object element contains of communication objects and objects of content. The communication objects describe differences of students by social and human factors. Human factor means that every person is individual and specific approaches can be implemented for different persons. We found that social factor is important element in Turkey. Turkish people are very sensitive for social status of different persons and respective environment must be applied in such cases.

Objects of content describes cultural and language differences. We analysed cultural and linguistic situations in Estonia and Turkey and found that these elements have high importance for e-learning. Implementation of cultural element and language preferences of different groups of students into the e-learning environment will increase interest for education and motivate students of different cultural and linguistic societies for study.

2.2 Educational Layer (Middleware)

The educational middleware layer provides services for a reliable and effective learning environment (Cloete, 2001). It contains (1) user authentication, (2) assignment, (3) course enrollments and (4) testing services.

2.3 E-paradigm Layer

The objective of the e-paradigm layer is to provide an electronic learning paradigm composed of technological strategies possible in electronic learning. The objects found on this layer form the basis of the specific learning situation. They often prescribe which objects from upper layers may be suitable for selection (Cloete, 2001). The E-paradigm layer 2 represented by "Possible technological strategies" (synchronous, asynchronous and combination). The synchronous and asynchronous objects are commonly identified on the e-paradigm layer. In synchronous learning environments geographically dispersed, students and lecturers share a virtual classroom within the same physical time frame. Examples include remote lecture rooms with video conferencing, or students attending real-time lectures from home. The asynchronous object is characterised by its being independent of location, time, and learning speed of the learner. A typical example is that of the learner who prefers to study at his/her own pace and time. The number of methods for objects on this layer is limited, and is realised on other levels. For example, selection of the asynchronous object will have a direct influence on the methods of the course distribution object found on the educational middleware layer. Methods may be through web downloads or precompiled CDs while in the synchronous environment, e-books and on-line material may be more relevant (Cloete, 2001). In our EES Model-2 we added to this layer an object "combination" that explains by combination of synchronous and asynchronous objects. An example is that learner who has unstable time schedule on his job has opportunity to choose and combine between two main ways of study: synchronous (to study in the same time frame with lectures attending real-time lectures) and asynchronous (to be independent of location, time and speed of the learning process).

2.4 Physical Layer (Bottom)

The physical layer provides for the transparent transmission of messages (which may be course communication, course material or course directives) between students and lecturers tied together in an e-learning scenario. The physical layer includes the specification of hardware and software technology objects necessary to accomplish e-learning. The number of methods included in these objects is usually limited to one but may sometimes extend to two. For example, an object on this layer may be an Internet connection. The methods of the Internet connection object describe the prerequisite hardware and software strategies necessary to accomplish an Internet connection. The Physical layer of the EES model was extended in the EES Model-2 to: "Government purchased devices" (e.g. laptops, tablets), "BYOD" (Bring Your Own Device, multiplatform, single platform), "computer laboratories".

2.5 Evaluation Plane

An evaluation plane stretches across the top two layers. This plane performs evaluation functions related to these two layers as a whole. The purpose of the evaluation layer is to determine whether or not the methods selected from the instructional layer and from the educational middleware layer are accomplishing the established goals and objectives. The evaluation plane is divided into a summative evaluation sub-plane and a formative evaluation sub-plane. Formative evaluation is typically conducted during the lifetime of a process, whereas summative evaluation is conducted at the end, or after the lifetime of a process (Wills 1995; Cloete 2001). In an e-learning system, one may for example choose to do both types of evaluation and must then include objects from both sub-planes, or one can include only one type of evaluation, analysing one's learning situation through various methods (from selected objects) as found in that particular sub-plane. More detailed description of evaluation plane can be found in Cloete (2001).
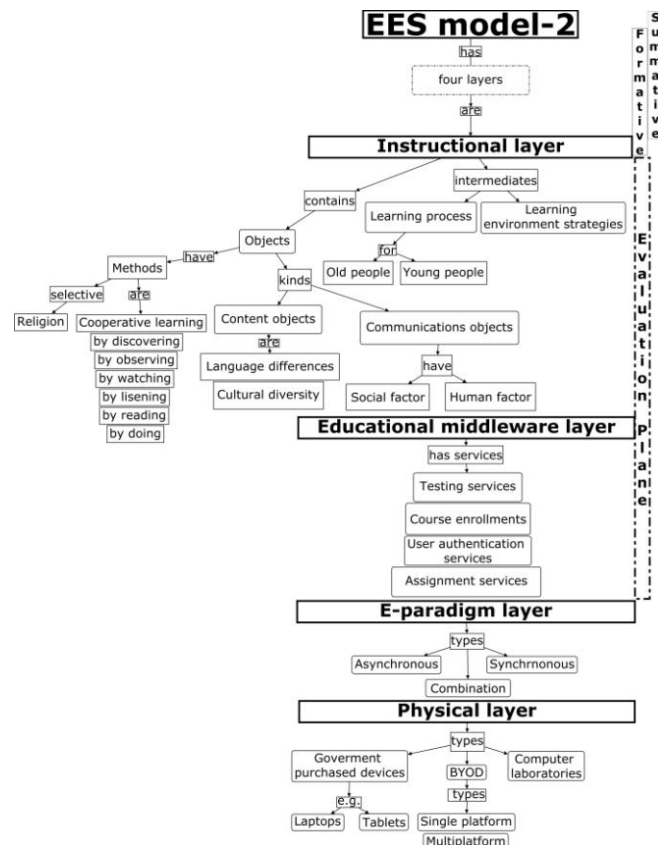
Figure 2. Electronic Education System Model-2

3. DISCUSSION

The Cloet's (2001) EES model was updated and extended in this study (EES Model-2). We found that several factors, such as student's age, differences of students by social-cultural and human factors, language differences and religion were not included into EES model. According to many studies in the field (e.g. Sherkat, 2007; Terry and Irving, 2010; Cavazos, 2015), nowadays these issues are very actuals in modern society and have significant influence to education and higher education in particular. Thus we added them into the EES Model-2. This updates are important for further studies related to e-learning process modelling.

The most updates were related to uppermost Instructional layer. First we updated Learning processes object of the layer taking into account interests of students of the different age groups. For example, older people are more conservative in implementation of new technologies into to their life and need more time for adaptation to the new environment.

Other important objects of the uppermost layer are cultural diversity and language differences. Cultural preferences must be taking into account during e-learning process design. In Turkey customs are very important part of life of young people and can be used to design more productive educational process. For example, respect of old people and teachers is still common in this country.

It was found that language differences factor is very important and sensitive for young and old students in both countries, Turkey and Estonia, which are very different. Thus, we highly recommend apply this object in e-learning design.

Next updates were related to communication object of the Instructional layer. We added human and social factors to be implemented in e-learning modelling in the part of communication specifications. Human factor contains individual specific needs of every student. Taking into account this factor the efficiency of the e-learning can be increased. For example some students can be more familiar with some objects of study, other need more time for explanation. Or some students are very flexible for change of software environment

and other needs more time to adopt. The social factor is important element in Turkey. Turkish people are very sensitive for social status of different persons. It is not a rule in Turkey, but, for example, we found it very often that young people grouping into clusters by social status and don't allow access this groups for the people of lower social class, as people came from villages or from families with low income. In such situations, to support more effective education, it is recommended to provide different virtual classes for such students.

We added religion into the methods of study of instructional layer. This element is mentioned as selective due to its specific implementation. Religion can strongly motivate students for seeking of knowledge in countries where religion has big importance. Islamic religion prescribes and motivates all age people to learn and discover the world in all the ways. This factor has absolutely importance in such Islamic countries as, i.e., Turkey, all Arabic countries, Malaysia, Indonesia, some African countries, etc. From the other side some authors (e.g. Sherkat, 2007) found that there is a fundamentalist Christianity problem in our society, in American society in particular. According to this study, young sectarian and fundamentalist Christians often have difficulty dealing with environments. E-learning will ease educational process in this particular case. Anyway, e-learning system model have to take into account this factor for societies, where this problem exist. This issue is case specific and preliminary explorations must be provided in each particular study.

Our study has high significance for increase of quality of e-learning in higher education in specific cases. We strongly recommend application of this updated EES Model-2 to support high educational standards of higher education and provide rights of students with different needs and abilities. The new developed EES Model-2 will be used for our future work to enhance quality of e-learning in higher education in particular countries (like Turkey), as well as in the field of study in general.

REFERENCES

Cavazos, A. G., 2015. Multilingual faculty across academic disciplines: language difference in scholarship. *Language and Education*. Vol. 29, No. 4.

Cloete, E., 1999. Some perspectives on network centric distance learning and software engineering. *Proceedings: future trends in distributed computing systems'99*. Cape Town, South Africa, December.

Cloete, E., 2000. Quality issues in system engineering affecting virtual distance learning systems. *Proceedings: COMPSAC'2000*. Taiwan, October 2000.

Cloete, E., 2001. Electronic education system model. *Computers & Education*, Vol. 36, pp. 171-182.

Ismail, J., 2002. The design of an e-learning system: Beyond the hype. *Internet and Higher Education*, Vol. 4, pp. 329-336.

Drlik, M., Skalka, J., 2011.Virtual Faculty Development Using Top-down Implementation Strategy and Adapted EES Model. *Procedia - Social and Behavioral Sciences*. Kyrenia, Cyprus, Vol. 3, No. 28, pp. 616-621.

Dulai, T. et al, 2013. Service discovery to create a well personalized e-learning system. *Proceedings of the 3rd European Conference on e-learning (ECEL)*, Paris, France, November 25-26.

Gullu, F. et al, 2014. Comparing implementation patterns of e-learning for higher education in Turkey and Estonia. *ECEL-2014*. Denmark, Copenhagen, pp. 644-650.

Myers, S. M., 1996. An Interactive Model of Religiosity Inheritance: The Importance of Family Context. *American Sociological Review*, Vol. 61, pp. 858-866.

Sherkat, D. E., 1998. Counterculture or Continuity? Competing Influences on Baby Boomers? Religious Orientations and Participation. Social Forces. Vol. 76, pp. 1087-1115.

Sherkat, D. E., 2007. Religion and higher education: The good, the bad, and the ugly. Retrieved from http://religion.ssrc.org/reforum/Sherkat.pdf

Stolzenberg, R. M., Blair-Loy, M., Waite, L. J., 1995. Religious Participation Over the Early Life Course: Age and Family Life Cycle Effects on Church Membership. *American Sociological Review*, Vol. 60, pp. 84-103.

Terry, N. P., and Irving, M. A., 2010. *Cultural and linguistic diversity: Issues in education*. (5 ed., Vol. 4). Kendall Hunt Publishing Co.

USE OF CLOUD-BASED GRAPHIC NARRATIVE SOFTWARE IN MEDICAL ETHICS TEACHING

Alan S. Weber

Weill Cornell Medical College in Qatar, Premedical Department
Box 24144, Education City, Doha, State of Qatar

ABSTRACT

Although used as a common pedagogical tool in K-12 education, online graphic narrative ("comics") software has not generally been incorporated into advanced professional or technical education. This contribution reports preliminary data from a study on the use of cloud-based graphics software Pixton.com to teach basic medical ethics concepts and the human dimension of medical ethics dilemmas in a premedical program at an American medical college in the State of Qatar. Qualitative and quantitative end-of-semester data (open-ended and 7-point Likert scale questions) were collected from randomized control and study groups from 22 total students in a 4-week medical ethics module, half of whom wrote an argumentative essay on a contemporary medical ethics dilemma and the other half who created a 10-15 panel graphic narrative consisting of a real-life doctor-patient-family encounter involving a contemporary ethical issue.

1. INTRODUCTION

The study aimed to provide preliminary data for larger sample size randomized controlled trials investigating student learning about medical ethics questions by comparing two pedagogical modalities: a argumentative / persuasive research paper and a graphic narrative using a cloud-based online graphics software program called Pixton.com. The research attempts to answer the general question about the effectiveness of using graphic narratives (stories) in order to help students understand the human dimension of biomedical conundrums that they will eventually face in their professional practice. A total of 22 students participated in a 4-week medical ethics module and then qualitative and quantitative end-of-semester data was collected from the students via questionnaires.

2. BACKGROUND

The narrative medicine movement began in the 1990s and seminal overview treatments of the topic by Rita Charon and Brian Hurwitz appeared a decade later, such as Charon's *Narrative Medicine: Honoring the Stories of Illness* (2006), and Hurwitz's *Narrative Research in Health and Illness* (2004). Narrative medicine is a clinical and research perspective in the healthcare field that investigates how stories (narratives) structure medical experiences, ranging from formalized case histories, ethics dilemmas, the patient experience of disease, and events in the medical workplace. Narrative medicine is an important and growing branch of the medical humanities (medical sociology, medical history, literature and medicine, etc.) which similarly seeks to explore humanistic elements in medical care both as an end in and of itself, and as a means to improve medical outcomes and patient satisfaction (Weber, 2010). In an editorial in the *Australian Journal of Medicine*, Jill Gordon aptly pointed out: "To appreciate whether the humanities are indeed foreign to medicine, try to imagine a health care facility in which no ethical issues are explored, no lessons have been learnt from the past, no cultural awareness is displayed, no written words (other than technical communications) appear, and no books, films, television programs, plays or concerts are discussed by patients or staff. Imagine that there are no artworks, no music and no other aesthetically pleasing elements.

Although some of our hospitals are admittedly run down, the products of the arts and humanities are nevertheless all around us" (2008, p. 420).

The author's experience in working in the Persian (Arabian) Gulf at an American medical college has reinforced the realization that medical practices, although grounded in the shared biomedical model of disease dominant in wealthy industrialized countries, can vary considerably from culture to culture, particularly with respect to medical ethics, doctor-patient relations and the patient experience of disease (Weber, 2009). Therefore the stories that both patients and medical practitioners tell about disease and their lived experiences are impacted by a range of socio-culture, religious, and economic factors. From a pedagogical perspective, the medical humanities has three key characteristics in medical education, according to Shapiro et al. (2009):

1. They use methods, concepts, and content from one or more of the humanities disciplines to investigate illness, pain, disability, suffering, healing, therapeutic relationships, and other aspects of medicine and health care practice.
2. They employ these methods, concepts, and content in teaching health professions students how to better understand and critically reflect on their professions with the intention of becoming more self-aware and humane practitioners.
3. Their activities are interdisciplinary in theory and practice and necessarily nurture collaboration among scholars, healers, and patients.

Graphical imagery is immediate, visceral and can communicate different kinds of information (and is especially effective at expressing human emotion), and has particular practical use for illiterate populations in conveying meaning. Therefore graphical language is pervasive in modern society, from advertising, the Internet, and all forms of print media as well as embedded within the design of objects. The nexus between images and story-telling may stretch back to the Paleolithic cave paintings of Lascaux in Montigac, France which possibly depict a narratological and even cinematic sense of reality (Noxon, 1964). William Hogarth (1697-1764) is generally credited, however, with developing modern sequential art, also known as a comic or cartoon. His often reproduced engravings *A Rake's Progress*, *A Harlot's Progress* and *Marriage à-la-mode* take on a genuine moralistic tone satirizing libertinism, prostitution, and marriage for financial gain; thus he established the genre of sequential art as serious social commentary and as a didactic form of expression. He also was interested in medical topics (Haslam, 1996). Various forms of sequential art developed into the modern period, from the purely humorous comics often found in daily newspapers, to related forms which combine parody, satire, and social commentary (such as *Doonesbury*, *Pogo*, and the political cartoon) to book-length illustrated stories such as Art Spiegelman's *Maus* (depicting his father's survival of Auschwitz and its effect on his son) and Joe Sacco's *Palestine*, an exploration of the social plight of Palestinians.

Graphical techniques are also beginning to impact diagnostic and therapeutic techniques in medicine. For example, The Pictorial Representation of Self and Illness Measure (PRISM) employs simple graphical shapes such as circles in order to measure levels of pain and suffering. It has been validated and applied to a variety of patient populations, such as fatigued cancer patients (Gielissen et al., 2013), vertigo sufferers (Weidt et al., 2014), and victims of orofacial pain (Streffer et al., 2009).

Since the range of topics which occupy modern graphic artists encompasses all of human experience, it is not surprising that a substantial body of graphic narrative specifically related to illness, disease and healing exists. The most frequent topics that have been dealt with recently are cancer and mental illness, undoubtedly due to the complexity of these diseases and the vastly different responses of families and sufferers when facing these conditions. Representative book-length examples of this genre include Marisa Marchetto's *Cancer Vixen* (2006), an autobiography (Marchetto is a professional cartoonist) that describes her personal struggle with cancer, and Brian Fies's *Mom's Cancer* (2006) which focuses on the effects of the disease on family members. Other notable medical graphic narratives include: Lesley Fairfield's *Tyranny* about anorexia nervosa; Tucky Fussell's *Mammoir: A Pictorial Odyssey of the Adventures of a Fourth Grade Teacher with Breast Cancer*; David B.'s *Epileptic*; and Darryl Cunningham's *Psychiatric Tales*, another autobiographical work detailing his employment in a psychiatric ward.

Pixton online comics can easily create the kind of graphic narratives that have appeared from professional artists; the comics are built in frames which consist of user controlled pre-defined background templates. Background images such as .jpgs can also be imported and over-laid in various ways. In addition to objects, character forms from templates can be introduced into the panels and posed in various configurations using

pivot points that can be grabbed by the cursor, normally along the body joints. Most importantly, many aspects of the characters' faces can be configured by selecting predefined elements and then dragging these elements to resize them. Thus, a wide variety of emotional responses can be custom drawn with Pixton. Two similar simple graphics tools include a desktop application by Plasq called *Comic Life* (http://plasq.com/downloads/comic-life-desktop/) and the cloud-based *Make Beliefs Comix* (www.makebeliefscomix.com). As Shamburg points out, "these programs simplify the more technical aspects of comic creation and let a user focus on the creative aspects of production. These programs allow you to save, edit, revise, and share your work" (2014, p. 2).

A growing number of research studies are reporting successful educational outcomes using Pixton in the educational setting. In a technology graduate-level seminar, Kovalik et al. demonstrated increased engagement when students used Pixton as an advanced organizer before engaging in online discussion, i.e. in a flipped-classroom modality (2011). In addition, Meyers (2014) introduced creative practice via Pixton into an undergraduate course in communications theory.

3. STUDY OBJECTIVE

The purpose of this preliminary study, to be followed by a larger randomized controlled trial, was to compare differences in learning outcomes related to basic medical ethics concepts in a premedical department following an American medical curriculum (Weill Cornell Medical College in Qatar, a satellite campus of Weill Cornell Medical College, located in New York City) when students wrote a traditional argumentative research-based paper versus a graphic novel scenario using online graphics software. Thus the study investigated both modes of learning (blended online learning versus completely face-to-face instruction) and rhetorical modes (written essay versus graphic narrative).

