ICICTE 2017

International Conference on Information Communication Technologies in Education

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Conference Director: Nancy Pyrini
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The International Conference on Information Communication Technologies in Education (ICICTE 2017) Proceedings

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PREFACE TO THE PROCEEDINGS

Ġorġ Mallia
Chair, ICICTE 2017 Communications Committee

Dependence on technology in all walks of life has now got to the point where it is no longer a visible phenomenon. Technology's very invisibility in our lives means that it has integrated itself so seamlessly with the everyday workings of society, that it has become indivisible from our lifestyles.

The technological change started slowly a few decades ago, then picked up wildfire speed till it became a veritable tidal wave, inundating us with changes so fast that they passed us by without us noticing, but not without us using the fruits of those changes. Technology infiltrated our pockets and minds with smartphones. It created a network that tied us together, and that worked with speeds so fast as to render our lives a race against keeping up. We buy the new technology as soon as it comes out and fill our homes with it. And our children absorb it with the facility of natural, intuitive users. They have gone well beyond Prensky's *digital native* terminology, which is now rendered useless in the face of our students having almost symbiotically adopted technology, in the process becoming virtual cyborgs, well beyond the imaginings of science fiction writers of old. A case of reality being much stranger than fiction -- or at least very different, because there is nothing strange in all of this. We have accepted it as the normal way of all things.

These children and young people populate our schools and universities. They are the product of a society that is driven by technology. They learn on the go, independent of their instructors and the institutions that civilisation has insisted they frequent. Their learning is individual and mobile. Information is at their fingertips, and they absorb it, not necessarily discriminately. Not necessarily with all the tools at hand for synoptic recall or intellectual synthesis, but with an ease that has become automatic for them. We, the education professionals, need to understand just how fundamental the change is that has happened within the institutions (physical and virtual) where we work to provide educational facilitation to these students. We need to work with the technologies that are bread and butter to their lives (and ours) and understand how to utilise them to organise, inform, instruct and guide our students, both cognitively and affectively, in substantive and procedural ways.

That is why conferences like the International Conference on Information, Communication Technologies in Education are so important. They bring together cutting edge experimentation that acknowledges the importance of technological innovation in educational settings. They engage participants in deep, scientific discussion and create physical networks that promote the understanding of change and how that can be utilised to productive ends. Just because technology has become invisible in our lives does not mean it is not there, and that makes it doubly more important that it be studied and harnessed to move society forward in ways that are sustainable and organised.

Now in its seventeenth edition, ICICTE has proved itself in this regard, and these proceedings are a clear indication of the variety of experimentation and depth of understanding that our participants have undertaken. This collection of papers should prove to be stimulating reading for all education professionals who go beyond the curricular routine and are willing to push the envelope in favour of innovation.

On behalf of the Steering Committee, it is my great pleasure to welcome all those attending this annual conference, be they presenters, workshop leaders, or participants. I would like to say that you are now part of the ICICTE tradition. This is a "family" conference, in which the mixture of the scientific and social have proved to be a very successful base on which to build a friendship-based scholarship. It is also wonderful to be back on Rhodes, where we had very successful conference meetings in 2011, 2012 and 2016. The backdrop provided by wonderful Greek islands like Rhodes creates the atmosphere necessary for disseminating knowledge in both plenary and social settings, creating a real community spirit that is at the heart of what this conference is to all its participants past and present. This is a "Greek" conference in that sense, though the community in it is vastly international, both on the organisational and on the participant sides.

ICICTE would not be even remotely feasible without the tireless work of the Conference Director, Nancy Pyrini, who deals not only with the indispensable logistics, but also is the face of the conference to our many delegates. Nancy is both the mind and heart of ICICTE. There would not be this annual get-together of friends without her.

These *Proceedings* are the result of a synergistic process that involves the members of the Scientific Committee, ably led for many years by Dr Greg Anderson, and the editing work of Dr Linda Morris, aided by Dr Costas Tsolakidis of the University of the Aegean. The members of the Scientific Committee two-way blind review papers (though there are times when the review process goes through multiple phases), and Dr Morris scrupulously edits and formats the papers that are then produced by myself to form this assembled volume.

But there are a lot of people involved in the success story that ICICTE has become. As in past many years, this conference has been successfully organised by Southampton Solent University of the United Kingdom, represented by Dr. Chris Barlow, who chairs the Steering Committee. This is done in collaboration with the Justice Institute of British Columbia, Canada, represented by Dr Anderson. We are very happy this year to welcome new co-organisers, the South Aegean Region, Greece. And would like to also thank the Municipality of Rhodes for their wonderful hosting and kindness. We are also aided greatly by Matt Hickling, George Sarrigeorgiou, and Marie Louise Kold, among others.

We sincerely hope you find these *Proceedings* illuminating, and if they are of use to you in ways that make you use what you read here in your own professional capacity, then we have succeeded. Please do contact any of the authors with whose work you find you share an affinity and make sure that you join us in the annual sojourn of creative, innovative scholarship that is ICICTE.

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UNDERSTANDING LITERACY IN A CONNECTED WORLD: WHY TEACHING DIGITAL SKILLS IS A CRUCIAL PART OF HIGHER EDUCATION, AND HOW TO MAKE IT WORK

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As instructors in a higher education setting, we often assume that our students come to us with the basic literacies needed to navigate the world around them. But while this may have been true previously, the extremely fast pace of change in our current digital reality has meant that many students do not leave secondary school with the skills and fluencies that they will need to succeed in our connected world, where the very idea of literacy has rapidly shifted and morphed into something completely new in recent years. As such, it falls to those of us who teach these students to find ways to help students acquire these emerging literacies, while simultaneously presenting students with the content knowledge of the various subject areas in which we teach.

In this paper, we have endeavoured to provide instructors with a solid grounding of the literacies and skills that our students will need to navigate an increasingly digital culture, as well as offering suggestions for integrating these important lessons into our pedagogical practice. Thus, we begin by unpacking what is meant by the term "literacy" within the context of our digital world. We then offer some models for understanding the new and emerging literacies that we need to navigate our present reality, and we examine *why* these literacies are so key to the ability to succeed and thrive. Finally, we offer ways that we might integrate opportunities for developing these emerging literacies into university courses in authentic and meaningful ways.

Changing Understandings of Literacy

> This is the thing about literacy today, that needs above all not to be misunderstood. Both the people who say that reading/ writing have declined and that reading/writing are stronger than ever are right, and wrong. It's not a return to the word, unchanged. It's a literacy transformed by the existence of the electronic media that it initially has nothing in common with. It's also transformed by all the textual forms – mail, the newspaper, the book, the bulletin board, etc. It's not purely one thing or another. (Snarkmarket, 2009)

The concept of literacy has a fundamentally different feel than it did in a pre-Web world. What once meant simply "reading and writing" takes on a broader definition as we expand our idea of what constitutes "text."

"Traditional" literacy is typically understood as the ability to read and write. In this model, texts are defined as various forms of writing (e.g., books, chapters, articles, poetry, etc.), and to be "literate" means to be able to work with texts proficiently. In the past several decades, however, we've seen a mainstream shift in what is considered a "text" and with it, a much broader idea of "literacy." On a daily basis we now encounter traditional print texts, visual and audio texts, and a wide variety of digital texts that include video, audio, and written components. A "text" now includes anything that we "read" or interpret: books, posters, movies, songs, comics, websites, games… Because of this, we now speak of the "multiple literacies" required to interpret or decode this wide array of texts: visual literacy, physical literacy, mathematical literacy, media literacy, info literacy, just to name a few. In classrooms, theories like Gardner's (1983) multiple intelligences (which shares some of the same philosophical roots) has now led to differentiated instruction to meet the needs of learners with various learning preferences.