4. METHODOLOGY

Exploratory investigations to test the viability of using an online graphics software program for medical ethics training among premedical students began in March of 2014 in a four-week module on Islamic bioethics within a sixteen-week history of medicine course entitled Perspectives on Islamic Medicine offered at WCMC-Q. All nine students were instructed to choose as a final project a controversial medical ethics question (scenario or case) in Islamic medical ethics, a growing field of scholarship which investigates the intersections among customary Muslim modes of thought and behavior (*al 'urf*), shariah law, contemporary juristic reasoning (*ijtihad*), and novel bioscientific innovations such as stem cells, animal cloning, artificial life support, assisted suicide, Artificial Reproductive Technologies (ART) and organ transplantation. After reviewing peer-reviewed literature and formulating arguments and counterarguments on a specific ethics question, students translated their dilemma into a narrative using online comics software Pixton (www.pixton.com). These scenarios were required to be evidence-based, i.e. students were asked to imagine a real-life medical ethics encounter that could occur in an Islamic context, either involving Muslim patients and Muslim doctors or taking place in a nation following shariah law.

In Spring, 2015, this assignment–broadened to include general and Western medical ethics–was repeated with 22 premedical students who were divided equally into control and study groups, one writing an argumentative paper and the other a graphic narrative. The objective was to compare differences in self-reported learning about medical ethics between the two different types of final project using an end of semester 10 question self-report questionnaire. The primary bases of evidence (3 peer reviewed sources were required both to write the argumentative paper and to construct the graphic narrative scenario) were drawn from the student's personal experience, peer-reviewed articles and book chapters from the course readings, and research obtained from the Georgetown SFS in Qatar's Islamic Medical and Scientific Ethics (IMSE) Database and related reference collection.

5.   DISCUSSION AND RESULTS

Pixton was first introduced into the author's Spring, 2014 course. Two out of the 9 students encountered serious difficulties in using Pixton.com and subsequently used the accounts and assistance of other students in the class in order to complete the assignment. Follow-up revealed that these students were from first-generation college-goer families and did not possess full computer literacy. Standard end of semester feedback evaluation forms indicated that the software was successful in teaching the learning outcomes of Islamic medicine and Islamic medical ethics, and made the experience of learning more enjoyable. Thus the author proceeded to a more formalized and randomized pilot study in the Spring, 2015 semester.

In a Spring semester 2015 medical ethics module, 22 students participated in the following activities: course readings from Beauchamp and Childress's *Principles of Biomedical Ethics*, 7th edition (2013), class discussions, role-playing, and online YouTube videos (documentaries of the Terri Schiavo case and AIDS activism). During the second week of the module, students were randomly assigned to a control group who were instructed to write an argumentative / persuasive essay and an experimental group who used Pixton.com to create a graphic narrative. Due to time limitations, instructors assisted students in choosing appropriate peer reviewed medical ethics sources to complete their final projects. Sources included standard bioethics journals, as well as the AMA's *Virtual Mentor American Medical Association Journal of Ethics* (http://virtualmentor.ama-assn.org/). Students who chose a topic in Islamic medical ethics made use of the Islamic Medical and Scientific Ethics (IMSE) Database at Georgetown School of Foreign Service in Qatar (http://imse.library.georgetown.edu/), the first database in the world dedicated to Islamic bioethics.

After the completion of the final projects, students were administered a 10-question questionnaire containing 5 free response questions, and 5 seven-point Likert Scale questions with a scale ranging from "Entirely Disagree" to "Entirely Agree." Seventeen students completed the questionnaire. The mean score for the question "Enough training and support was provided to use Pixton software" was 5.8 indicating that the majority of students did not encounter difficulties in using the software. However, 5 out of 11 students reported problems writing the graphic narrative; 3 problems were related to creating a story and difficulties with narratives in general and relating the story to medical ethics, and 2 problems related to technical issues with Pixton. For the follow-up study described below, the author plans to provide more detailed in-class training using Pixton with a hands-on workshop and online tutorials. Also, although a medically related graphic novel was assigned as course reading, little time was spent in class doing an in-depth analysis of the graphical and narrative elements. The mean response for the graphic narrative writers for the question "the final project was helpful in learning about medical ethics" was 5.0, while for the argumentative paper students the mean response was 4.7. In an unpaired t-test at the 95% confidence level, the two-tailed P value was 0.6876, demonstrating that in student self-report, there was no statistically significant difference in graphic narratives and argumentative papers in learning about medical ethics. This preliminary data on a small sample may indicate that the two rhetorical modes are equally effective in teaching medical ethics concepts. Thus the graphical narrative could be added to the range of pedagogical approaches in teaching medical ethics, such as the traditional argumentative paper.

From the observational notes of the instructors, the observers noted that most of the students, except for the few encountering technical difficulties, enjoyed the experience of using Pixton.com since it was a unique and new approach to learning that they had not encountered in high school. This confirms a growing body of literature in serious gaming and edutainment that adding both an online component and entertainment aspects to learning ('making learning fun') can positively impact student motivation for learning.

5.1 Follow up Study

The author is planning to carry out a more rigorous experimental design (a randomized controlled trial) by comparing the pre- and post-test scores on a validated multiple choice exam measuring knowledge of basic medical ethics concept related to the human dimension of medical ethics. The test will measure student mastery of factual medical ethics decisions which relate to interpersonal relations, affective responses, the narrative structure of ethics cases, and human motivation. This perspective contrasts with other modalities of medical ethics teaching, such as policy-based approaches (following and applying rules) or legal medicine (complying with state and federal statutes).

In the follow-up research, the Jefferson Scale of Empathy-S–a widely used psychometric test that measures medical student empathy, will be additionally administered as a pre- and post-test to elucidate differences in empathy change when comparing learning through a traditional argumentative essay versus the graphic novel. The Jefferson Scale of Empathy-Student version (JSE-S), is a 20 question self-administered 7-point Likert scale scored test available from the Center for Research in Medical Education and Health Care at Thomas Jefferson University in Philadelphia, Pennsylvania, USA. A preliminary reliability study of the JSE-S will first be carried out on a target population in Qatar. Reliability of questions will be measured through Alpha – item-deleted, item-total correlation, and inter-item correlation.

6. CONCLUSION

Ethnologists have yet to uncover a human society which does not include some form of music or storytelling, including cosmogonies, myths, memorializations of past events, heroes and deities, etc. This suggests that narrative may be genetically encoded and fundamental to human cognitive functioning, stretching to perhaps neurolinguistic structures of the human brain. Further investigation into the microstructures of the human brain at the neuronal level, such as The NIH BRAIN Initiative (Brain Research Through Advancing Innovative Neurotechnologies) started in 2013 or the related European Union collaboration called the Human Brain Project (which collectively will map all the neurons of the human brain, and create informatics models) will undoubtedly reveal how narrative and graphic narrative structures specifically organize, affect, and impact the phenomenological properties we call memory, experience, emotion and cognition. In the meantime, various qualitative (narratology, discourse analysis, postmodern philosophy, Philosophy of Mind) and quantitative (randomized controlled trials) research methods can perhaps elucidate how graphic narrative, and specifically electronically-enabled experiential learning in the creation of graphic narrative, can impact learning.

ACKNOWLEDGEMENT

REFERENCES

Beauchamp, T., and Childress, J.F., 2013. *Principles of Biomedical Ethics*, 7th ed., Oxford: Oxford UP.

Charon, R. and Montello, M., eds., 2002. *Stories Matter: The Role of Narrative in Medical Ethics*. New York: Routledge.

Charon, R., 2006. *Narrative Medicine: Honoring the Stories of Illness*. New York: Oxford University Press.

Cunningham, D., 2011. *Psychiatric Tales: Eleven Graphic Stories about Mental Illness*. New York: Bloomsbury.

David B., 2006. *Epileptic*. New York: Pantheon Books.

Fairfield, L., 2009. *Tyranny*. New York: Tundra Books.

Fies, B., 2006. *Mom's Cancer*. New York: Abrams ComicArts.

Fussell, T., 2005. *Mammoir: A Pictorial Odyssey of the Adventures of a Fourth Grade Teacher with Breast Cancer*. Bloomington, IN: AuthorHouse.

Gielissen, M.F., Prins, J.B., Knoop, H., Verhagen, S., and Bleijenberg, G., 2013. Pictorial representation of self and illness measure (PRISM): A graphic instrument to assess suffering in fatigued cancer survivors. *Psychological Assessment*, Vol. 25, No. 2, pp. 658-63.

Gordon, J.J., 2008. Humanising doctors: what can the medical humanities offer? *The Medical Journal of Australia*, Vol. 189, No. 8, pp. 420-421.

Haslam, F., 1996. *From Hogarth to Rowlandson: Medicine in Art in Eighteenth-Century Britain*. Liverpool: Liverpool University Press.

Hurwitz, B., Greenhalgh, T., & V. Skultans, eds., 2004. *Narrative Research in Health and Illness*. Malden, Mass.: BMJ Books.

Kovalik, C.L., and Williams, M.A., 2011. Cartoons as advance organizers, *Journal of Visual Literacy*, Vol. 30, No. 2, pp. 40-64.

Marchetto, M., 2006. *Cancer Vixen*. New York: Pantheon Books.

Meyers, E.A., 2014. Theory, technology, and creative practice: Using Pixton comics to teach communication theory, *Communication Teacher*, Vol. 28, No. 1, pp. 32-38.

Noxon, G., 1964/1965. Pictorial origins of cinema narrative: The Illusion of movement and the birth of the scene in the Paleolithic cave wall paintings of Lascaux, *The Journal of the Society of Cinematologists*, Vol. 4/5, pp. 20-26.

Shamburg, C., 2014. Language learning between the panels: Comics, performance, Shakespeare, and ELL. In M. Gura (Ed.), *Teaching Literacy in the Digital Age* (111-119). Washington DC: International Society for Technology in Education.

Shapiro, J., Coulehan, J., Wear, D., and Montello, M., 2009. Medical humanities and their discontents: Definitions, critiques, and implications. *Academic Medicine*, Vol. 84, No. 2, pp. 192-198.

Streffer, M.L., Büchi, S., Mörgeli, H., Galli, U., and Ettlin, D., 2009. PRISM (pictorial representation of illness and self measure): a novel visual instrument to assess pain and suffering in orofacial pain patients, *Journal of Orofacial Pain*, Vol., 23, No. 2, pp. 140-6.

Weber, A.S., 2009. Narrative medicine in the training of international medical students. *Pedagogical Education: Contemporary Problems, Modern Concepts, Theories and Practices*. Ed. I.I. Sokolova. St. Petersburg: Russian Academy of Education.

Weber, A.S., 2010. Medicine and literature courses for Arabic speakers, *Romanian Journal of English Studies*, Vol. 7, pp. 427-44.

Weidt, S., Bruehl, A.B., Moergeli, H., Straumann, D., Hegemann, S., Büchi, S., Rufer, M., 2014. Graphic representation of the burden of suffering in dizziness patients, *Health and Quality of Life Outcomes*, Vol. 12, No. 184, pp. 1-8.

A PROPOSAL TO ENHANCE THE USE OF LEARNING PLATFORMS IN HIGHER EDUCATION

Bertil P. Marques[1], Jaime E. Villate[2] and Carlos Vaz de Carvalho[1]

[1]Dep. Eng. Informática – ISEP, GILT- Graphics, Interaction and Learning Technologies, Porto, Portugal
[2]Oporto University, Fac. Engenharia, Porto, Portugal

ABSTRACT

The results of several studies conducted to analyze the quantitative and qualitative use of learning technologies in Higher Education in Portugal showed that, in general, these technologies are not used systematically and effectively and e-learning platforms tend to be relegated to repositories of contents rather than as full-fledged tools actively enabling and promoting learning. Several gaps were also identified at the management, pedagogical and technical levels. Following best-practice in this domain, a holistic intervention including these three levels is crucial to achieve positive results. Therefore, following these studies, a set of guidelines and recommendations was created to raise the level of technology adoption in higher education and improve the educational performance of each institution by raising teaching/learning levels so that they are in accordance with the Bologna paradigm. This way it is possible to have a systematic approach, expanding the intervention to the entire institutional campus and resulting in an effective learning platform usage by teachers and students.

1. INTRODUCTION

The Web 2.0 advent resulted in the creation of structured online platforms where everyone could publish their own content, therefore opening the doors of internet publishing to the general public. Learning Management System (LMS), or e-learning platforms, are specialized online platforms that support e-learning, that is, online learning and training through content and communication sharing. From an early moment the LMS Moodle was one of the favorite platforms for two reasons: it was as free and it had all the versatility of other e-learning platforms but still keeping its concept and usage simple. Nowadays Moodle has millions of users and thousands of schools use it in a daily basis.

To understand the actual status of the use of learning technologies in the Portuguese Higher Education a case study was conducted, structured in three basic stages, as shown in Figure 1:
- Study for analysis of surrounding context;
- Intervention to specify the parameters of the research and its implementation;
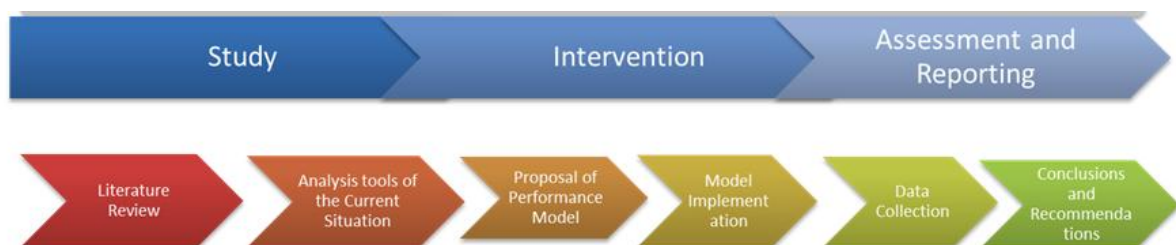- Assessment and Reporting, for data collection and formulation of conclusions.

Figure 1. Methodological reseach scheme.

The study began with a bibliographical research on existing projects and initiatives. Then, to collect more specific and updated results, three analyses of the use of the Moodle platform were done, allowing the identification of gaps which needed solution. Based on the conclusions of those analyses a set of recommendations was designed to take full advantage of the use of an e-learning platform in a particular institution, without losing content value and maintaining a balanced experience for all stakeholders. Figure 2 depicts in more detail each of the sub-steps. This set of rules or recommendations was also influenced by the application of the Bologna paradigm (European Union, 2006), so that the use of this platform is a starting point for the student's exploration of many subject related with his/her course.
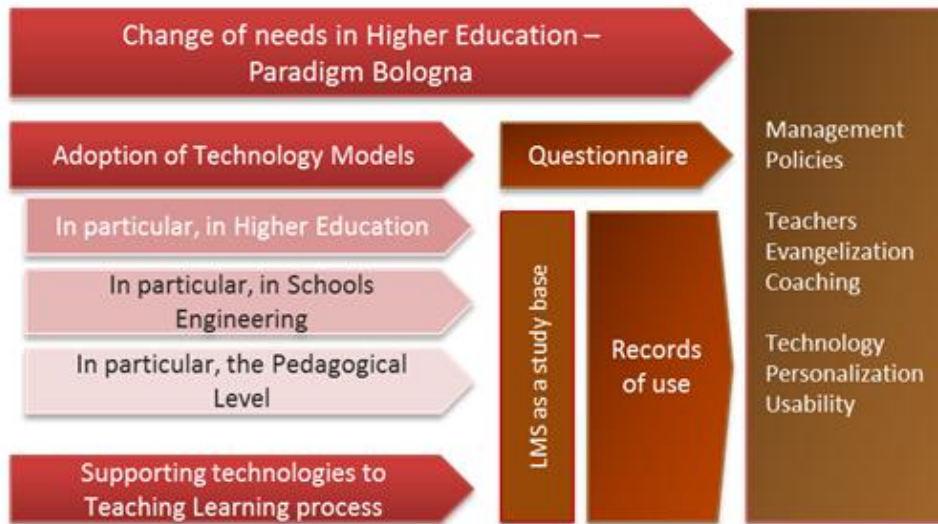

Figure 2. Steps towards the use of e-learnig.

The purpose of management intervention is to assure the creation of the necessary institutional conditions for the effective adoption of technology in teaching. This would lead to a standardization of all departments in the institution, contributing to the improvement of results at a teaching/learning level in the context of Bologna.

Management intervention should address political-strategic decisions. The role of the researcher includes the management persuasion about these studies reliability and adoption of the proposals. A proposal to include teacher's department in this initiative was presented with the intention of improving teacher's tasks through the platform usage. CUs approval rates would, therefore, be also improved. The proposal at technology level embraces the personalization, usability and customizing the platform features and tools to the users.

This implies the development of 4 or 5 software modules to be integrated in the platform. The aim of the intervention at this level is to upgrade the platform into a user-friendly tool for teachers and students so that it is more profitable to the teaching/learning process in the context of Bologna. E-learning platform success in the user's community is, this way, enhanced.

The analysis of the implementation of all proposals will then check whether your application and action taken at the institution has made recommendations to the Bologna process of teaching/learning in Higher Education leading to a positive influence on the current practices of the institution.

2. STUDY

The initial part of the research process was divided in two main stages:
- Literature Review - Starting point of that work, allowed to ascertain the key areas. An analysis of the Bologna declaration and the associated paradigm, as well as their influences on the Portuguese higher education has been made. We also studied the technologies to support the teaching / learning process. We also analyzed the adoption of models of technology and adapted to the particular situation of use as educational support in higher education.

174

- Analysis of Current Situation - This step allowed to take knowledge of the current situation of adoption and use of technology-based educational tools in higher education, focusing on the use of Learning Management Systems. The reference model was UTAUT - User Acceptance Model of Technology Use. The use of an e-learning platform (Moodle) in three different scopes (always in the scope of higher education and, more specifically, engineering) was analyzed (Marques et al, 2010a) (Marques et al, 2010b) (Marques et al, 2011).

Data was collected in three consecutive academics years. The use of the platform as a content repository is far lower than it would be expectable (from 30% to 60% of the disciplines use it as such, depending on the department) but still high when compared with the number of teachers that effectively use the e-learning platform as such, that is, exploiting the existing tools like assignments, quizzes, discussion forums, chat, etc. In fact, and even if the use of the e-learning platform by the teachers slightly increased during the three years, in the end the level of usage was still between 10 and 25%. There is some unbalance between departments in the same school, Computer Science and IT related departments have a higher adoption ratio, while in other departments the use of the platform is hardly relevant with values from 2 to 6%. Some reported contributing factors for this low level of usage were the lack of time to learn how to use the platform, operational difficulties and lack of knowledge of the platform potential.

3. INTERVENTION

The next two steps in the research process were the following:
- Proposal of Performance Model - As a result of the above sub-steps in the intervention stage a performance model was proposed to address deficiencies identified in the previous substep. This model proposes:
  - In terms of management, political and strategic decisions (see details on section 3.1).
  - In terms of teachers, actions such as training/ issemination, coaching and persuasion (see details on section 3.2).
  - At the technological level customization, improved usability and automation tools (see details on section 3.3).
- Model Implementation - This step corresponds to the performance in the field by applying the proposals set out above.