Even more broadly, though, we can think of literacy as competency or fluency in a particular area of knowledge. With this understanding of literacy, we can broaden our list of "types of literacies" to things like financial literacy, ecoliteracy, social or emotional literacy, and physical literacy. As well, as Belshaw (2011) points out, it's not really possible to make a binary distinction between literate and illiterate - we might be more literate (more competent) in some areas than others, but literacy is more of a continuum than an either/or state.

If we define literacy as the ability to read (or interpret) the world around us,[1] then digital literacy should not be thought of as requiring a separate set of skills. Rather, digital literacy adds a layer to traditional literacy, enabling us to read or interpret the connected reality we live. Unfortunately, many of the existing models of literacy for the 21st century (that is, those that explicitly include online spaces) separate digital literacies from their "traditional" counterparts.

In these models, digital literacies are treated as totally separate from "offline" literacies. But if it's no longer possible to separate our on- and offline worlds (as Jurgenson [2011] argues), it doesn't make much sense to separate on- and offline literacies either.

Instead we might imagine digital and traditional literacies as two overlapping sets. In many cases, digital literacies are not separate from these other literacies - rather, they simply add an additional layer to them. For instance, visual literacy might include particular skills in an offline context, but when

[1] Paulo Freire, an educator and theorist known for his work in the area of critical pedagogy, famously asserted, "Reading the world always precedes reading the word, and reading the word implies continuously reading the world" (Freire & Macedo, 1987, p. 35). While we have not focused on the critical lens here, it's important to consider Freire's argument: That our context for reading - our worldview - will always inform the way that we interpret the texts around us.

looking at an online visual text, we might need these skills *plus* some additional skills to help us interpret the digital elements of the text. Of course, there are certainly some literacies that are unique or specialized to digital (or traditional) settings, it is important to acknowledge that there is a great deal of overlap, just as the online and offline worlds are becoming increasingly enmeshed.

We'll now turn to some models of literacy that include digital and emerging literacies. Each of these models has its pros and cons, and there are many overlapping pieces, but it is helpful to look at several major models in order to get a sense of how we might understand digital literacies.

Models for Understanding Emerging Literacies

If you Google the phrase "models of literacy," you'll find no shortage of ideas. Search for "types of literacy" and you'll get an equally broad range of answers. From "traditional" to "new," "financial" to emotional," there seem to be as many different understandings of literacy (and what it includes) as there are people writing about it. Add in the term "digital" and you'll discover an entirely new set of definitions and skillsets.

Before we begin, a few things to note: first, you'll notice that these models tend to fall into one of two categories. Some outline what successful, literate learners should *be* - global citizens, designers, navigators - while others outline what these learners should *do* - collaborate with others, share artefacts with a global audience, analyze and manage information. Second, it's important to understand that this is by no means a comprehensive list of all (digital) literacy models; rather, this list provides an overview of a few frameworks that have been influential in educational circles. Finally, while we refer to them here as models of *digital* literacy, these frameworks go by a wide variety of names, including media literacy, 21st century literacy, info literacy, and computer literacy, but they share the common element of dealing with online texts.

ISTE

One of the most prominent organizations in the area of digital literacy standards is the International Society for Technology in Education (ISTE). ISTE first released standards for " Learning to use technology" in 1998. Since then, ISTE has updated their standards for students twice: once in 2007 ("Using technology to learn") and again in 2016 ("Transformative learning with technology").

The most recent ISTE (2016) student standards contain both a descriptor of what successful learners should *be* and an action statement outlining what these learners should *do.* The standards are:

- Empowered Learner: Students leverage technology to take an active role in choosing, achieving, and demonstrating competency in their learning goals, informed by the learning sciences.

- Digital Citizen: Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.
- Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaning learning experiences for themselves and others.
- Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
- Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
- Creative Communicator: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
- Global Collaborator: Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.

Key ideas in the context of this paper: the critical curation of information; the focus on creating artefacts for particular contexts; the inclusion of global collaboration

NCTE

Another well-known framework is that of the National Council for Teachers of English (NCTE). The NCTE first published a 21st Century Literacies Framework in 2008. The 2013 update includes these goals:

- Develop proficiency and fluency with the tools of technology.
- Build intentional cross-cultural connections and relationships with others so to pose and solve problems collaboratively and strengthen independent thought.
- Design and share information for global communities to meet a variety of purposes.
- Manage, analyze, and synthesize multiple streams of simultaneous information.
- Create, critique, analyze, and evaluate multimedia texts.
- Attend to the ethical responsibilities required by these complex environments. (NCTE, 2013)

Key ideas in the context of this paper: the emphasis on cross-cultural collaboration; the focus on the skills needed to deal with an abundance of information

6 Cs

The third approach that we'll look at is Michael Fullan's (2013) list of 6 Cs, first developed in 2013. These key areas, necessary for student and society well being in the 21st century, are:

- Character education: honesty, self-regulation and responsibility, perseverance, empathy for contributing to the safety and benefit of others, self-confidence, personal health and well-being, career and life skills.
- Citizenship: global knowledge, sensitivity to and respect for other cultures, active involvement in addressing issues of human and environmental sustainability.
- Communication: communicate effectively orally, in writing and with a variety of digital tools; listening skills.
- Critical thinking and problem solving: think critically to design and manage projects, solve problems, make effective decisions using a variety of digital tools and resources.
- Collaboration: work in teams, learn from and contribute to the learning of others, social networking skills, empathy in working with diverse others.
- Creativity and imagination: economic and social entrepreneurialism, considering and pursuing novel ideas, and leadership for action.

Key ideas in the context of this paper: the broader conception of literacy; the emphasis on developing networking skills and working with a variety of people

Obviously, there are elements of these models/frameworks that are targeted to K-12 students; however, many students are entering higher education without these skills - and, as we will see below, these literacies are crucial for anyone hoping to succeed in our increasingly connected reality. Thus, we would argue that the models apply equally to tertiary education settings, and so it falls on university and college instructors to teach and model these skills in their courses.

Why Teach Digital and Emerging Literacies?

Now that we know what digital and emerging literacies look like, we need to understand why they are so important. In order to understand this, we need to look more closely at the challenges of "reading" our connected world. Note that we have certainly not identified every one of the challenges that exist: rather, we have chosen to highlight a few in order to underscore the need for digital literacy development.

Challenge #1: Information Abundance

With nearly ubiquitous access to the Internet, we now have instant access to an incredible amount of information at the touch of a button. Given this information abundance, one of the most important literacies relates to the efficient and critical consumption of information. As Schwartz (2004) has noted, "Learning to choose is hard. Learning to choose well is harder. And learning to choose well in a world of unlimited possibilities is harder still, perhaps too hard" (p. 144). Traditional information literacy strategies have readers check for validity of a text (whether found online or offline) by examining details such as the source, author, accuracy, objectivity, currency, and relevance. However, when dealing with digital texts, we see a number of added layers of complexity (as in the outer "digital" ring in our first diagram above). In particular, the sheer volume of information makes it more difficult to sort through what is important.

In order to address this challenge, we need to develop our attention literacy. Simon (1971) writes:

> … in an information-rich world, the wealth of information means a dearth of something else: a scarcity of whatever it is that information consumes . . . . What information consumes is rather obvious: it consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention and a need to allocate efficiently among the overabundance of information sources that might consume it. (pp. 40-41)

Developing attention literacy involves developing the skill of focusing our attention on the relevant pieces of information. This often means learning to use particular tools and apps to curate information.

Challenge #2: The Proliferation of "Fake News"
In 1957, the British Broadcasting Corporation pulled off the fantastic spaghetti tree hoax, a short "documentary" detailing the incredibly fruitful harvest of the spaghetti tree that year in a small Italian village. Because most British people at the time were unfamiliar with the actual origins of spaghetti, they were easily convinced that the food grew on trees (My Switzerland, 2013).