The purpose of management intervention is to assure the creation of the necessary institutional conditions for the effective adoption of technology in teaching. This leads to the systemization of use, contributing to the general improvement of results at a teaching/learning level. The purpose of the intervention at pedagogical level is to create the necessary conditions to help teachers perform their tasks, with the e-learning platform, subsequently improving those tasks. Finally, the technologic intervention is the ground base for the creation of modules and tools that both students and teachers can use to have a friendlier and more intuitive platform.

3.1 Management Intervention

The intervention at the management level involves political decisions in order to regulate and organize the institution so that the intervention has an entire campus scale, involving the largest majority of students and teachers sharing best practice so that large gains are achieved in each discipline's success rate. The ultimate goal is then to raise the learning technology usage to a level that enables the improvement of the quality of the organization in the teaching/learning processes. But, at this level, the researcher's role can only be to persuade the governing body to adopt its proposals.
- **G1 proposal:** Directors and managers should play an important role in spreading the adoption of technology usage in the teaching/learning process. The organization's mission statement should clearly include the use of technology in the teaching/learning processes and set its goals:
  - Promoting the participation of primary stakeholders (teachers and students);
  - Raising their interest in the adoption of learning technologies.

- **G2 proposal:** There must be a clear leadership for a fully efficient technology adoption. The appointed leader should be responsible for strategy formulation and plan implementation:
  - o Defining a 3-5 years strategy plan including historical data, trends and projection analysis;
  - o Assessing the effectiveness and efficiency of resources (technology and human) to answer students and teacher's needs;
  - o Designing operational plans and regular activity reports with a clear identification of the strengths and weaknesses to improve the quality of service;
  - o Providing support to the stakeholders and ensuring the availability of resources;
  - o Verifying measures taken to ensure data integrity.
- **G3 proposal:** The use of the e-learning platform by all curricular units (CUs) should be mandatory.
  - o Requesting the mandatory use of the platform so that teachers may benefit from it (by increased use of the embedded learning tools) and students have the opportunity to access more diversified sources of content and communication with colleagues and teachers. This way CUs can become more interactive experiences.
- **G4 proposal:** Incentives should be provided to encourage teachers to fully use the available platform.
  - o Promoting the report and sharing of best-practice.
- **G5 proposal:** The adoption of the technology should be frequently monitored. At a teaching/learning level the monitoring and evaluation of the adoption of the technology should be performed at an external and internal level. This process involves:
  - o Performing periodic evaluations along with process and validating results in order to measure the attainment of goals and the progress of the strategy plan;
- **G6 proposal:** Curricular unit planning should describe the use of learning technologies:
  - o Planning in a clear and concise way;
  - o Providing suitable technology and tools;
  - o Including frequent interaction of students between themselves and with teachers;
  - o Accommodating different learning styles;
  - o Allowing students to have unrestricted access.

3.2 Pedagogical Intervention

This set of proposals take on the intervention at the pedagogical level, focusing on the teacher's role and improving their pedagogical performance through the use of the e-learning platform, through training assessment.

- **P1 proposal:** Promote the use of e-learning technologies as a means of communication between teachers:
  - o Exchanging information and best-practice between different UCs through synchronous and asynchronous tools embedded in the e-learning platform could represent substantial improvements of the pedagogical practice.
- **P2 proposal:** Promote the use of technologies as a means of communication between students and also between students and teachers:
  - o Using existing communication tools embedded in the e-learning platform should be promoted among students once it will actively facilitate relations between them and also students with the teachers. As a result a more close and interactive guidance with optimal learning experience will be achieved.
- **P3 proposal:** Providing technical support to platform users.
  - o Compiling teachers and students issues and providing adequate answers and solutions (for instance as Frequently Asked Questions - FAQs), easily accessible on the platform in order to help other users with the same or similar questions.
- **P4 proposal:** Providing pedagogic support on the e-learning platform usage.
  - o Making tutorials and guides available to help teachers organize and present information using the best pedagogic practices so optimal quality information is provided to students.

- **P5 proposal:** Provide teachers training support in order to help them use the platform.
  o Providing continuous training to teachers in order to take full advantage of the platform potential.

3.3 Technological Intervention

The proposal at technology level embraces the personalization, usability and customization of the platform features and tools to the needs and abilities of the users. This implies the design and development of applications (plug-ins) to be integrated in the platform so that it is upgraded into a user-friendly tool for teachers and students, raising the user experience for them.

- **T1 proposal:** Summary plug-in
  o Keeping record of each lesson's contents is a teacher common task, and it could be beneficial if students could access that record directly from the e-learning platform.
- **T2 proposal:** Collaboration plug-in
  o Sharing files and information help the cooperation between workgroup members. Shared edition, versioning and other tools add value to the platform and improve student-student, teacher-student and teacher-teacher collaboration.
- **T3 proposal:** Integrated social networking.
  o Developing modules based on social networks like wikis and chats is a way of both promoting the platform usage and adding to the information availability.
- **T4 proposal:** Overall improvements.
  o Improving system security and stability, infrastructure upgrading, integrating with other tools and reinforcing tech support.

4. CONCLUSIONS

This study has proven that, in spite of all the advantages of using e-learning platforms we are still a long way from taking full advantage of them. We have compiled a set of carefully selected proposals that aim to make the user experience uniform throughout the whole institution and add value to the platform and its tools but also easing teachers' work with it.

By following these rules the target institution is setting a path towards excellence, keeping a bond with its students and adding value to its work, setting the foundations to a promising future where it can be a reference to others.

REFERENCES

B.P, Marques; J.E, Villate and C.V, Carvalho, Tecnologias da Informação e Comunicação no apoio à aprendizagem no Ensino Superior. CISTI2010, 5ª Conferencia Iberica de Sistemas y Tecnologías de Información, Santiago de Compostela, España, 16 al 19 de Junio, ISBN: 978-989-96247-3-3. Proceedings pp. 361-366, 2010a.

B.P, Marques; J.E, Villate and C.V, Carvalho, Technology Acceptance on Higher Education: the case of an Engineer's School. ICERI2010, International Conference of Education Research and Innovation, 15 to 17 November, Madrid, Spain, CD Proceedings, ISBN: 978-84-614-2439-9, pp. 5094-5102, 2010b.

B.P, Marques; J.E, Villate and C.V, Carvalho, Applying the UTAUT model in Engineering Higher Education: Teacher's Technology Adoption. CISTI2011, 6ª Conferencia Ibérica de Sistemas e Tecnologias de Informação, Chaves, Portugal, 15 a 18 de Junho, ISBN: 978-989-96247-4-0. Proceedings pp.549-554, 2011.

European Union, European Affairs and International Relations Office; Online, consulted in March 2007 http://www.gaeri.minedu.pt/index.asp?doc=10031&menuid=726 2006.

CLOUD COMPUTING AND VALIDATED LEARNING FOR ACCELERATING INNOVATION IN IOT

George Suciu[1], Gyorgy Todoran[1], Alexandru Vulpe[1], Victor Suciu[2],
Cristina Butca[2] and Romulus Cheveresan[2]

[1]*University POLITEHNICA of Bucharest, Bd. Iuliu Maniu 1-3, 061071, Bucharest 6, Romania*
[2]*BEIA Consult International, Str. Peroni 16, 041386, Bucharest 4, Romania*

ABSTRACT

Innovation in Internet of Things (IoT) requires more than just creation of technology and use of cloud computing or big data platforms. It requires accelerated commercialization or aptly called go-to-market processes. To successfully accelerate, companies need a new type of product development, the so-called validated learning process. Furthermore, the development of the IoT paradigm has advanced the research on Machine to Machine (M2M) communications and has enabled novel acceleration platforms. However, there is a need for converging currently decentralized cloud systems, general software for processing big data and IoT systems. The paper describes a cloud platform that will bring together several services and instruments that the companies usually rely on in their go-to-market process. The main contribution of this paper consists in the integration of several services in the platform. The proposed platform will allow companies to bring their products to market faster and in a more successful manner, will be accessed via the Internet and will host the tools and virtual environments needed for the go-to-market accelerated process. Finally, is presented the acceleration results of a Cloud IoT architecture for processing big data from M2M telemetry.

1. INTRODUCTION

Cloud Computing represents a relatively new concept that refers to an integrated service offered as a whole application, which offers access to information and data storage without the user having to know the physical location and configuration of the systems providing these services.

Additionally, cloud computing is a general term for anything that involves delivering services over the Internet. Research currently in progress is extending the advances of M2M to Internet of Things (IoT) and cloud computing, by developing highly innovative and scalable service platforms that enable secure-, smart- and partly-virtualised-services (Bonomi, 2012).

Validated learning is the practice of effectively measuring the accuracy of assumptions and using the results of the validation to understand whether the assumption was correct and if so, continue onto the next test (Munch, 2012). If assumption was not accurate, then it will be decided whether the strategy, assumption or feature needs to be improved or to change direction. The concept of learning cycles in platforms for social learning (Shabalina, 2013) must also be mentioned. A learning cycle is a concept of how people learn from experience. A learning cycle will take a number of steps or phases, the latter being followed by first.

The paper is structured as follows: Section 2 presents the literature review in the field of virtual collaboration spaces, describing learning cycles and Validated Learning. Section 3 describes the approach of existing training methods and presents the proposed acceleration platform for innovation in industry. Section 4 describes a Cloud IoT architecture of a platform for processing big data from M2M telemetry. The conclusion summarizes the contributions of this paper.

2. VIRTUAL ACCELERATION SPACES

Collaboration is essential in accelerating innovation, because this is where the need for tools that support the dedicated collaboration arises. Research topics in this area include support simulations for business model learning. A serious simulation will help the development of business model learning solution. This will be coupled with an engine that will analyze the results of new ICT product and expert system releases and will propose some adjustments. The real key to accelerating business is validated learning, such as the validation of methods for a business model (Blank, 2013).

The adoption of a validated learning method requires new ways of measuring the accelerated innovation process. Experiments for validated learning are pilot services and tools can be developed iteratively. The aim of the technological infrastructure is to support the achievement of these experiments. The existing infrastructure allows a quick start for each new experiment, which will be used for developing the new infrastructure.

2.1 Validated Learning

The validated learning process represents the systematical search for matches between technology and market by validating the mechanics of a business model. Consequently, validated learning consists in iterating rapidly between experiments, data collection and informed decision making. Each company must install its own version of a validated learning process focused on the context of its business and industry to which it belongs.

The validated learning process is not just about learning a skill. It is about learning whether assumptions about the business model are correct or not. Adoption of validated learning process requires new ways of measuring progress on acceleration.

Therefore, the validated learning process is defined as a process that is learned by applying initial ideas and measuring them to validate the effect. Each test of an idea is a single iteration of a wider process consisting of several iterations, in which one learns something and then successive tests are applied. Furthermore, to perform quality evaluation for e-learning environments a method has been proposed to build the quality tree by selecting the quality characteristics from a list of common characteristics applicable to the whole e-learning experience (Militaru, 2012).

2.2 Learning Cycle

Using the learning cycle methods, the marketing innovation can be carried out by different companies from a modular unit that can be used in different stages of the go-to-market cycle. Learning cycles are social learning platforms. New players are involved in a less formal context to promote creative thinking and innovation.

Diverse perspectives, ideas, interests and local knowledge are taken into account in order to find alternative solutions that are optimal in comparison with the established approaches. The resulting solutions can be tested in small-scale pilot programs and patented (Siroker, 2013). If they succeed, new approaches can be adopted in the official management cycle.

Learning styles include a number of theories that suggest systematic differences in natural or usual pattern of individuals for the acquisition and processing of information in learning situations. A basic concept is that individuals differ in the way they learn.

3. PROPOSED CLOUD ACCELERATION PLATFORM FOR INNOVATION IN IOT

To acquire knowledge and qualified persons, IT&C system developers rely heavily on consultants, advisors and other providers of domain specific knowledge and can provide training and coaching programs [5]. Thus, they seek processes that ensure quality installation and maintenance services at limited costs. Market requirements are constantly growing and it is a challenge for providers to accelerate knowledge, but IT&C

technologies can represent a major role in enabling industrial stakeholders to expand their businesses and innovate.

The several services that will be integrated in the platform are: awareness creation services, trainings, seminars, online courses, coaching and mentoring services, software tools that support specific parts of the acceleration process, services that provide access to data needed to speed up go-to-market, services to look for partners, project management tools (Figure 1).
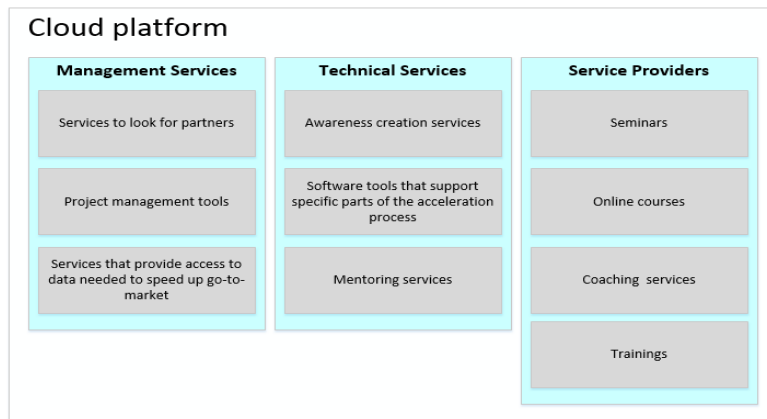

Figure 1. Services integrated in the platform

We will briefly describe each of them:

Service to look for partners is a management service that lets the users take a hands-on approach to a wide range of activities related to getting support, building projects and finding opportunities.

Project management tools is a service that offers support for task management, resource allocation, tracking, Gantt charts, and much more.

Services that provide access to data needed to speed up go-to-market are search based services. With these services SEO optimization on start-ups' websites can be achieved and in this way the acceleration of go-to-market process can be obtained.

Awareness creation services are the most effective and least expensive channels for online advertising and building a positive reputation.

Software tools that support specific parts of the acceleration process provide a scientific approach to creating and managing start-ups and getting a desired product in the customers' hands faster.

Mentoring service helps the users to refine their business strategy, map out the direction that their business should be taking and assist in setting goals for their business to succeed.

Seminars are meetings in which people can learn about a topic. They are usually interactive sessions where the participants engage in discussions about the delineated topic.

Online course is an electronic learning method. The platform for online courses provides functions such as: controlled access to educational materials, systematic consultation or searching large volumes of text and multimedia content, creating content through embedded HTML editors, editing tests and tutorials, editing glossaries / dictionaries, importing and exporting of educational content in popular formats such as MS PowerPoint files, MS Word, HTML, PDF, RTF or pictures and movies; creating archives / directories of the whole resources.

Coaching service is distinct from other forms of training because it focuses on the method of learning. Business coaching includes principles from sports coaching such as teamwork, personal excellence, and "going for the goal". A business coach focuses on helping an individual "learn what it takes" for him or her to improve existing capabilities, set meaningful goals, and be accountable for his or her results. A coach helps an individual understand and eliminate barriers to more effective performance.

Trainings are organized activities aimed at imparting information and/or instructions to improve the recipient's performance or to help him or her attain a required level of knowledge or skill.

180

4. RESULTS FOR M2M TELEMETRY AND CLOUD IOT ARCHITECTURE

In this section we present the acceleration results for an IoT architecture composed by a M2M telemetry system and cloud web servers (Figure 2).
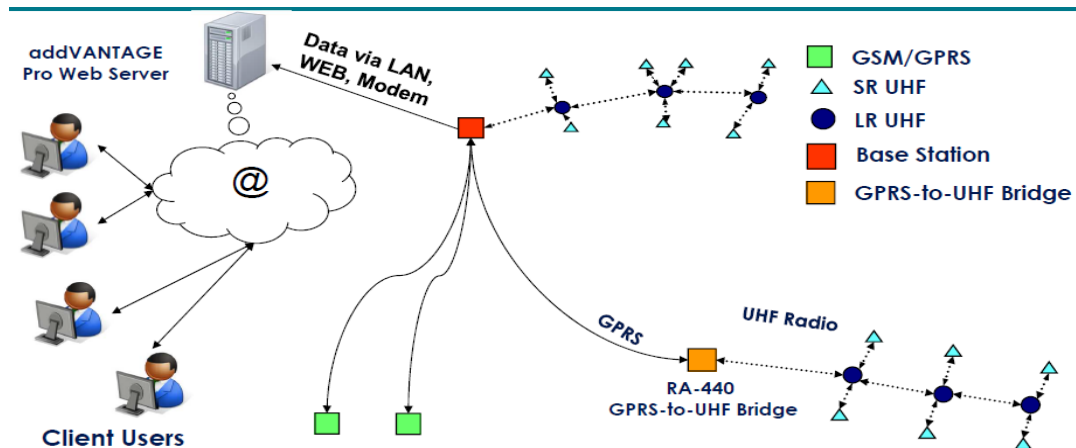

Figure 2. Architecture of the M2M telemetry system

The addVANTAGE Pro software (Adcon, 2014), which is based on a client/server architecture, collects data from one or several Telemetry Gateways (receivers) and makes it available for viewing or for specialized analysis. The server is that part of the software where all the actual processing takes place. It is responsible for downloading data from the Telemetry Bridge, storing data into the database, starting and stopping extensions, and servicing clients as they connect. The software and telemetry devices work together to form the telemetry system, which can be defined as a system that allows the user to:

- measure certain parameters over a predefined area;
- send those parameters over relatively large distances to a central point;
- process the parameters as needed for various applications such as agriculture, meteorology, irrigation control, water management, and environmental analysis.

The electrically converted parameters are first stored in the memory of a remote telemetry unit (RTU). An RTU has its own intelligence in the form of a built-in microcontroller, which periodically performs several tasks, such as: interrogating the sensors, storing the measured data, checking the radio channel, checking the local battery status, and so forth. It is part of a remote station, which consists of the RTU, its assembly parts, and its sensors. The RTU is equipped with a radio module or a GSM modem, which allows for real-time wireless communication with a base station.

The base station consists of a Telemetry Gateway (or receiver) and user PC. The Gateway acts as a network controller—at regular intervals (typically 15 minutes, but this can be changed) it requests data via radio or modem from the RTUs in the network.

The receiver stores the incoming data in its memory, thus allowing the receiver to supervise a large number of RTUs and keep their data for a period of time without the need to download the data to the PC. The number of controlled RTUs depends on the receiver type, and some receiver models can handle over 1000 units.

Cloud IoT is represented by SlapOS, a decentralized Cloud Computing system. It can automate the deployment and configuration of applications in a heterogeneous environment. SlapOS supports IaaS, PaaS and SaaS applications (Saad, 2014).