The spaghetti tree hoax was possible because of the difficulty of looking up information in a pre-Web world. Today, however, we have the opposite problem: there is now such a proliferation of texts (digital and otherwise) that it becomes difficult to separate fact from fiction - especially when tools like Photoshop make it increasingly easier to create fake images. Unsurprisingly, then, another key literacy skill for our digital world is the ability to determine fact vs. fiction by reading all types of text with a critical eye. Without this skill, it is easy to fall prey to the many scams and fraudulent sites that circulate online.

Challenge #3: Communicating with a Global Audience
Thanks to the incredible connections made possible by the Internet, we now have the ears (and eyes) of a potentially global audience when we share ideas online. In many ways, the globalized, connected nature of our world is a powerful tool, as it allows us previously unfathomable access to new perspectives and voices. However, communicating and collaborating with others around the globe is a complicated task, one that requires new understandings of the idea of audience and also takes into account the concept of "context collapse," described by both Wesch (2009) and boyd (2013).

Wesch notes that in face-to-face interactions, we are able to use context clues to determine how we should present ourselves. In open digital spaces, however, these context clues are not available; rather, our work has the potential to be seen by "an infinite number of contexts collapsing upon one another [...], virtually all possible contexts" (Wesch, 2009, p. 23). This added complexity means that presenting work online is considerably different from simply submitting an assignment for the teacher's eyes.

All of this complexity has profound impacts on the skills needed to communicate with a global audience. As we saw above, emerging literacy models point to the need for young people to learn to communicate and collaborate globally, as well as to produce artefacts for a variety of audiences, in order to be successful in our connected reality. Thus, it is important for those of us in all levels of education to create opportunities for students to practice these important literacies.

Challenge #4: The Rapid Pace of Change

Another significant challenge in our digital world is the rate at which technology advances. Ray Kurzweil (2005/2012), a well-recognized futurist, explains the pace of change like this:

> In the nineteenth century, we saw more technological change than in the nine centuries preceding it. Then in the first twenty years of the twentieth century, we saw more advancement than in all of the nineteenth century. Now, paradigm shifts occur in only a few years time (p. 304).

This rapid change makes it difficult to "prepare" students for their future careers as we did in the past, because the very nature of work has changed (and continues to change) with new technologies.

For students, then, an increasingly critical digital literacy is the ability to be a self-directed, independent, lifelong learner. As careers and fields of study shift, students must be able to adapt quickly and learn new skills and information independently, essentially taking up a just-in-time model of learning. As such, it's critical that we move beyond simply teaching content and provide our students with the ability to learn *how* to learn in their field of study.

Challenge #5: Complexities of Digital Identity

A final challenge of our digital age is the complexity of building and maintaining a digital identity. Given the extent to which our on- and offline lives are now enmeshed, absence from online spaces can be a disadvantage and may even be perceived as suspicious (Hill, 2012). Marshall (2015) notes, "If you do not have a clear online presence, you are allowing Google, Yahoo, and Bing to create your identity for you"(para. 7). Thus, the development of a digital identity has become a de facto requirement for participation in today's networked world. However, as we see frequently online, digital identity is incredibly fragile and is fraught with possibilities for missteps that can easily become part of an online permanent record, particularly given the culture of documentation in which we now find ourselves.

Given these complexities, then, it is critical for those of us working with young people to help them to build positive digital identities that showcase their skills and abilities in their field of study. Not only does this provide a solid basis for the continued development of students' digital identities, but there is also evidence to suggest the online portfolios will replace traditional CVs in the years to come; thus helping students to build platforms for showcasing their work gives them a head start as they begin their careers.

Ideas for Integration of Digital Literacy Development in Course Design

Given the challenges presented here, we offer below a few assignments that have allowed us to integrate opportunities for digital literacy development within our courses. In our context, we work with pre-service teachers, and so the examples below relate primarily to this area, but these assignments could be easily adapted to most fields of study.

Building a Professional Learning Network

In the *Networked Professional Learning assignment,* students participate in networked learning environments. In practice, this means students are introduced to a number of social networking tools where they might connect to others in their field, learn how to find and curate relevant sources in order to read widely from a number of traditional (e.g., academic journals) and non-traditional sources (e.g., blogs, Twitter), and connect with others in their field (in this case, educators) who are already 'connected.' Then, students use these same tools to share and reflect on their learning, including by writing blog posts and tweeting resources they have discovered.

The ultimate goal of these interactions is to aid students in developing their professional learning networks (PLNs), with the intention that these students will graduate already part of an established group of professionals in their area of study. Moreover, in the course of this process, students also develop the skills to address the challenges described above. For instance, as students learn how to find and the sort through academic and non-academic sources, they are learning strategies to deal with the challenges of information abundance and of fake (or incorrect/biased) sources. As they blog and tweet, students also learn to connect to a global audience in a variety of ways. Perhaps more importantly, the PLNs built by students will provide them with a network of colleagues and resources that will enable their continued learning in their evolving fields.

Developing an Online Identity

The *ePortfolio assignment* is a piece of the networked professional learning assignment: here students take control of their online identity through the development of an open, online portfolio (in this case focused on their teaching experiences. Not only are students asked to take ownership of their digital presence, but they also come away with a rich portfolio that showcases their strengths and abilities; on more than one occasion, former students have credited their ePortfolios as a key factor in being hired.

This assignment can easily be integrated into almost any field of study, and it provides an important opportunity to students to build their positive digital identities as well as creating a platform for showcasing their skills and knowledge. As well, the process of building the ePortfolio is itself an opportunity for students to gain new tech literacies that can assist them in communicating with a global audience.

Learning to Learn Online

Finally, *the learning project assignment* requires that students use both online and (local) community resources to learn any skill or topic that is of deep personal interest to them. Additionally, as they learn, students are required to openly document their learning on the web in innovative and authentic ways (i.e., make their learning visible). Over the years, the assignment has resulted in our students taking on a variety of passion-based topics: playing the guitar, speaking a new language, even highly specialized skills such as tattooing and welding. This assignment is particularly powerful in that students are able to choose their own pathways for learning, taking their individual interests and passions into account.

Again, this assignment could easily be adapted to fit a variety of fields of study. More importantly, the assignment enables students to develop a variety of digital literacies. For instance, students share their learning by trying out and then using a variety of different tools, which builds tech literacy. As well, by sharing their projects online, students are able to practice communicating with audiences around the globe. Perhaps most importantly, students are given the opportunity to learn *how* to learn online, a key skill that will allow them to be self-directed, lifelong learners.

Conclusion

Our world is a rapidly changing place, and young people will need to develop previously unimaginable digital literacies and skills in order to succeed in it. While institutions of higher education have often relied on K-12 systems to teach these important skills, we will all need to find ways to integrate the development of emerging literacies into our subject areas if we want our young people to succeed.

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VIRTUAL INQUIRY: USING VIRTUAL EXPERIMENTS IN INQUIRY- BASED SCIENCE TEACHING

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Abstract
This paper aims to examine the possibility to use virtual simulations in inquiry-based primary science teaching. Virtual simulations are concluded in research to generally assist science teaching as they assist experimentation and skills. Inquiry-based teaching is considered by research as an effective approach to science teaching, since it promotes and develops skills not only about science content but also science process and nature. This research aims to investigate if simulations can be beneficial specifically in inquiry–based teaching in primary schools. Through a qualitative approach it was concluded that simulations assist skills required in inquiry teaching, but not all.