Big Data is typically considered to be a data collection that has grown so large it can't be effectively or affordably managed (or exploited) using conventional data management tools: classic relational database management systems (RDBMS) or conventional search engines, depending on the task at hand. Today, classic RDBMS are complemented by a rich set of alternative DMS specifically designed to handle the

volume, variety, velocity and variability of Big Data collections (the so-called "4Vs" of Big Data). These DMS include NoSQL, NewSQL and Search-based systems.

5. CONCLUSIONS

To successfully accelerate, companies need a new type of product development, the so called validated learning process. A validated learning process systematically searches the fit between technology and market, by validating the mechanics of a business model.

In this paper we describe how acceleration can be performed using a cloud computing platform, validated learning processes and learning cycles for innovation in IoT. Validated learning systematically searches for matches between technology and market by validating the mechanics of a business model and consists in iterating rapidly between experiments, data collection and informed decision making.

Learning cycles are social learning platforms. New players are involved in a less formal context to promote creative thinking and innovation. As future work we will take into account perspectives, ideas, interests and local knowledge in order to find alternative cloud computing solutions that are optimal in comparison with established approaches.

ACKNOWLEDGEMENT

REFERENCES

Book

Siroker, D., Koomen, P., 2013. *A/B Testing*, US Patent.

Blank, S., 2013. *The four steps to the Epiphany*, Columbia Business Law Review.

Adcon, 2014, *AddVANAGE Pro 6.1. Administrator Guide* – Adcon, Austria.

Journal

Saad, W. et.al, 2014, Designing and implementing a cloud-hosted saas for data movement and sharing with SlapOS", *International Journal of Big Data Intelligence 1*, no. 1, pp. 18-35.

Conference paper or contributed volume

Bonomi, F. et.al, 2012, Fog computing and its role in the internet of things. *Proceedings of the first edition of the MCC workshop on Mobile cloud computing, ACM*, pp. 13-16.

Militaru, T. L. et al, 2012. The evaluation of the e-learning applications' quality. *IE2012, 11th International Conference on Informatics in Economy*. Bucharest, Romania, pp. 168.

Munch, J., 2012, Evolving Process Simulators by Using Validated Learning. *ICSSP, International Conference on Software and System Process. IEEE*. pp. 226-230.

Shabalina, O., Sadovnikova, N., Kravets, A., 2013, Methodology of teaching software engineering: game-based learning cycle, *ECBS-EERC 2013, 3rd Eastern European Regional Conference on the Engineering of Computer Based Systems*. IEEE, pp. 113-120.

AN OWL ONTOLOGY FOR METADATA OF INTERACTIVE LEARNING OBJECTS

Bruno N. Luz[1,2], Rafael Santos[2], Bruno Alves[2], Andreza S. Areão[1],
Marcos H. Yokoyama[1] and Marcelo P. Guimarães[2,3]

[1]*Federal Institute of Education, Science and Technology of São Paulo – IFSP, Boituva, SP, Brazil*
[2]*Master's Program in Computer Science – FACCAMP, Campo Limpo Paulista, SP, Brazil*
[3]*Federal University of São Paulo - UNIFESP, São Paulo, Brazil*

ABSTRACT

The main purpose of this paper is to present the importance of Interactive Learning Objects (ILO) to improve the teaching-learning process by assuring a constant interaction among teachers and students, which in turn, allows students to be constantly supported by the teacher. The paper describes the ontology that defines the ILO available on the Internet. Besides, it shows the implementation of tests conducted on the virtual environment eTutor. Finally, it presents the assessment of the results based on the use of ILO in the subject Introduction to Hardware and Computing taught to 20 students.

KEYWORDS

Learning Objects, Interaction, Ontology, e-Learning, education

1. INTRODUCTION

Thanks to the use of Technologies of Information and Communication (TIC) combined to the Internet, several resources have been providing great support to teachers in the teaching-learning process [6]. Besides, time and location have been eliminated as obstacles in the educational field.

Among the several technological resources, there are the Learning Objects (LO), which are units of learning that exist in order to support the teaching-learning process. Although creating LO is complex due to the absence of user friendly tools of creation [7], they can promote significant progress in the teaching-learning process through TIC [6]. The Learning Objects (LO) help to create knowledge by incorporating features of interaction, adaptation and reutilization in several diferent contexts [24].

All tutoring contents tagged as Learning Objects (LO) should allow access and understanding by both: computers and users. However, they are generally described using language that can only be interpreted by human users. Therefore, to allow them to present meaning both to users and computers, [18] and [2] presented the Semantic Web.

The Semantic Web enables users to create data archives on the Internet, as well as to write the rules to ensure their interoperability. One way of linking these data is through the data model called ontologies [8] [12] [13]. Besides the specification of concepts about domains [12] [20], the ontologies are also applied to improve the machine's learning process and recovery of information [12] [13].

Several authors have pointed out the importance of using the Learning Objects (LO) in the educational context [4] [5] [6] [7] [24] [27]. The goal of this paper is to describe the Learning Objects (LO), which are an extension of the models described by [5], [26] e [27], using an ontology.

With the resources mentioned above, teachers can follow each student's learning curve and make appropriate interventions according to the individuals needs. The developed ILO were implemented on and assessed through the virtual environment eTutor. This paper assesses the ILO's application during the *Introduction to Hardware and Computing* classes attended by 20 students from the Computing Science course.

This paper is organized as follows: section 2 presents the use of ontologies for e-Learning; section 3 mentions the definition of standards for ILO; section 4 shows the ontology that has been created; section 5

discusses and validates (with eTutor support) the ontology offered during classes of the Computing Science course; finally, section 6 shows the conclusion.

2. E-LEARNING ONTOLOGY

The ontologies are contemplated in several fields of Computing Science such as Web information recovery, through online products and services like Ontoweb [10], which is a smart system of agents that work towards the contextualized search on the accessed sources; SEAL [19], which enables the creation of semantic portals based on ontologies; and the OntoSearch [23], which facilitates the reutilization of the ontologies on the Semantic Web.

The paper [9] presents the development of an ontology server that, by using LOM implements an ontology navigation service that dynamically develops HTML pages (including images and textual documentation), which shows the ontology's hierarchy and uses HTML forms to permit users to edit and translate the ontology straight from the LOM's model to the OntoLanguage.

[14] focus his paper on cooperative learning, which utilizes one ontology to form groups focused on individual and group learning goals, roles and instructional learning events.

Considering the models of domain, student, cooperation and pedagogical, [3] defines an ontology to build Interactive Learning Environments in order to answer the questions What, When and Where to study?

To optimize search and the distance learning proccess, [11] has developed a tool based on agents, which is called Web Semantic Search (WebSS). Its main goal is to give conditions for recovering educational contents in the servers of a Learning Management System (LMS) that offers a highly respected and efficient tutoring platform also known as AulaNet.

[17] applies ontologies in order to explicitly characterize the project and the learning objects, as well as the relationship among them. According to the authors, the application of ontologies may result in more efficient semi-automatic tools of extraction, which will , in turn, increase its reuse value. The authors also present a tool based on IMS-LD called Learning Object Context Ontology (LOCO).

Some papers have been adopting ontologies to define learning objects, as presented in [1] which shows an ontology represented through the Web Ontology Language (OwL) [28] to demonstrate the Learning Design semantic (IMS-LD). Meanwhile, [25] describes the ontology as a Web based tool for the development of Learning Units. [25] mentions the use of ontologies to explicitly characterize learning projects, learning objects and the relationship among them.

[22] employs an ontology to represent the Constructivist Learning by being able to identify the competencies and abilities that can be generated by the LO. Besides, they assure the reuse of the objects.

Although the ILO presents the same concepts when compared to the traditionals LO [8], the ILO differenciate from the other proposals due to the fact that their main purpose is to promote interaction among students, teachers and environment.

3. INTERACTIVE LEARNING OBJECTS

Although the relationship of tutoring contents and LO with interaction has been described by [16] when presenting his metodology to build interactive LO, the author wasn't concerned about structuring the construction of the LO by following standards such as LOM or SCORM.

[21] demonstrates one tool of creation for LO that promotes for LO that promotes the interaction between the teacher and the LO, as well as among the student and the objects. However, the author doesn't fulfill the demand presented in this paper, which is to assure the teacher is able to intercede depending on the current learning stage of the student.

A LO must take into consideration several possibilities of interaction: between teacher and student, student and teacher, LO and student, and LO and teacher. [16] has pointed out the importance of the interaction processes in the cooperative learning models, which generates a higher demand for the creation of ILO. This interaction is supported through the use of educational tools such as chat, tips, alerts, messages and appendixes.

In order to fulfill the proposed interaction, the SCORM's metadata standard was adapted. Thus, the compatibility with the traditionals LO was maintained. Among them, those from the interaction class are highlighted. They were created to specify all the educational context of the interaction, from the way it is perceived from the users point of view to how it is offered by the environment.

As soon as an activity starts, the ILO offer options of interaction to the students, such as asking for tips or having a conversation with the teacher through chat. Resources such as attached files (videos, presentations and tutorials) are also available for students while they are using tips.

The ILO assure one interaction that can be automatically turned on. For example, after a certain period of time without interacting with the ILO, the student has the option to receive a tip. At this point, the teacher is warned that the student has reached a certain period of time without interacting, which might indicate some difficulties to move forward. The alerts work based on a color code system that indicates where the student stands regarding his/her use of tips and time spent in the acitivity. The resources are implemented in a Virtual Learning Environment built with this purpose, eTutor.

4. ILO´S ONTOLOGY

The ILO's ontology was made possible by using the language OWL and by considering the principles of Semantic Web. Therefore, the intention was to facilitate the search mechanisms and to provide meaning to the data for the computers' interpretation.

Some important levels in the process of creation and validation of the ontologies are: vocabulary; hierarchy (taxonomy); context (level of application); Syntax Level; Architecture; Design and Structure [12].

The LearningObject class refers to the instances of the objects and it is related to the metadata classes: aggregations and content. The content class wasn't described in this version of the ontology due to the fact that it belongs to the Learning Object's tutoring content.

The LearningObject class represents the instances of objects described along with its metadata. The Content class represents the composition of the LearningObject, which is not included in this version of the ontology. The Vocabulary class encompasses, among the Ontologies and Standards used as reference, those metadata that have fixed values composition and can not be altered beyond those already forecasted. The relationship among the classes follows this format: Metadata hasSubClass General.

Each element of the ontology is described in its formality, containing: class name, URI, Equivalent Class, Disjoint Class and Annotations.

All the 55 elements of metadata were used following the ILO Standard and divided in Data Properties and Object Properties. The first one refers to the simple kind of elements that can be directly related to the metadata. Following, in this case, the model **its <**name metadata>**Is.** The second one fulfills the compound elements as indicated in the Aggregations class and having the structure **has** <name metadata>.

In the Properties model of Objects all the relationships like **has** <name metadata> have an inverse relationship identified as **its**<name metadata>**Of.**

The profile used in the OWL Language was OWL-DL, which is an intermediate version as important as the descriptive logic. Therefore, the profile is less formal than OWL Full and it has followed the specifications of the entire domain without further problems. The current ontology is available at: <*http://www.nogueiraluz.com.br/projetos/ILOv1.owl*>.

The ontology presented in the previous section was implemented at the eTutor's ILO tool and tested by 20 students. The tests were given during the *Introduction to Hardware and Computing* classes from the Computing Science course. Assessments, reading archives, questionnaires, appendixes and tips were among the ILO's activities.

Regarding the tests, initially the students were taught how to use the environment, as well as how to ask for support in case of an intervention. The presentation also included the students' perspective during an activity and the options available such as: tips, appendixes and Chat.

The teacher has put together an ILO in a questionnaire format containing 6 multiple choice questions. Each question contained 3 tips configured accordingly. The tips could either pop up automatically, after a 1 minute interval without the student's interaction with eTutor, or could be asked by the student at any time.

After having finished the activities, the students have received a questionnaire, which the main goal was to map the students' opinion about the interaction with the teacher, follow up and the ILO.

5. DISCUSSION

All participants answered 6 questions after having finished the activities. The questions were meant to assess the ILO. The percentage, as well as the questions are presented in Table 1 and the quantitative assessment and the percentage of answers found are shown too.

Table 1. ILO Assessment questions

Questions	Yes	No	Does not apply
1- Have you ever been in a Virtual Learning Environment before?	15%	85%	Does not apply
2- Did you feel like the teacher was supporting you ?	85%	15%	Does not apply
3- Did you ask for tips during activities?	55%	45%	Does not apply
4- When needed, Did the teacher offer you help and activity follow up?	65%	5%	30%
Questions	**Excellent**	**Great**	**Regular**
5- What is your opinion about interaction during activities?	45%	30%	25%
6- How do you rate eTutor's tool and the Interative Learning Objects?	55%	30%	15%

According to this assessment, 85% rated the ILO as Excellent and Great. Likewise, 75% of the students rated the interaction of activities as being positive. Only 15% of students had already used other LO in Virtual Environment (AVA) before, against 85% who had never accessed an AVA before.

The students who already knew other AVAs, reported that they felt the teachers gave the needed support when using the ILO in the eTutor. They also rated the possibilities of interaction as being Excellent. In this group, 67% of students were giving the support they needed thanks to the help pointed out by the environment.

6. CONCLUSION

The demand for new tools of support to the teaching-learning proccess is evident and has been growing steadily. This paper presented the ILO, which are intended to improve the monitoring of student's learning curve in order to detect their difficulties and apply the solutions accordingly, individually and immediatly. In addition, the teacher can plan the content to be taught according to the students' needs.

Consequently, this paper has defined the ILO ontology that permits the interaction among all participants: teacher and student; student and environment; and environment and teacher. The above mentioned ontology works according to the SCORM standard, as well as to the Semantic Web principles. As a result, it encourages ILO's creation, padronization and sharing.

eTutor was extremely important during the ILO's assessment, once it permited not only the ILO's assessment but also its testings. All the results were positive.

For further investigation and future research, it is highly recommended not only to map the ILO ontology's main classes: Content and LearningObject, but also to apply assessments with the coolaboration of professors from different fields of study.

REFERENCES

[1] Amorim, R. R., Lama, M., Sánchez, E., Riera, A., Vila, X. A., 2006. A Learning Design Ontology based on the IMS Specification. *In Journal of Educational Technology & Society,* Vol. 9, n° 1, pp. 38-57.

[2] Berners-Lee, T., 2002. Bringing the World Wide Web to Its Full Potential by Dieter Fensel (Editor), Wolfgang Wahlster, Henry Lieberman, James Hendler, MIT Press, 2002. Bowman, M., Debray, S. K., and Peterson, L. L. 1993. Reasoning about naming systems. *In ACM Trans. Program. Lang. Syst.* 15, Vol 5 (Nov. 1993), pp. 795-825.

[3] Bittencourt, I., Bezerra, C., Nunes, C., Costa, E., Tadeu, M., Nunes, R., Costa, M., Silva, A. 2006. Ontologia para Construção de Ambientes Interativos de Aprendizagem. *Proceedings of XVII Simpósio Brasileiro de Informática na Educação* (SBIE) – ISSN 2316-6533. UNB/UCB, Brazil.

[4] Campos, F., David, J. M. N., Braga, R., Nery, T., Santos, N., 2012. Rede de Ontologias: apoio semântico a linha de produtos de objetos de aprendizagem. *Proceedings of Anais do XXIII Simpósio Brasileiro de Informática na Educação* (SBIE), ISSN 2316-6533. Rio de Janeiro, Brazil.

[5] Castro, C. V., Satler, M. F., 2010. Modelo Ontológico para la Secuenciación de Objetos de Aprendizaje. *In IEEE-RITA*, Brazil, Vol. 5, Nº 2.

[6] de-la-Fuente-Valentín, L., Pardo, A., Kloss, C. D., 2011. Generic servisse integration in adaptive learning experiences using IMS learning design. *In Computers & Education*. Vol. 57, Issue 1, pp. 1160-1170.

[7] Durand, G., Downes, S., 2009. Toward simple learning design 2.0. *Proceedings of 4th International Conference on Computer Science & Education*. Nanning, China, pp. 894–897.

[8] Gluz, J. C., Vicari, R. M., 2011. Uma Ontologia OWL para Metadados IEEE-LOM, Dublin-Core e OBAA. *Proceedings of XXII Simpósio Brasileiro de Informática na Educação* (SBIE). ISSN: 2176-4301. Aracaju, Brazil.

[9] Gómez-Pérez, A. 1998. Knowledge Sharing and Reuse. *In Handbook of Applied Expert Systems*, pp. 10-11, USA.

[10] Gomez-Perez, A., Manzano-Macho, D. 2003. OntoWeb Deliverable 1.5: A Survey of Ontology Learning Methods and Techniques. *In Universidad Politecnica de Madrid*.

[11] Goñi, J. L., Fernandes, M. C. P., Lucena, C. J. P., 2002. e-Learning e a Web Semântica. *Proceedings of IV Simpósio Internacional de Informática Educativa*. Vigo, Espanha.

[12] Hazman, M., El-Beltagy, S. R., Rafea, A., 2011. A Survey of Ontology Learning Approaches. *In International Journal of Computer Applications*. Vol. 22, Nº 9. ISSN: 0975-8887.

[13] Isotani, S., Bittencourt, I. I., Mizoguchi, R., Costa, E. 2009. Estado da Arte em Web Semântica e Web 2.0: Potencialidades e Tendências da Nova Geração de Ambientes de Ensino na Internet. *In Revista Brasileira de Informática na Educação*, Brazil, Vol. 17, Nº 1.

[14] Isotani, S., Inaba, A., Ikeda, M., Mizoguchi, R. 2009. An Ontology Engineering Approach to the Realization of Theory-Driven Group Formation. *Proceedings of International Journal of Computer-Supported Collaborative Learning*, Vol. 4, Issue 4, pp. 445-478.

[15] Jiang, Y., Wang, X., Zheng, H., 2014. A semantic similarity measure based on information distance for ontology alignment. *In Information Sciences*, Vol. 278, pp. 76-87.

[16] Kemezinski, A, Costa, I. A., Wehrmeister, M. A., Hounsell, M. S. e Vahldick, A., 2012. Metodologia para Construção de Objetos de Aprendizagem Interativos. *Proceedings of XXIII Simpósio Brasileiro de Informática na Educação* (SBIE). Rio de Janeiro, Brazil.

[17] Knight, C., Gasevic, D., Richards, G., 2006. An Ontology-Based Framework for Bridging Learning Design and Learning Content. *In Educational Technology & Society*, Vol. 9, nº 1, pp. 23-37.

[18] Koivunen, M. R., Miller, E. 2001. W3C Semantic Web Activity. In: Semantic Web Kick-off Seminar in Finland, Nov 2. *Available in <http://www.w3.org/2001/12/semweb-fin/w3csw>*. Access in 13/09/2014.

[19] Maedche, A., Maedche, E., Staab, S., Stojanovic, N., Sure, Y., Studer, R., 2001. SEmantic portAL - The SEAL Approach. *In Spinning the Semantic Web*.

[20] Maedche, A., Staab, S., 2001. Ontology Learning for the Semantic Web. *In IEEE Intelligent Systems, Special Issue on the Semantic Web*, Vol. 16, Nº 2.

[21] Marczal, D. e Direne, A. 2012. FARMA: Uma ferramenta de autoria para objetos de aprendizagem de conceitos matemáticos. *Proceedings of Anais do XXIII Simpósio Brasileiro de Informática na Educação* (SBIE). Rio de Janeiro, Brazil.

[22] Miguel, V., López, M. G., Montaño, N., 2008. "Desarrollo de una ontologia para la conceptualización de un ambiente virtual de aprendizaje constructivista". *In AVFT (online)*. Vol. 27, Nº 2, pp. 125-128.

[23] ONTOSEARCH, 2006. Welcome to ontosearch2. *Available in <http://www.ontosearch.org/>*. Access in set/2014.

[24] Rodríguez, V., Ayala, G., 2012. Adaptivity and Adpatability of Learning Object´s Interface. *In International Journal of Computer Applications*. Vol. 37, Nº 1.

[25] Sánchez, E.; Lama, M.; Amorim, R. R.; Negrete, A., 2007. Web LD: a web portal to design IMS LD units of learning. *In Seventh IEEE International Conference on Advanced Learning Technologies*.

[26] Sosnin, P., 2010. Creation and Usage of Project Ontology in Development of Software Intensive Systems. *In Polibits*, vérsion *On-Line,* Nº 42, pp. 51-58.

[27] Vicari, R. M., Bez, M., Silva, J. M. C., Ribeiro, A., Gluz, J. C., Passerino, L., Santos, E., Primo, T., Rossi, L., Bordignon, A., Behar, P., Filho, R., Roesler, V., 2010. Proposta Brasileira de Metadados para Objetos de Aprendizagem Baseados em Agentes (OBAA). *In CINTED-UFRGS – Novas Tecnologias na Educação*, Vol. 8, Nº 2, Julho, 2010.

[28] W3C. 1994. World Wide Web Consortium. *Available in <http://www.w3.org/2002/ws/>*.

UTILIZING E-LEARNING SYSTEMS IN THE LIBYAN UNIVERSITIES: CASE STUDY; TRIPOLI UNIVERSITY, FACULTY OF ENGINEERING

Dr. Aisha Ammar Almansuri[1] and Rowad Adel Elmansuri[2]

[1]University of Tripoli - Libya
[2]University of Huddersfield - UK

ABSTRACT

E-learning in teaching and learning considered as the easy way to use information and communication technology by using of the internet. With the support of E-learning higher education can be delivered anywhere and at any time. Although E-Learning is very importance in Libyan higher education, It's implementation is facing many challenges in the Libyan universities. This paper focuses on the implementation of E-learning in Libyan Universities. The main aim of this paper is to discover the implementation of E-learning in Libyan higher education and to identify the factors affecting the use of its technology. The research findings and recommendations will benefit the Libyan policymakers and the stakeholders.

KEYWORDS

E-learning, Higher Education, Libya.

1. INTRODUCTION

During the last three decades, researchers have started to pay extensive attention to learning styles such as those working in the field of computer science who have adopted the idea of using learning styles in education, one of these ideas is E- learning in teaching and learning which can be defined as information presented and learned by using a network or Internet.

E-learning used in colleges and universities to make learning more accessible and efficient. It gives students the chance to learn at anytime, anywhere, and at their own. Accordingly, e-learning improves the learning process by offering a different way of delivering education. This is does not prevent the fact that some People find it easier to understand a new concept by reading a textbook or verbal explanation.

Despite the importance of E-Learning in higher education (HE), in Libya, a number of challenges still face the implementation of E-learning in Libyan universities such as ICT infrastructure; Leadership; Culture; and E-learning strategy.

In order to achieve effective adoption and implementation of E-learning technology and to gain the potential advantages from employing this technology, this research will investigate the potential benefits of using e-learning in Libyan Higher Education and identify the factors affecting the use of E-learning technology, to make recommendations regarding viability and potential implementation. Recommendations of this study will benefit the teachers and learners as well as the policymakers who are planning and designing the Libyan HE system.

2. LITERATURE REVIEW

E-learning has started in many developing countries in order to convene the increase of the requirement for education and meet the increasing decline of trained teachers, (UNESCO, 2006).

2.1 E-learning

There is a wide range of definitions for E-learning. It can be defined as learning facilitated and supported through the use of information and communications technology. Lahwal et al., (2009) clarified that E-learning is a kind of learning supported by Information and Communication Technologies (ICT), it is an interactive learning in which the learning content is available online and offers feedback to the student's learning activities. Khan (2001) stated that E-learning can be thought of as anything that includes technology with interactivity to support learning, training and communication between groups and between individuals. It included web-based learning (WBL); internet-based training (IBT); advanced distributing learning (ADL); and online learning (OL).

E-learning also can be easily operated for large groups of students such as online each group for instance can be in different place. Since in some instances of E-learning tools and materials, the lecturer and the learner can modify the learning materials to their own needs and suitability, students have more control over the learning process and have the possibility to better understand the material leading to a faster learning compared to instructor-led training.

2.1.1 E-learning Challenges

E-learning can be a sensible example of useful use of technology in life and this effective learning culture may meet the growing need of flexibility in facilitating education to the population. However, many challenges facing E-learning shows its growth in the world, different factors such as technical, economy, political and cultural conditions are the challenges to implement E-learning in different countries.

Kenney et.al, (2005) clarified that E-learning was seen as a chance to cut costs and make savings in space and human resources, which are unlikely to be realized in the short term and development of E-learning by the government through funding allocations. In developing countries, it is difficult to provide different facilities and opportunities required to establish E-learning environments. On the other hand, some researchers believe that E-learning is not an appropriate way of teaching. For instance, Lytras and Pouloudi (2001) stated that it is a waste of time because E-learning courses often fail to support value of creating processes both for teachers and learner and their recognition requires huge efforts.

Bleimann (2004) added that isolation by no social contact, missing part of the informal social communication and face to face contact of traditional classroom training, also, it may cost more to develop; it needs new skills in those who create course content.

Sims and Sims (1995) stated that many challenges facing higher education institutions that increase the pressure on them, e.g. retaining enrolment, providing adequate resources, sustaining quality, raising funding, and strengthening the curriculum. Rhema and Miliszewska (2010) clarified that a number of technological challenges faces Libya, such as lacks in the required technological infrastructure, while availability of computer laboratories are available in most Libyan higher institutions, the network facilities is lack and makes a serious limitations on Internet access. Also, the limitation of using the educational software within institutions, and the technical support is almost unavailable in Libya.

2.1.2 E-Learning in Libyan Higher Education

According to Rhema and Miliszewska (2010) the implementation of E-learning and the use of ICTs in Libya are still in an early stage similar to in most developing countries. Although Libyan Universities still use the old method of education that depends on face-to-face communications between students and teachers in, and outside of, classroom, in campus. Some Libyan universities, such as Tripoli University, Benghazi University, and Academy of Postgraduate Studies and Economic Research, have the basic ICT infrastructure (such as computers, Internet access, and a local area network).

Kenan et al., (2011) clarified the barriers of implementing e-learning in Libyan HEIs as E-learning in Libyan institutes is in early years, and still there are many challenges that affect the adoption of E-learning that can be categorised as: Technological, mismanagement, Cultural and other issues. They provided a set of recommendations for students and instructors to improve e-learning in Libyan HE institutions as follows:

- Improve students' computer skills before enrolling E-learning course;
- The content of the e-learning course should be designed to meet the National Qualifications Framework (NQF) and Libyan Qualifications Authorities (LQA) requirements.
- The attitudes towards e-learning should be taken into consideration.

- Teachers should support learners and institutions should employ an adequate staff members.

The authors provided recommendations for institutions as follows:

- Senior managers should support the implementation of e-learning and allocate a fixed budget.
- Instructors should be offered adequate training and course developers to be updated on changes to software and hardware. And tools should be kept up to date at all times.

   Some recommendations for governmental HE policies have been addressed by the authors as follows:

- Share coordination and resource between different institutions and encourage the successes institutions, to share their success with other institutions.
- Develop partnerships between government, and the private sector.

3. METHODOLOGY

A semi-structured, face-to-face interview technique used to collect the necessary data from the Libyan students and lecturers from Tripoli university faculty of engineering department of architecture in order to explore their opinions, as well as to give their advice about how to find solutions to the problems of implementing E-learning in Libyan higher education. Furthermore, to understand their opinions of current and traditional way of studding in Libyan higher education institutes. Also, researchers used one students' study group to make an argument about some points related to using E-learning in higher education, and find out the problems and solutions to the problems.

4. MAIN FINDINGS

4.1 Summary of the Students' Main Findings

- Most of students are using software, social media and internet in their study as a kind of E-learning.
- Almost all students believe that E-learning is an appropriate way of teaching and studding.
- All students have chosen the all benefits addressed in the literature, the most benefits of using E-learning are because it provides a flexible learning and help built self- knowledge and self- confidence after that mange time, improve preservation and reduce cost.
- Most of students have used E-learning in some courses.
- All students believe that E-learning services in the Libyan higher education are not good.
- Students have chosen many reasons of the limitation of using e-learning in Libyan institutes such as: Limitation of using E-learning in Universities; lack of ICT infrastructure; lack of personnel qualified; Limitation of using the educational software within institutions and resistance to change from teachers.
- Students selected the all options of E-learning challenges collected from literature, the highest rate went to the lack of implementing e-learning by government and lack of public awareness about ICT, after that the limitation of basic infrastructural resources and people do not accept the concept of E-learning.
- Most students are using social website to communicate with the University.
- The majority of students preferred to use computer in presenting lectures.
- Most of students prefer to use computer for doing homework.

Other comments raised by students about the benefits of using E-learning are:

- Enable people to teach anytime and anywhere and save more time.
- Help student to do research for homework
- Need computer to log in into university web site and don't need to carry papers or documents

4.2 Summary of the Lecturers' Main Findings

- Although Universities did not provide any kinds of E-learning, most lecturers are using computer, world wide web, and software such as PowerPoint to deliver lectures.

- E-learning can be used for many purposes: delivering courses, lectures and instructions, learning over distance, conferences, communications between lecturer and students.
- There were computer labs for students, and internet access for teachers before the revolution of 17/2/2011, but because of the armed conflict, many things are broken.
- E-learning in general are very useful way to teach and learn in all learning stages for many reasons summarised as follow:
  Most E-learning programs can be taken when needed; Spread and share knowledge and saves the students time, effort and cost; E-learning ensures that all learners receive a consistent message of the target learning; E-learning can accommodate the various learning styles to get the message more effectively by using audio, visuals, interactivity, and simulation; It's self-paced as most E-learning programs can be taken when needed; Easy way to find information, references, lessons etc.. and Flexibility to join discussion areas at any hour, or meet with colleagues and instructors in chat rooms.
- Libraries in Libyan Universities are still using the tradition way, however, the department of architecture provided an electronic library includes materials collected by lecturers and students.
- The University web site, have got a registration in many electronic libraries and scientific journals for teachers and postgraduate students.
- The University communicate with teachers and students through the University electronic gate web site.
- communication between the department, teachers and students are by using facebook and e-mail
- Barriers of implementing E-learning in Libyan Universities as follow:
  Weak infra structure (servers, internet reliability, lines expensive); Political issues; Administration; Lack in physical resources, including accommodation, computer and other ICT related resources, connectivity and access for those people with individual needs; and Shortage in information advice and guidance, to ensure that learners are on the correct learning programme at the right level, advice on progress into new learning programmes, monitoring, assessment and on-programme support.
- Lack in learning management and use of management information in order to improve the quality of content and teaching.
- Many points to improve and apply E-learning in Libyan higher education as follow:
  Provide a generous funding and lots of careful planning and expertise; Offer good management and administration; The right person in the right position; Improve ICT infrastructure; Connect with advanced resources over the world; Provide qualified staff and Improve students' computer skills; Changes should be taken gradually in a correct manner; and Employ people who have skills.
- The future of Libya will be excellent, because Libya have got many things could make it one of the best countries in the world.

5. CONCLUSION AND RECOMMENDATIONS

The findings of the study suggest some useful recommendations that could be used in achieving the aim of this study which is to analyse the opportunities for E-learning in Libyan Universities, in order to assess the viability and benefits of its introduction in present and future developments. A variety of points, suggestions and recommendations are highlighted in this section. The objective is not to create a definite strategy but to recommend some general principles.

Recommendations for lecturers and students to improve E-learning in Libyan Universities as follows:
- Improve the methods of teaching and learning and follow the world's education market.
- The content of the E-learning course should be designed to meet the National Qualifications Framework (NQF) and Libyan Qualifications Authorities (LQA) requirements.
- Instructors should support learners and encourage them to use E-learning in their study.
  Recommendations for institutions as follows:
- Improve learning management, including the management of the curriculum, staff and use of management information.
- Senior managers should support the implementation of E-learning and allocate a fixed budget.
- Instructors should be offered adequate training and course developers to be updated on changes to software and hardware.

- Tools should be kept up to date at all times.
- Connect with advanced resources over the world.
- Provide a qualified staff and changes to e-learning should be taken gradually in a correct manner..
- The attitudes towards E-learning should be taken into consideration.
- Better training to students and staff, and better ongoing technical support from the system vendor
- Provide appropriate training at different levels,
- Make researches to gather data for future developments;
- Libyan institutions have to accept E-learning and to fulfil the potential of ICT and to get quick technological development, Libyan institutions may follow a neighbouring countries' experiences for teaching and learning.
  Recommendations for governmental higher education policies as follows:
- Improve physical resources, including accommodation, computer and other ICT-related resources.
- Provide a generous funding and lots of careful planning and expertise.
- Improve ICT infrastructure.
- Share coordination and resource between different institutions and encourage the successes institutions, to share their success with other institutions.
- Increase partnerships between government, and the private sector.
- Convince the community and the learners' needs,
- Integrate E-learning in the education system.
- Libyan government should pay more attention and great effort to ensure the development and motivation towards e-learning and suitable responses.

Finally, it can be summarising that students and lecturers indicated a positive attitude towards E-learning. E-learning in Libyan higher education institutions as in many developing nations is still remains an unexplored entity and further research is needed to discover and determine the types, and challenges of educational settings as associated to ICT and E-learning in higher education institutes in Libya. It is wished that the findings of the dissertation will be as a source of information for academics, and decision-makers involved the implementation of E-learning in Libya. Clearly indicate advantages, limitations and possible applications.

REFERENCES

Bleimann, U. , 2004. Atlantis University: a new pedagogical approach beyond e-learning. Campus-wide Information Systems, 21(5):191-195

Kenan Th., Pislaru C. And Bennett L . 2011, Investigation of e-learning implementation in HE institutions in Libya Student, Poster, Dept of Engineering and Technology, School of Computing and Engineering, available online [*http://www.hud.ac.uk/media/universityofhuddersfield/content/documents/computingandengineering/events/researchersconference/posters/kenan.pdf*]

Kenney, D. R., Dumont, R., & Kenney, G. S., 2005, Mission and place: Strengthening learning and community through campus design. Westport, CT: Greenwood Publishing Group.

Khan, B. H. 2001c. Webbased training: An introduction. *In B. H. Khan (Ed.), Webbased training*. (pp. 5- 12). Englewood Cliffs, NJ: Educational Technology Publications

Lahwal F., Amaimin M., and Al-Ajlan A., 2009 Perception Cultural Impacts: Principles for Trainer's skills for Elearning, *Fifth International Joint Conference on INC, IMS and IDC*.

Lytras, M.D. and Pouloudi, A.E. 2001, ''E-learning: just a waste of time'', in Strong, D., Straub, D. And DeGross, J. (Eds), *Proceedings of the 7th Americas Conference on Information Systems (AMCIS)*, Association for Information Systems, Boston.

Rhema, A. And Miliszewska, I. 2010. Towards E-Learning in Higher Education in Libya. *Informing Science and Information*,l7,423-437, Available online (*http://iisit.org/Vol7/IISITv7p423-437Rhema735.pdf*)

Sims R., . Sims S., 1995. The Importance of Learning Styles: Understanding the Implications for Learning, Course Design, and Education, Greenwood Publishing Group.

UNESCO, 2006. Teachers and educational quality: Monitoring global needs for 2015. Report. Retrieved September 20, 2009 from *http://www.uis.unesco.org/TEMPLATE/pdf/Teachers2006/TeachersReport.pdf*.

Reflection Papers

MAKING SENSE OF GAME-BASED USER DATA: LEARNING ANALYTICS IN APPLIED GAMES

Christina M. Steiner, Michael D. Kickmeier-Rust and Dietrich Albert

Knowledge Technologies Institute, Graz University of Technology, Austria

ABSTRACT

Digital learning games are useful educational tools with high motivational potential. With the application of games for instruction there comes the need of acknowledging learning game experiences also in the context of educational assessment. Learning analytics provides new opportunities for supporting assessment in and of educational games. We give an overview of current learning analytics methods in this field and reflect on existing challenges. An approach of providing reusable software assets for interaction assessment and evaluation in games is presented. This is part of a broader initiative of making available advanced methodologies and tools for supporting applied game development.

KEYWORDS

Applied games, assessment, evaluation, learning analytics.

1. INTRODUCTION

Applied games are games serving a primary purpose that goes beyond the aspect of pure entertainment. Most common in this field are digital educational/learning games, which represent an increasingly used e-learning technology. Their highly motivating character makes them effective educational tools for creating authentic learning tasks and meaningful, situated learning (de Freitas, 2013). With the application of educational games for instruction and learning there comes the need of accounting for learning game experiences also in the context of educational assessment. Conventional educational measures are not suitable in the context of educational games, since they are usually highly invasive and compromise flow (Van Eck, 2006).

Learning analytics (LA) is considered as a key approach providing new opportunities for learning performance measurement, assessment, and improvement in and of applied games. Translating LA to learning games combines two major trends in e-learning and stimulates new research questions in both fields. After introducing the general notion of LA (section 2), this paper provides an overview of current analytics research and developments in applied games (section 3). Based on a discussion of existing challenges, in section 4 an asset-based approach is outlined that supports realizing and integrating LA in game technologies. This approach shall foster a broader uptake of applied games and LA by the game industry and facilitate their broader adoption in educational practice.

2. BASIC NOTIONS OF LEARNING ANALYTICS

LA is defined by the Society of Learning Analytics Research (http://www.solaresearch.org/) as "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs". LA is used to empower learners, instructors, and educational institutions, as well as to support intelligent tutoring systems. LA consists in a multi-step, cyclical process of data collection and pre-processing, analytics and action, and post-processing (Chatti et al., 2012). Data collection and pre-processing involves the gathering of educational data from different learning tools or applications and preparing and translating it into an appropriate format. The analytics and action phase denotes the actual application of analytic methods (e.g. structure discovery, relationship mining etc. – for an overview see e.g. Baker & Siemens, 2014) to extract meaningful patterns

and information from the data and to make use of the obtained results, (e.g. visualization, feedback, recommendations, adaptation). Post-processing refers to the idea of continually improving analytics, by refining analytics methods, using new methods, including new data sources etc. Until now, a lot of work in LA has focused on researching the methods of data collection and analysis; only recently more intensive efforts on their application in educational practice are being made (Ferguson, 2012).

3. LEARNING ANALYTICS IN APPLIED GAMES

By recording user (inter)actions on a micro level learning games produce large amounts of data that may be used for LA. In fact, all digital games use in-game mechanics to appropriately respond to gamers' actions. These analyses, however, focus on assessing playing performance instead of learning (Baalsrud Hauge et al., 2014). A crucial question is how to harness and make sense of game-based user data in an educationally relevant manner. The valorisation of analytics for learning game assessment has started only recently. By combining ideas from gaming analytics, web analytics and traditional LA it is possible to establish meaningful analytics for educational purposes. In general, two types of LA in applied games can be distinguished (Westera et al., 2014): In-game analytics (real-time) and post-game analytics (off-line).

A post-game approach to LA refers to supporting summative learning outcome measurement or identifying general learning patterns, and – more rarely, though – to the evaluation of the game artefact. Serrano-Laguna et al. (2012, 2014) proposed a two-step generic approach for LA in educational games, which is applicable with any kind of different game. Generic traces are gathered from gameplay, including game traces (start, end, quit), phase changes (game chapters), input traces (mouse movements, clicks), and other meaningful variables (e.g. attempts or scores). These data give rise to reports with general and game-agnostic information, like the number of students who played a game, average playing time, game phases in which users stopped playing etc. Visually reported, this information provides initial useful information on how learners interacted with a game. In a second step, additional information may be extracted by letting teachers define assessment rules based on and combining generic game trace variables to obtain new information (e.g. setting maximum time thresholds). These rules are defined closely in line with each game to match the educational objectives. A more specific approach of realising post-game LA was presented by Westera et al. (2014), who have used correlational and regression analyses to investigate switching behaviour between game objects and activities as predictor for learning performance.

In-game LA is designed into a game and usually serves two purposes: Providing teachers and learners analytics results as a basis for action (e.g. selection of educational resources, decision on additional support or learning tasks etc.), or realizing dynamic adaptation during game time. Such stealth or embedded assessment avoids disrupting game experience, since assessment is appropriately integrated in the game and carried out non-invasively (e.g. Bellotti et al., 2013; Snow et al., 2015). Stealth assessment is usually implemented by linking observable game behaviour with an underlying model of learning outcome, competence etc. and regularly updating the user model (e.g. based on Bayesian score models or Competence-based Knowledge Space Theory). In this way, learning can be monitored and fostered, for example by generating progress reports and selecting new game experiences (Shute et al., 2009). Continuous non-invasive assessment was implemented in the educational games developed in the ELEKTRA and 80Days projects (Kickmeier-Rust & Albert, 2010): In a nutshell, learner actions during a complex problem-solving situation are monitored and interpreted in run-time in terms of available and lacking skills, current competence and motivational state. The information coming from this assessment is used to trigger adaptive interventions from a menu of different intervention types and tailored to the individual's current state and needs, in order to support and guide the learner in the game and learning task and to retain motivation (Kickmeier-Rust et al., 2011). Another example of in-game LA was presented by Baker et al. (2007), who realised skill assessment in an educational action game by using game events as evidence for users' mathematical skills, and to analyse study gains in accuracy over time and in speed over time with learning curves. Such kind of approach proved useful for formative assessment in educational games and may also be used to inform re-design and improvement of intelligent tutoring systems. Ventura et al. (2014) outlined a method for assessing persistence in educational games based on the time that learners spent on unsolved problems; this information may be used to tune gameplay difficulty, feedback and hints. Stephenson et al. (2014) elaborated an automated detector of engaged behaviour in a simulation game. The

aim thereby was to identify and model which learner actions give evidence of user engagement and, in the end, are predictive for success in the game. An integration of an engagement detector in the game may enable reporting the results back to learners and teachers for reflection.

To summarise , LA has started to spread into the field of learning games, which is in fact a development that strengthens the position of both types of technologies. Nevertheless, there are still several challenges ahead, some of which are discussed in the next section.

4. EXISTING CHALLENGES AND AN ASSET-BASED SOLUTION APPROACH

Despite the theoretical and empirical evidence for the potential of educational games, there is still some reluctance among teachers towards their broader take-up and use in educational practice; for example because assessment routines built-in in educational games are usually black boxes and not tangible for teachers (Serrano-Laguna et al., 2012). Likewise, leisure game developers are hesitant to enter the applied games market, due to the high effort involved in learning game development and the difficulties of measuring learning outcomes. There is a need to make available approaches for transparent and reliable assessment in educational games - approaches that are based on valid assessment models, that are easy to use and provide meaningful educational information, and that give game industry evidence on the quality of a game. To maximise the potential benefits of LA for learning with applied games, LA actually should be incorporated already in the design phase of an educational game (Baalsrud Hauge et al., 2014). A great challenge with LA in educational games is the wide variety of different games available, which complicates the development of generic analytics tools that are applicable independent of a concrete game. The technical challenges of providing technologies for data collection, aggregation, analysis, and visualisation are therefore high.

The European project RAGE (http://rageproject.eu/) aims at making available interoperable methodologies and tools for supporting applied game development. An applied gaming ecosystem will provide centralised access to reusable software components (so-called 'assets'). Among others, assets for user data analytics are developed that can be used to gather and analyse interaction data from games and to integrate automated assessment and adaptation mechanisms in them. Assets for on-line and non-invasive interaction assessment are implemented that enable game developers to easily specify domain models, data collection, and interpretation rules as a basis for competence-based and motivational assessment. These assessment routines will empower learning game environments by providing meaningful input for game balancing assets supporting adaptation to individuals' competence and motivational states.

Existing analytics approaches in educational games often focus on realising continuous assessment for automatic live adaptation. The application of LA should be strengthened with respect to feeding back the information on skills acquired and learning progress to learners and teachers in a suitable way. In RAGE LA results also feed into dashboards and visualisation assets for users. These may further leverage the educational value of LA and may potentially be transferred to educational actions outside a gaming context.

In addition to supporting LA for measuring and reporting learning success and for dynamic adaptation, the asset-based approach of RAGE shall also serve assessing and improving an educational game itself. An asset is elaborated to enable in-game evaluation. This evaluation asset thus represents an instrument for continuous evaluation of the quality of learning games by providing insights to users' perception of games and their progress towards game goals. This is done by translating log data into meaningful information about game quality, user experience, and learning based on pre-defined, configurable evaluation metrics. The asset will facilitate the use of analytics for game evaluation purposes and will advance evaluation methods of applied games towards a meaningful triangulation of different data sources. The RAGE technologies will be exemplified, tested, and evaluated in asset-based games (mobile and desktop implementations) targeting employability skills in the context of different application scenarios.

There is still more work to do to fully exploit the potential that LA in educational games may bring to optimize learning experiences. Beyond addressing the need for advanced, controllable, interoperable, and flexible technologies that facilitate the integration of LA in games, it needs to be taken into account, in particular, that games may be part of multiple learning activities and tools that learners carry out and use in parallel and, potentially, on the same educational objective or domain (Miller et al., 2014).

ACKNOWLEDGEMENT

REFERENCES

Baalsrud Hauge, J. et al., 2014. Implications of learning analytics for serious game design. *IEEE 14th International Conference on Advanced Learning Technologies*. Los Alamitos, California, pp 230-232.

Baker, R. and Siemens, G., 2014. Educational data mining and learning analytics. *The Cambridge handbook of the learning sciences*. Cambridge University Press, New York, pp. 253-274.

Baker, R.S.J.d. et al., 2007. Modeling the acquisition of fluent skill in educational action games. *Proceedings of User Modeling 2007.* pp. 17-26.

Bellotti, F. et al., 2013. Assessment in and of serious games: An Overview. *Advances in Human-Computer Interaction*.

Chatti, M.A. et al., 2012. A reference model for learning analytics. *International Journal of Technology Enhanced Learning*, Vol. 5, pp. 318-331.

de Freitas, S. 2013. *Learning in immersive worlds. A review of game-based learning.* JISC E-learning programme. Retrieved March 1, 2013 from http://www.jisc.ac.uk/media/documents/programmes/elearninginnovation/gamingreport_v3.pdf

Ferguson, R., 2012. Learning analytics: drivers, developments and challenges. *International Journal of Technology Enhanced Learning,* Vol. 4, pp. 304-317.

Kickmeier-Rust, M.D. and Albert, D., 2010. Micro adaptivity: Protecting immersion in didactically adaptive digital educational games. *Journal of Computer Assisted Learning*, Vol. 26, pp. 95-105,

Kickmeier-Rust, M.D. et al., 2011. Apt to adapt: Micro- and macro-level adaptation in educational games. *Technology-enhanced systems and tools for collaborative learning scaffolding. Studies in Computational Intelligence vol. 350.* Springer, Berlin, pp. 221-238.

Miller, W.L. et al., 2014. Unifying computer-based assessment across conceptual instruction, problem-solving, and digital games. *Technology, Knowledge, and Learning,* Vol. 19, pp. 165-181.

Shute, V. J. et al., 2009. Melding the power of serious games and embedded assessment to monitor and foster learning: Flow and grow. *Serious games: Mechanisms and effects*. Routledge, Taylor and Francis, Mahwah, NJ, pp. 295-321.

Serrano-Laguna, A. et al., 2012. Tracing a little for big improvements: Application of learning analytics and videogames for student assessment. *Procedia Computer Science*, Vol. 15, pp. 203-209.

Serrano-Laguna, A. et al., 2014. Application of learning analytics in educational videogames. *Entertainment Computing*, Vol. 5, pp. 313-322.

Snow, E.L. et al., 2014. The dynamical analysis of log data within educational games. *Serious games analytics*. Springer, Heidelberg, pp. 81-100.

Stephenson, S. et al., 2014. *Towards building an automated detector of engaged and disengaged behavior in game-based assessments*. Poster presented at the Annual Conference on Games+Learning+Society.

Van Eck, R., 2006. Digital Game-Based Learning. It's Not Just the Digital Natives Who Are Restless. *Educause Review*, Vol. 41, pp. 16–30

Ventura, M. et al., 2014. Assessing persistence in educational games. *Design recommendations for adaptive intelligent tutoring systems: Learner modeling, Volume 2.* U.S. Army Research Laboratory, Orlando, FL, pp. 93-101.

Westera, W. et al., 2014. Serious gaming analytics: What students' log files tell us about gaming and learning. *International Journal of Serious Games*, Vol. 1, pp. 35-50.

PRACTICING LOW-CONTEXT COMMUNICATION STRATEGIES IN ONLINE COURSE DESIGN FOR INTERNATIONAL STUDENTS STUDYING IN THE U.S.

Sharon Lalla, Ed.D.
New Mexico State University
Las Cruces, NM

ABSTRACT

A myriad of cultural differences can take educators in a multitude of directions when planning intentional design strategies in an online course to become more inclusive of international student needs. The topic of cultural diversity is a complex discussion. Nevertheless, there are ways educators can begin to practice culturally inclusive strategies. Using Hall's (1976) low-context communication style, this paper addresses two components of the online course, the syllabus and the learning management system, and offers suggestions for beginning the journey toward culturally inclusive pedagogical practices to address barriers in the curriculum for international students.

1. INTRODUCTION

In 2013/2014, higher education in the United States saw a growth of international students by 8.1% for a total of 886,000 students. Specifically, undergraduate student enrollment increased by 9% and graduate student enrollment increased by 6%. A large number of international students are entering U.S. higher education from all over the world with the majority of enrollments from China, India, and South Korea (Open Doors 2014). This continued growth places international students "as central players in intercultural exchange and diplomacy between nations" (Lee & Rice 2007, p.385). The opportunities for increased global participation in US higher education is due to the nature of online instruction. The ability to take courses from anywhere in the world from the comfort of one's own home, office, or coffee house entices potential students. Online instruction has increased and there is no stopping its capabilities.

New avenues for instruction require inclusive teaching philosophies in curriculum design and teaching practices (Hellstén & Prescott 2004). This paper briefly discusses cultural complexities but will focus on language proficiency as a major challenge for international students in online instruction. Following the discussion, recommendations are made to assist educators in leveraging the technology afforded by an LMS to adapt curriculum to be more inclusive of international students.

2. CULTURAL FACTORS

When we think of the diversity of our learners we consider a number of learner characteristics described by gender, age, socioeconomic status, ethnicity, physical and cognitive disabilities, and culture to name a few. As we look at culture, a myriad of lenses come to the forefront. In online courses, however, it is often difficult to determine the nationality or even the gender of our online students. Online students begin as raceless and genderless. As a result, it is imperative that we design our courses with sufficient cultural competence so that we might better prepare to meet the expectations of international students (Bista & Foster 2011; Cartledge & Kourea 2008; Zhang & Kennedy 2010).

We can take a look at a number of intercultural factors from works of Hofstede (1980), Hampden-Turner and Trompenaars (2000) and Faiola and Matei (2005) to provide us with a lens in which to study cultural phenomenon. In the interest of brevity, some intercultural variables include individualistic or collectivistic cultures, specific or diffuse cultures, low- or high-context cultures, and power management. In addition, the use of technology offers an opportunity to leverage what we know about international students to reduce the barriers experienced by international students.

Universal design for learning (UDL) is an attempt to design curriculum with all learners in mind, however, suffice it to say that the goal is a lofty one. Nevertheless, the results of keeping a broad perspective in mind by applying UDL principles to course design is that if we design for the margins, we are actually more inclusive of many more learners. Take for example, a built-in design to provide a virtual office meeting for students who wish to understand an assignment with an optional attendance requirement. A virtual meeting is 'live' which gives students an opportunity to connect with the instructor, ask questions and get clarifications. If the session is recorded, other students who could not attend the live session would benefit by viewing the recording at a later opportunity. This flexibility supports students with language barriers, traditional students who cannot attend at a time specified, and even students who feel uncomfortable seeking answers to questions they think they should know.

2.1 Learner Experiences

Learner experiences in other countries conflict with the unfamiliar educational culture in the US.

In many countries, the educational system requires little participation in the classroom and offer limited critical thinking opportunities. The teacher is the holder of knowledge and acquisition of knowledge is described as memorization. As a result, student challenges include language barriers, weak critical thinking skills, differences in cultural communication, and rote learning (Hellstén & Prescott 2004; Yeboah 2011).

International students experience both educational and non-educational challenges (Chen and Bennett 2012; Yeboah 2011). The responsibility is often left to the student to adapt to the host culture (Bevis 2002; Lee & Rice 2007) rather than to institutions to accommodate their unique needs. According to Yeboah (2011), these challenges result in significant transformations in both education and non-educational settings.

According to Allen (2010), English language instructors might not know what problems international students are facing online. There is a mainstream approach that shoots for designing a curriculum to try to accommodate the majority of homogenous learner needs. In fact, international students can experience hostility due to their lack of English fluency (Lee & Rice 2007).

Martirosyan, Hwang, and Wanjohi (2015) indicate that self perceived language proficiency in reading, writing, listening, and speaking is a key factor in academic success for international students. In a study by Zhang and Kennedy (2010), English language proficiency is the biggest challenge in online courses. Their results indicate that the English proficiency requirement needs to be raised to prepare students for online classes in the US. This increase in proficiency might be due to the fact that the mostly text-based online environment required in an online course requires too much interpretation.

2.2 Low-Context Communication Style

Language proficiency plays a significant role in online learning. Consequently, educators should incorporate pedagogical strategies that address language barriers in order to help students succeed academically.

Halls (1976) introduces low and high context communication styles to describe cultural differences. Low context is a method of communication requiring explicit and direct language. Low-context communication includes facts, words, verbal messages, tasks, directions, and explanations. An LMS where virtual learning is occurring is not self-explanatory (Klein & Lalla 2011). While the user interface presents explicit buttons labeled in English such as Submit and Attach, there are numerous user interface designs that confiscate such as a course starting point and where to go to submit assignments. Other examples of low-context communication instances in an LMS include the syllabus, announcements, and the gradebook.

This author suggests that educators can begin to implement intentional strategies to address language barriers by focusing on the learning management system (LMS) and the course syllabus. By first focusing on low-context communication, we can concentrate on being intentional about using explicit language to improve clarity.

2.3 Low-Context Strategies

The syllabus is usually the first instructional material students access in the online course. As a result, the following suggestions about explicit communication are offered to improve clarity in the syllabus:

- Provide instructor email contact and varied virtual office hours using clearly stated time format
- Describe course structure and purpose
- Provide a graphic syllabus to visually represent learning objectives and assignments
- Describe teaching style and instructor-to-student and student-to-student interaction requirements
- Give students choice when communicating with instructor (e.g., email, Skype, web conferencing)
- Include the time zone for all support services, including tech support. Link to everytimezone.com
- Include academic support services (e.g., tutoring, librarian assistance, and the writing center)
- Describe and list dates for synchronous requirements if applicable (vary times morning and evening)
- Indicate instructor response times to communications and to assignments
- Indicate technology prerequisite skills
- Describe minimal computer, internet, browser, and technology required for the course
- Present assignment schedule in advance clearly identifying date/time format you will use

The LMS offers a range of tools and activities: Left to right menus, words used to describe buttons and hyperlinks, branding, and color usage offers mixed messages to the international student. The following low-context suggestions are offered to improve learner understanding.

- Provide the LMS URL prior to beginning of course
- Hide all LMS tools that will not be used
- Provide a Getting Started unit to tell students where to begin the course
- Use features that provide clear and consistent navigation (left to right flow can be confusing)
- Provide a video with closed captions to explain how to navigate through your course
- Offer and record an optional 'live' virtual meeting to meet students and answer questions
- Provide video and textual instructions on how to change the interface language of the LMS
- Provide video and textual instruction on how to use the tools you are using in the LMS
- Provide video and textual instruction on how to acquire prerequisite technology
- Provide instructions on how to add a translate button to your browser
- Use a quiz or writing assessment to evaluate language proficiency
- Use a survey to inquire about specific learner needs and interests
- Provide a glossary of terms

3. CONCLUSION

Effective teaching practices should be reflected in both designing for and delivering to international students. The complexity of intercultural variables makes it seem like a daunting task especially in an online class where visual cues offered by face-to-face instruction are unavailable. In addition, the modern learning management system is pushing its capabilities to include multiple multimedia tools and flexible user interfaces; however, these virtual environments are largely text-based which depend upon a solid proficiency in the English language.

This article focused on language barriers and suggests that educators begin by applying low-context strategies in the syllabus and to facilitate LMS use. By focusing on low-context communication issues, U.S. educators can take the first step toward designing a culturally inclusive online course that could potentially benefit all learners.

REFERENCES

Allen, T., 2010. *Perceived Barriers to English Language Learning Among International School Students*, Dissertation, UMI Number: 3433012

Bista, K. and Foster, C., October 2011. Issues of International Student Retention in American Higher Education, *The International Journal of Research and Review*, Vol 7, No 2, pp. 1-10.

Bevis, T. B., 2002. At a glance: International students in the United States, *International Educator*, Vol 11, No 3, pp. 12–17.

Cartledge, G. and Kourea, L., 2008, Culturally Responsive Classrooms for Culturally Diverse Students With And At Risk for Disabilities. *Council for Exceptional Children*, Vol 74, No 3, pp. 351-371.

Chen, R. T. and Bennett, S., 2012. When Chinese Learners meet constructivist pedagogy online, *Higher Education*, Vol 64, pp. 677-691.

Coates, H., 2005. A Critical Examination of the Effects of Learning Management Systems on University Learning and Teaching. *Tertiary Education and Management*, Vol 11, No 1, pp. 19-36.

Faiola, A., and Matei, S. A., 2005. The cultural cognitive style of multimedia development: identifying designer cognitive structures for the web. *Proceedings of International Communication Association*, pp. 1-26.

Hall, E. T., 1976. Beyond Culture, New York, NY: Doubleday.

Hampden-Turner, C. M., & Trompenaars, F., 2000. *Building Cross-Cultural Competence: How to Create Wealth from Conflicting Values*. New Haven, CT: Yale University Press.

Hellstén and Prescott, 2004, Learning at University: The International Student Experience, *International Education Journal*, Vol 5, No 3, pp. 344-351.

Hofstede, G. H., 1980. *Culture's Consequences, International Differences in Work-Related Values*. Newbury Park, CA: Sage.

Klein, S. and Lalla, S., 2011. Digital ecologies: Observations of intercultural interactions in learning management systems. In Kirk St. Amant and Filipp Sapienza's (Eds.) *Culture, Communication, & Cyberspace: Rethinking Technical Communication for International Online Environments.* Amityville, NY: Baywood.

Lee, J. J. And Rice, C., 2007. Welcome to America? International student perceptions of discrimination, *Higher Education*, Vol 53, pp. 381-409, DOI 10.1007/s10734-005-4508-3

Martirosyan, N. M., Hwang, E., & Wanjohi, R., 2015. Impact of English Proficiency on Academic Performance of International Students, *Journal of International Students*, Vol 5, No 1, pp. 60-71.

Open Doors Report on International Educational Exchange, 2014, Institute of International Education, Washington, DC: National Press Club.

Yeboah, A. K., 2011. *Factors that Promote Transformative Learning Experiences of International Graduate-Level Learners*, Dissertation UMI Number: 3505134

Zhang, Z. and Kennedy, R. F., March 2010. Learning in an Online Distance Education Course: Experiences of Three International Students, *International Review of Research in Open and Distributed Learning*, Vol 11, No 1. Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/775/1481

Posters

INNOVATION DIFFUSION MODEL IN HIGHER EDUCATION: CASE STUDY OF E-LEARNING DIFFUSION

Sanjana Buć[1] and Blaženka Divjak[2]
[1]Institut IGH d.d. , Rakušina 1, Zagreb, Croatia
[2]University of Zagreb, Faculty of Organization and Informatics, Pavlinska 2, Varaždin, Croatia

ABSTRACT

The diffusion of innovation (DOI) is critical for any organization and especially nowadays for higher education institutions (HEIs) in the light of vast pressure of emerging educational technologies as well as of the demand of economy and society. DOI takes into account the initial and the implementation phase. The conceptual model of DOI in higher education (HE), where e-learning is considered as innovation, will be elaborated in the poster.

KEYWORDS

Diffusion of innovation; Higher education; E-learning; Strategic planning of e-learning implementation

1. INTRODUCTION

Europe 2020 Strategy (European Commission, 2010) puts a strong emphasis on smart, sustainable and inclusive growth based on innovation and creativity of both enterprises and institutions of higher education and science.

According to Rogers (Rogers, 2003) Diffusion of Innovations (DOI) is the process by which an innovation is communicated through certain channels over time among the participants in a social system and according to him an innovation is any "idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers, 2003). The relevant research question is how to model the DOI related to higher education and especially in the context of e-learning implementation.

2. DIFFUSION OF INNOVATION IN HIGHER EDUCATION

According to (Rogers, 2003) four main elements influence the spread of an innovation. They are the innovation itself, communication channels, time necessary for innovations to be adopted and a social system that combines internal and external influences. It also can be recognized that there is the essential influence of human capital i.e. there should be a critical mass of people that understand, adopt and spread the innovation. Otherwise the sustainability is not ensured.

The special case of diffusion of innovation in higher education is the implementation of e-learning. Under the term of e-learning we comprise all educational technologies starting with technology supported learning and blended learning and ending up with the massive open online courses (MOOCs) and personalized online learning. According to (Bates, 2011) it is a major innovation in education.

The innovation process in an organization consists of two main groups of activities (Rogers, 2003): (1) Initiation, consisting of information gathering, conceptualization and planning for the adoption of innovation, decision to adopt, and (2) implementation, consisting of all the events, actions and decisions involved in putting the innovation into use.

In further research of diffusion of e-learning as an innovation in HE according to the given conceptual model (Figure 1) we will define critical factors of DOI for each phase of the innovation process starting with the e-readiness assessment of a HE institution and social factors that influence decision making on levels of e-learning implementation.

After the decision has been made the most influential success indicators for e-learning diffusion into HE institution are going to be researched taking into account the following: leadership and strategic alignment, dedicated change agents among staff and students, e-learning usefulness recognized by staff and students, innovation in teaching, appropriate organization and support structure for staff and students, technical infrastructure, quality assurance of e-learning (Begičević et al, 2007; Bates, 2011; Gonçalves & Pedro, 2012). The developed model will be upgraded by means of social network analysis (SNA) in order to find key communication factors in DOI.

Finally, the described research will contribute to DOI theory because the majority of the existing research is focused on factors that influence an innovation adoption (Vishwanath & Barnett, 2011) and putting aside the focal problem of diffusion of innovation through information exchange through communication.
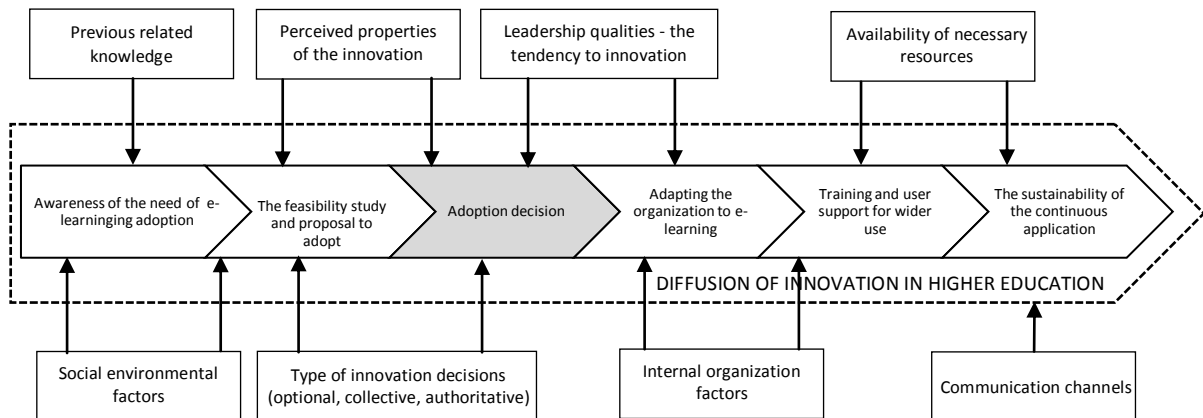
Figure 1. Conceptual model of DOI in higher education

Special issues that influence DOI in higher education are the type of HE institution (private of public); the level of autonomy of HE institution, the academic freedom of researchers/professors as well as the complexity of fulfilling the usual three-folded mission (education, research and outreach).

3. CONCLUSION

The conceptual model of DOI can be tailored for HE institutions but general factors need to be properly translated into specific environment, interpreted meaningful and possible connections should be established. The recognition of communication agents and channels that enhance the diffusion of e-learning will contribute to DOI management in HE system. We are going to present these specifics on the poster.

ACKNOWLEDGEMENT

REFERENCES

Bates, T. and Sangrà, A. (2011) *Managing Technology in Higher Education: Strategies for Transforming Teaching and Learning* San Francisco: Jossey-Bass/John Wiley & Co

Begičević N., Divjak B. and Hunjak T. (2007). Prioritization of e-learning form: a multicriteria methodology. *Central European Journal of Operations Research*, Vol 15 (4) 405-419.

Gonçalves, A. M., & Pedro, N. (2012). Innovation, e-Learning and Higher Education : An Example of a University' LMS Adoption Process. *World Academy of Science, Engineering and Technology 66 2012*, *6*(6), 258–265. Retrieved from http://www.waset.org/journals/waset/v66/v66-46.pdf

Rogers, E. (2003) *The Diffusion of Innovations.* 5th ed. ur. New York: The Free Press.

Vishwanath, A. & Barnett, G.A. (eds.) (2011) *The Diffusion of Innovations: A Communication Science Perspective*. New York: Peter Lang Publishing

DEMONSTRATING DREAM: A DIGITAL RESOURCE EXCHANGE ABOUT MUSIC

Rena Upitis[1], Karen Boese[1] and Philip C. Abrami[2]
[1]*Queen's University, Kingston, ON Canada*
[2]*Concordia University, Montreal, QC Canada*

ABSTRACT

The Digital Resource Exchange About Music (DREAM) is an online tool for exchanging information about digital learning tools for music education. DREAM was designed by our team to encourage music teachers to learn about digital resources related to learning to play a musical instrument, both in classroom and independent music studio settings. In addition to enabling music teachers to learn about resources, DREAM allows music teachers to evaluate the resources based on their own experiences using the resources, to read about other teachers' views of the resources, and to add resources to the learning objects repository. During the demonstration of DREAM, we will showcase some of the resources and discuss the evolution of the design of DREAM. We will encourage participants to explore DREAM on the devices we provide and/or on their own laptops, tablets, or smartphones.

KEYWORDS

Digital music tools, learning objects repository, music education

1. SESSION DESCRIPTION

Digital applications for music education have been growing at an astonishing rate, and these resources are changing the ways people teach, learn, and make music (Burnard, 2007; Partti, 2012; Rainie & Wellman, 2012; Waldron, 2013). The Digital Resource Exchange About Music (DREAM) is an online tool especially designed for music teachers to help them access the best of the many digital applications that are currently available (www.dreammusictool.ca). DREAM is one of a suite of digital tools for music learning designed by a research and development team comprised of members from two Canadian universities, Queen's University and Concordia University, and The Royal Conservatory (RCM), a national conservatory teaching and examination system. The first tool in the suite, iSCORE, supports students in their path to becoming self-regulated musicians. Two tools that are presently under development include an iOS mobile app for annotating music videos called Notemaker, and another web-based tool called Cadenza, which, like iSCORE, also was designed to support student self-regulation.

DREAM allows users to explore digital learning tools in music education, and to add their own tools to the digital repository. DREAM provides a forum for teachers to keep informed about the latest websites, apps, and recordings that apply to music learning, as well as to exchange their own evaluations of the resources. DREAM enables users to download the resources they would like to use directly on their laptops, tablets, or smartphones. For example, DREAM can be used to locate games that support sight-reading—a perennially difficult area for most music students to master—and to learn about drills to support ear training and theory. Users can also listen to excellent recordings of repertoire, and explore professional resources. DREAM currently contains over 3,500 high quality resources, all of which have been vetted by professional musicians and educators.

DREAM was designed by our team to encourage music teachers to become familiar with digital resources related to learning to play a musical instrument, both in classroom and independent music studio settings. In accordance with the other digital tools we have designed, DREAM is an evidence-based tool, created on the basis of research that shows how students can become self-regulated learners when their music learning is scaffolded appropriately. We have secured funding from the Social Sciences and Humanities Research Council of Canada, under the Partnership Grants program, to design and develop tools and to conduct

research on the effectiveness of the digital tools in *The Suite,* and to share those findings with the academic community, musicians, teachers, and the general public. Our work is also supported by a Leadership Opportunity Grant from the Canadian Foundation for Innovation. While DREAM was designed by Canadian developers and researchers, the tool has international reach, especially in English and French speaking countries where there is a conservatory system or some other music pedagogy and examination process in place.

In addition to enabling music teachers to learn about resources, DREAM allows music teachers to evaluate the resources based on their own experiences using the resources, to read about other teachers' views of the resources, and to add resources to the digital repository. In the release version (DREAM, v. 1.4), resources were organized into six categories: (a) musical repertoire, (b) ear training and sight-reading, (c) practising, (d) history and theory, (e) creating and composition, and (f) professional resources. All of the entries in DREAM are searchable by title and key words, and users can also filter the resources by instrument, ability level, or platform (e.g., by type of tablet or smartphone). The resources—whether they are recordings, apps, websites, or software programs—are described in the language of origin (English or French).

We characterize DREAM as a Trip Advisor™ for music teachers—but instead of choosing, for example, a hotel based on such filters as free parking and internet, the teachers might select musical repertoire, filtering for instrument (e.g., violin) and difficulty level (e.g., intermediate). Once the teacher has selected a resource, DREAM recommends resources to users based on their prior choices. Again, this has parallels to travel sites, for once the user browses through some hotel choices, the user is shown other hotels that might be of interest, based on the user's choice as well as the selections of users with similar profiles.

The demonstration of DREAM will showcase some of the resources and discuss the evolution of the design of DREAM (Upitis, Abrami, Brook, Pickup, & Johnson, 2015). Before releasing DREAM in September of 2014, an extensive usability testing period took place. During the first usability study, the design and content evolved, based on the feedback from 12 core test participants and designers, a group of 24 classroom music teachers, as well as nearly 50 studio music teachers from across Canada. The results of this usability study provided evidence that DREAM could serve as a centralized place for music teachers to keep abreast about digital technologies, by providing a tool that would be valued in terms of efficiency and effectiveness.

The demonstration will also detail some of the patterns of use that have been revealed since DREAM was first launched in September of 2014. These will include site analytics on the number of unique users (close to 5,000), countries of origin, most popular resources, browsers and devices used, and the time spent on the site and total page views (over 40,000).

In addition to describing the design process, patterns of use, and showcasing some of the resources contained in DREAM, we will encourage participants to explore DREAM on the devices we provide or on their own laptops, tablets, or smartphones. Participants will be able to access resources in the learning objects repository, open their own accounts, and add comments to the resources that are already available in DREAM.

ACKNOWLEDGEMENTS

REFERENCES

Burnard, P., 2007. Reframing creativity and technology: promoting pedagogic change in music education. *Journal of Music Technology and Education*, Vol. 1, No. 1, pp. 196–206.

DREAM | Digital Resource Exchange About Music (DREAM) - Music Teaching Resources. 2015. *DREAM | Digital Resource Exchange About Music (DREAM) - Music Teaching Resources*. [ONLINE] Available at: http://www.dreammusictool.ca. [Accessed 18 January 2015].

Partti, H., 2012. Cosmopolitan musicianship under construction. Digital musicians illuminating emerging values in music education. *International Journal of Music Education*. doi: 10.1177/0255761411433727.

Rainie, L., & Wellman, B., 2012. *Networked: The new social operating system*. MIT Press, Cambridge, MA, USA.

Trip Advisor. 2015. *Trip Advisor*. [ONLINE] Available at: http://www.tripadvisor.ca/. [Accessed 26 January 15].

Upitis, R., Abrami, P. C., Brook, J., Pickup, D., & Johnson, L., 2015. Digital Resource Exchange About Music (DREAM): Usability testing results. *European Journal of Social and Behavioral Sciences (EJSBS),* Vol. 8, No. 2, ISSN 2301–2118.

Waldron, J., 2013. YouTube, fanvids, forums, vlogs and blogs: Informal music learning in a convergent on- and offline music community. *International Journal of Music Education*, Vol. 31, No. 1, pp. 91–105. doi: 10.1177/0255761411434861.

A STUDY ON TEACHER TRAINING TO INCORPORATE GAMIFICATION IN CLASS DESIGN
- PROGRAM DEVELOPMENT AND IMPLEMENTATION IN A TEACHER TRAINING COURSE -

Shingo Shiota[1] and Manabu Abe[2]
[1]Faculty of Education, Shizuoka University, Shizuoka Prefecture, Japan
[2]Faculty of International Studies, Keiai University, Chiba Prefecture, Japan

ABSTRACT

Having classes with "fun" incorporated into their design is crucial for learners. Students can learn from classes that combine learning with fun. In this study, we developed a program for university students in a teacher training course that aimed to teach ways of incorporating gamification into class design.

KEYWORDS

Gamification, game design, lesson planning, teacher training

1. INTRODUCTION

Having classes with "fun" incorporated into their design is important for learners. Recently, gamification has attracted attention as one method of achieving fun in a class design. According to Inoue (2012), "Gamification is the act of order to apply the knowledge that has been cultivated in a computer game to the reality of social activities." In this study, we developed a program for university students in a teacher training course that aimed to teach ways of incorporating gamification into class design.

2. DEVELOPMENT AND IMPLEMENTATION OF THE PROGRAM

In developing the program, we pursued the following three objectives. The first is to develop student teachers' understanding of gamification. The second is to have the student teachers produce an output, namely, create a class utilizing gamification. The third is to reduce the lesson time.

The program, which was developed by us, was conducted in a teacher training class for compulsory courses that were prepared by the author. The program was attended by 63 student teachers in their third year of studies at the Faculty of Education.

Table 1. Flow of the program

	Content
The first class (90 minutes)	**Directing and teaching building ①** ・"From dull to fun" "What is gamification?"
Challenge after class	Analyze your favorite game from the perspective of gamification.
The second class (90 minutes)	**Directing and teaching building ②** ・I want to analyze lessons from the viewpoint of production.
Challenge after class	To more make the lessons more interesting, design a class conscious lesson in your major subject.

3. RESULTS

To clarify the program achievements, we analyzed the participants' questionnaire responses and free descriptions.

A questionnaire was given both before and after the program. To examine whether the participants had acquired the ability to use gamification, we utilized a four-point scale to measure their "interest" and "confidence" in lesson planning (4: Very much, 3: Well, 2: A little, and 1: Not much). The analysis included the data of 55 student teachers who had participated in both classes, out of the 63 who participated in the program.

A t-test conducted to reveal the average value of the pre- and post-class responses; the responses demonstrated a clear and significant difference for the three questionnaire items in terms of "interest" and "confidence." The results are shown in Table 2.

Table 2. Questionnaire results (n = 55)

Question	Before	After	
(1) I like to devise lesson plans.	2.24	2.56	**
(2) I have the confidence to devise a fun teaching plan.	1.89	2.31	**
(3) I have the confidence to make a class interesting.	2.07	2.46	**

In addition, we analyzed the students' overall impressions of the lesson in their written responses. Consequently, we were able to examine the co-occurrences of the following words: "lesson–production–think–guidance" and "study–applications–element."

Based on these results, and considering the three objectives of the program, we considered the overall effects of the program. First, we discussed the participants' feelings, experiences, and understanding of gamification. In their free descriptions, the participants experienced empathy to notice, as well as the primary character of the game and analysis of the game. Utilizing these responses, we effectively analyzed the games and stories.

Second, clearly presenting the aspect that we "produce" class designs with gamification, the students demonstrated they were more aware of the connection between gamification and class development. The questionnaire results showed that the participants' "self-confidence to create a fun lesson plan" and "self-confidence that the lesson is interesting" improved. Furthermore, in the analysis of the participants' impressions, "lesson–production–think–guidance" showed a strong co-occurrence. Based on these two results, the program objectives are considered to have been largely achieved.

Finally, regarding the teaching time, it became clear from the results that a short time is possible.

As shown by the above results, the program was effective at developing student teachers' ability to use gamification in class design.

4. FUTURE DEVELOPMENT

We have developed a program tool to spread the program. The "lesson plan idea tool" will help teachers acquire ideas for incorporating gamification into their class design. In the future, utilizing the idea of a program tool, we hope to further develop the program, implement it, and measure its effects in university teacher training courses.

REFERENCES

Toru Fujimoto, 2015. Development and Practice of Gamified Coursework Design Framewaok, *Educational Technology Research*, *Vol.38*, No.4, pp351-361

Toru Fujimoto, 2014. Toward Effective Approaches to Educational Use of Digital Games, *Computer & Education,* Vol.31, pp10-15

Akito Inoue, 2012. *Gamification - gameis changing the business -*, NHK Publishing, Tokyo, JAPAN.

Nobukatsu Fujioka, 1989. *Idea of class manufacturing*, Japan books, Tokyo, JAPAN.

A CASE STUDY OF THE FEEDBACK DESIGN IN A GAME-BASED LEARNING FOR LOW ACHIEVING STUDENTS

Ting-Ling Lai[1] and Hsiao-Fang Lin[2]

[1]*Tamkang University, No.151, Yingzhuan Rd., Tamsui Dist. New Taipei City, 25137, Taiwan, R.O.C*
[2]*MingDao University, No.369, Wen-Hua Rd.,Pitou, ChangHua 52345 ,Taiwan, R.O.C*

ABSTRACT

The purpose of the study is to explore the effects of text-based and non-text-based feedback in a game-based learning system. The pilot study is a case study to find low-achieving math students' comprehension and motivation in using the game-based systems. Four low-achieving students from a suburban middle school participated in the study. Data collection includes observation and in-depth interview about the use of the GBL. The results will be provided for future design and revision the math GBL.

KEYWORDS

Game-based learning, Feedback, Low achieving students in mathematics

1. INTRODUCTION

Recently, there is a growing concern about increasing number of underachieving students in high schools. Students underachieve in mathematics result from many reasons, for example, lack of learning motivation, culture deprivation, low SES, or unpleasant learning experiences. A number of remediation instructions and strategies have been proposed, basic skill instructions help students to familiar and master skills for reading and comprehension, peer tutoring for students to collaborative learning, online learning programs provide personal learning resources for students to learn on their own pace inside and outside of classroom. Researcher also found that games may be helpful for digital natives.

Educational researchers suggest that learning is most effective when it is active, experiential, situated, and problem-based and provide immediate feedback (Gee, 2007 Prenksky, 2001). Many studies found that computer games help learners on knowledge acquisition, improving reasoning, space reasoning, problem solving ability as well as motives and attitude (Killi, 2007; Wouters, van Der Spek & Oostendorp, 2009). However, some studies found that most of computer games were designed for drill and practice; few of them were required to apply special subject content knowledge, or connect to curriculum standards (Ke, 2008).

Researchers point that feedback is one of fundamental elements of games (Kapp, 2012; Prensky, 2001). Studies found that students received immediate, elaborative, text-based feedback led to more effective learning and higher motivation (Corbalan, et al., 2010; Kleij, et al., 2012). Another study showed that emotional feedback for empathetic encouragement had direct effect on intentions to use CBA (Terzis, et al, 2012). The proposed game-based learning system is focus on the various types of feedback design. The overarching research question is how text-based and non-text based feedback design support low-achieving students in mathematics? And what motivate low-achieving students in mathematics engaged in the game-based learning system?

2. METHOD

A case study method is used to understand the various feedback designs for low-achieving math students. Four 7th grade students (2 males and 2 females) are selected from a suburban middle school. Student's

selection is based on their math achievement tests, math teachers' recommendations and their wiliness to participate the study.

Math Jungle is a game-based learning system for junior high school students to practice algebra questions. The GBL includes practice and test mode. In the practice mode, students receive 15 questions. Students will read the question stem, and answer the multiple choice types of questions. Students are allowed to answer the question twice. When the students answer the questions correctly in the first time, they will receive full scores. If they fail in the second time, the correct answers will be presented. During the answering questions, students can ask for help. Two types of feedback will be provided. The first type of feedback is elaborative, conceptual prompts, the second types of feedback is step-by-step solutions to the questions. Students can decide which types of feedback they would like to receive. If they still can't resolve the problem in the second time, the step-by-step solutions will be provided. As the results, points will be taken from the total scores. In addition to text feedback, an animated animal (leopard cat) works as an agent to guide through the practice mode. The leopard cat will have different facial expression and actions depend on the correct or incorrect answers. In the test mode, no prompts or hints will be provided. Students will randomly answer 10 questions in the unit without any immediate feedback. All the feedbacks and answers will be provided at end of the test mode. A database will record the time and answers that students spend on the practice and test mode. The record will provide teachers and parents for further remedial instructions.

In this pilot test, students will practice the first degree equation as study content. Students will use the math jungle GBL in a computer lab individually. Each student will have 50 minutes to finish the practice mode. Students can take as much time as they like to practice the 15 questions. Later, students will take the test mode to assess their math achievement. After the GBL session, students will take in-depth interview to describe their understanding and reaction of the feedback design.

3. DATA ANALYSIS AND EXPECTED FINDINGS

To understand the effects of feedback design, students' answers of math questions will be analyzed. Students will be interviewed for their thinking process in the incorrect answers. Student will be required to describe their affective reaction toward the GBL as well. The interview transcripts will be analyzed qualitatively. It is expected that students are able to demonstrate the problem solving process and use of the feedback in the GBL. Game designers and students can discuss the depth and length of the short instruction provided in the GBL, and the effects of feedback designs.

REFERENCES

Corbalan, G., et al. 2010. Computer-based Feedback in Linear Algebra: Effects on Transfer Performance and motivation. *Computers & Education* Vol.55. pp.692-703

Gee, J. P. 2007. 'Games and Learning: Issues, perils and potentials' In Gee, J. P. (ed.), *Good Video Games and Good learning: Collected Essays on Video Games, Learning and Literacy*. New York: Palgrave pp. 129-174

Kapp, K. M. 2012. The Gamification of Learning and Instruction：Game-based Methods and Strategies for Training and Education. San Francisco, Calif.: Jossey-Bass

Ke, F. 2008. A Case Study of Computer Gaming for Math: Engaged Learning from Gameplay? *Computers & Education*, Vol. 51, pp. 1609–1620.

Kiili, K. 2007 Foundation for Problem-based Gaming. *British Journal of Educational Technology* Vol. 38, No. 3.394-404

Kleij, F.M. van der, et al.2012. Effects of feedback in a computer-based assessment for learning. *Computers & Education,* Vol.58 No.1 pp.263 - 272.

Prensky, M. 2001. *Digital Game-based Learning*. New York: McGraw-Hill.

Terzis, V., et al. 2012. The Effect of emotional feedback on Behavioral Intention to use Computer Based Assessment. Computers & Education Vo.59., pp.710-712

Wouters, P. et al. 2013. A Meta-analysis of the Cognitive and Motivational Effects of Serious Games. *Journal of Educational Psychology,* Vol 105 No.2 pp. 249-265.

DEVELOPMENT AND EVALUATION OF AN INFORMATION MORAL LESSON TO PROMOTE AWARENESS IN CHILDREN

Kyohei Sakai[1], Shingo Shiota[2] and Kiyotaka Eguchi[3]

[1]*Graduate School of Education, Shizuoka University, Shizuoka Prefecture, Japan*
[2]*Faculty of Education, Shizuoka University, Shizuoka Prefecture, Japan*
[3]*LINE Corporation, Tokyo, Japan*

ABSTRACT

In conventional information moral education, lessons often focus only on trouble cases and perpetrators without examining the level of awareness among the parties involved. This is especially apparent among students who communicate over the Internet. For example, one student's perspective of writing ill on the Internet might greatly differ from that of another. Such differences have only confused the Japanese youth regarding the issue. Therefore, this study developed an information moral education lesson and conducted a workshop with a group of junior high school students to promote awareness and identify any incorrect behaviors that occur while communicating over the Internet. According to the survey results, a significant difference was revealed before and after the lesson was conducted.

KEYWORDS

Information moral education, Internet communication, Awareness, LINE, Workshops

1. INTRODUCTION

According to the "2013 Fiscal Internet Environment Survey of Youth" (Published in 2014), 36.6%, 51.9%, and 97.2% of elementary, middle, and high school students possess a mobile phone in Japan, respectively. Recently, opportunities for communication via the Internet have increased among Japanese children. In particular, the communication tool called "LINE" is currently being used by many children, and such an application has made it easier to send messages to friends. However, it has also become a tool to ostracize others, which has become the source of trouble among certain Japanese youth (Takeuchi, 2014). As a result of such problems, information moral education has been practiced in various regions. For example, some IT companies have dispatched employees to schools for presenting lectures and contributing to the development of information morals among Japanese children. However, such information moral education tends to focus only on trouble cases and perpetrators without examining the level of awareness among the students, especially with regard to reviewing their own actions and differentiating between writing negative and hateful comments on the Internet. Therefore, this study aims to develop and evaluate an information moral lesson that promotes awareness among junior high school students and their communication through the Internet.

2. THEORY AND METHOD

In the development of teaching and educational materials to promote awareness among students and their communication through the Internet, two perspectives have been incorporated. First, it is important to recognize the differences between one student's ideas and that of another's. Thus, teaching how each student has different beliefs and characteristics can be an effective approach to promote awareness among students. In the workshop that was developed by the authors, one activity involved comparing various students' opinions and recognizing the differences among them by presenting them in a card format. Second, it is

important that students understand the characteristics of communicating over the Internet. For example, it is sometimes difficult to understand the other party's feelings through the use of characters, which can result in miscommunication between the sender and the recipient. Therefore, it is important to not only communicate but also to consider the other party's situation. Therefore, we have developed a workshop-type information moral lesson for a group of junior high school students (five classes totaling 155 students) in Shizuoka Prefecture, Japan.

3. RESULTS

The survey provided the students with the following three questions: 1) Have you ever harassed a friend? 2) Do you think that you wrote ill about friends? and 3) Have you ever contacted your friends late at night? As shown in Table 1, a significant difference was observed for each of the items before and after the lesson was conducted.

Table 1. Questionnaire results (average value)

Question	Before class	After class	Significant difference
Have you ever harassed a friend?	1.37	1.66	**
Do you think that you wrote ill about friends?	1.47	1.60	*
Have you ever contacted your friends late at night?	2.38	2.71	**

Based on this result, the information moral lesson that we developed for the students provided a certain level of awareness among them. However, it is important to follow up for determining whether this lesson had a long-term effect on the participants.

REFERENCES

Ministry of Education, Culture, Sports, Science and Technology, 2014; 2013 Fiscal Internet Environment Survey of Youth, *Tokyo, JAPAN.*

Kazuo TAKEUCHI, 2014. *Smartphone Children corresponding Manual. CHUOKORON-SHINSHA, Tokyo, JAPAN*

DEVELOPMENT AND DESIGN OF PROBLEM BASED LEARNING GAME-BASED COURSWARE

Chiung-Sui Chang[1], Jui-Fa Chen[1] and Fei-Ling Chen[2]
[1]Tamkang University, Taiwan
[2]Kang-Nan University, Taiwan

ABSTRACT

In an educational environment, instructors would always think of ways to provide students with motivational learning materials and efficient learning strategies. Hence, many researchers have proposed that students' problem-solving ability enhances their learning. Problem-solving ability plays an important role for users in dealing with problems that arise during their learning. In order to facilitate high quality performance, computer programmers have been trained to solve the problems they encountered. The purpose of this study is to design and develop an e-learning game-based environment integrated with problem-based learning strategies for college freshman majored in computer science.

KEYWORDS

Problem based learning, Design-based research, Game-based learning.

1. INTRODUCTION

With the advance development of information technology in recent years, more and more electronic devices, such as PC, laptop, smart phone or tablet, have been widely used by college students. Many college students like to play games on their electronic devices, and digital simulation games have been designed to be more visual, interactive and problem-solving focused (Federico & Hélène, 2011). Moreover, game-based learning (GBL) is a popular and potential learning method in e-learning. Increasingly more research issues have been identified. Similar to entertainment and serious gaming, these issues have introduced a new important marketing direction to practical technologies such as human-computer interaction, multimedia interaction, and ubiquitous computing (Lin, Kinshuk & Mark Dutchuk, 2009). Besides, GBL is attractive to students who want to learn the complex/high level knowledge via digital simulation games.

Therefore, this study is developing a problem-based leaning game based courseware as the learning material and use design-based research to evaluate the design and development of this game-courseware, which simulated the business management of an e-cafe. This study would like to integrate the principle of "usability" to determine whether this courseware corresponds to the above principle and whether it could meet the expectations of learners as an education resource (Chang & Huang, 2013).

2. RELATED WORKS

2.1 Problem Based Learning

Problem Based Learning (PBL) focuses on active learning, finding the problems, thinking ability, and the process of solving problems. For instructors, it becomes a teaching aid and builds a safe environment for students. When PBL is incorporated into a course, it helps student to construct their knowledge concepts and integrate their basic knowledge (Şendağ, & Odabaşı, 2009*)*. In fact, several courses already have PBL incorporated into the course design in school settings. One study indicates that PBL incorporated into the course design helps students focus more on the connection between real problems and subject knowledge.

Furthermore, using PBL in online courses also help students improve their critical thinking (Cheng, She, & Annetta, 2014).

2.2 Design based Research

Design-based research (DBR) is a research methodology and also known as design experiments. It is defined as "an emerging paradigm for the study of learning in content through the systematic design and study of instructional strategy and tools" (Design-Based-Research Collective, 2003, p. 5). DBR approach is an iterative cycle of multiple steps, including design exploration, interventions enactment, outcome evaluation and analysis, and redesign (Chang, & Wong, 2014; Wong, Boticki, Sun, & Looi, 2011). Based on the research (Hartson, Andre & Williges, 2003), usability evaluations in this study is tied to each phase of the DBR, the following figure 1 is the original design of pbl game-based courseware development process adopted from DBR.
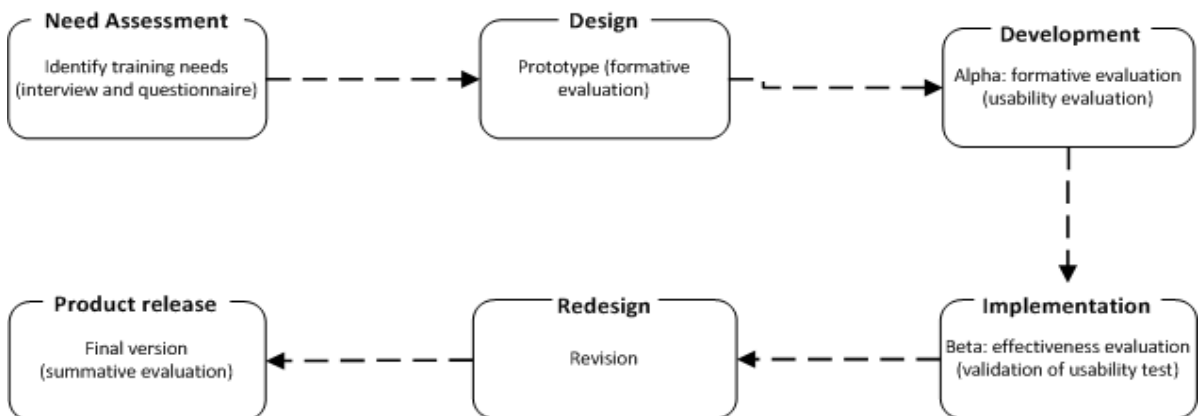
Figure 1. PBL game-based courseware development process adopted from DBR

3. CONCLUSION & FUTURE WORK

In this research, we propose a pbl game-based courseware called Programmers' Adventure, which were tested by 65 college freshman majored in computer science in an university, Taiwan. The Programmers' adventure courseware is designed for users to familiarize with knowledge of programming language. Based on the results of pilot study, students' subject knowledge about program language in application - cognitive process dimension have improved. In addition, game designers received positive feedback from students regarding the Programmers Adventure game. Finally, our research will test the usability of the Programmers Adventure game-based courseware. The results will give us several improvement suggestions in the future, and we hope to provide a well-designed game-based courseware for students to help them learn efficiently more complex/high level knowledge.

ACKNOWLEDGEMENT

218

REFERENCES

Chang, Chiung-Sui, & Huang, Ya-Ping. (2013). Usability assessment of e-café simulation game-based material. Proceedings of 7th International Conference on E-Learning, IADIS. Prague, Cz. pp. 132-136.

Cheng M. T., She H. C. & Annetta L.A. (2014) Game immersion experience: its hierarchical structure and impact on game-based science learning. Journal of Computer Assisted Learning, 1-22

The Design-Based Research & Collective. (2003). Design-based research: an emerging paradigm for educational inquiry. Educational Researcher, 32(1), 5-8.

Federico Pasin, Hélène Giroux. (2011). The impact of a simulation game on operations management education. Computers & Education, 57, 1240–1254.

Hartson, H. R., Andre, T. S. & Williges, R. C. (2003). Criteria for evaluating usability evaluation methods. International Journal of Human-Computer Interaction, 15(1), 145–181.

Şendağ, S., & Odabaşı, H. F. (2009). Effects of an online problem based learning course on content knowledge acquisition and critical thinking skills. Computers & Education, 53(1), 132-141.

Wong, L. H., Boticki, I., Sun, J., & Looi, C.K. (2011). Improving the scaffolds of a mobile-assisted Chinese character forming game via a design based research cycle. Computers in Human Behavirors, 27, 1783-1798.

AUTHOR INDEX