Virtual Simulations in the Science Class

Virtual experiments and computer simulations have been described to be useful in science teaching. Science teaching, according to current approaches is expected to be based in experimental laboratory, hands-on activities, which help learners understand phenomena and the applications of the new knowledge they construct. These experiments, however, are not always easy to implement in the science classroom, as they are expected to be carried out under safe conditions, planned carefully so that no interference of real world unexpected factors can emerge and affect the results. For example, even though using batteries, cables and lighting are useful to experiments, in order to learn about electricity and circuits, it is important to make sure, that no learner will be harmed from dangerous materials and that these materials will actually work. So safety and assurance of the result is required in experimental processes, if they are to assist in science teaching. Virtual experiments provide this advantage. Indeed, virtual experiments and simulations help learners work in a rather idealized computer, virtual, environment, and they can understand better the simple cause-and-effect relationship, among variables, in testing and experiments. For instance, in the simulation it is easy to see that when applying force in an ideal situation, with no friction, the object may move endlessly, which is difficult to be seen in actual world. Besides that, in the simulation it is easy to experiment with science phenomena, even nuclear reaction, with no risk (Jakkola & Nurmi, 2007).

Another major advantage that computer simulations and virtual experiments offer is the possibility to investigate phenomena and concepts that are not easy for learners to understand through their every day experience, such as phenomena and concepts relevant to topics of space and astronomy, human anatomy, air, wildlife and marine ecosystems. This way, educators and learners can broaden their opportunities for engaging in experimentation and learning in science fields of study that would be difficult to approach in a regular classroom otherwise. Relevant to this advantage, is the possibility they offer to observe and understand phenomena and concepts of the microworld. Molecules, atoms and their anatomy are not easy to understand for learners, neither is their behavior and its relationship to concepts and effect in natural phenomena. Simulations can help learners see how the flow of electrons, the electric current, runs or should run across electric circuits to let electric devices function properly. They can also help learners see how heating objects such as ice, provides energy and velocity to molecules, which then gradually leads to change in states of matter. This investigation of concepts and phenomena from a microscopic point of view is very significant in science learning and is strongly assisted by virtual experiments. In short, virtual simulations expand the opportunities of learners to get involved in discourse, observe, hypothesize, plan experiments, carry out experiments, test data, construct new knowledge and apply it, by providing possibilities to apply such skills in plenty of science topics (Jakkola & Nurmi, 2007; Zacharia, 2003).

Despite the advantages that simulations' use provides to learning, challenges exist as well. First, when working, experimenting and learning in a virtual environment, which can be oversimplified, learners do not have the opportunity to meet the authentic environment, in which scientists work, and the knowledge they may construct may differ from the one they can apply in the real world. When observing, for example, the greenhouse effect in a simulation, learners may get an idea about the outcomes, but may miss crucial information about variables, such as time needed, room temperature, light volume, which in only the real world may actually be understood and evaluated (Pinto et al., 2014; Zacharia, 2003). Apart from that, Chang, Chen, Lin, and Sung (2008), claim that the benefits of simulations are rather restricted to experimenting, but not to scientific exploration. Additionally, as Jakkola and Nurmi (2007) suggest, a teaching intervention using simulations, requires careful planning and teaching designing.

Inquiry in Science Teaching

Scientific work is highly dependent on inquiry. This is the main reason why research in science education stresses the importance of science teaching to include and, in fact, be based on inquiry. Thanks to inquiry, science teaching can be linked with authentic, real-life science phenomena, processes and challenges, which are similar to those that scientists come across in their work. By using skills, such as observation, critical thinking, group work, information searching, analysis of data, learners can construct knowledge and develop deeper understanding around science, more compatible to the scientific work and nature. This can be done with the help of approaches such as inquiry – based science teaching, instead of traditional approaches emphasizing only superficial learning concepts of various topics (NRS, 2000).

Teaching Inquiry-Based Science

According to Eastwell (2009), there are four different levels of inquiry research to be conquered by learners. The first level is confirmation research. At that level, learners are asked a question, which they would answer by using data given to them, through a pre-decided methodology, in order to reach predetermined findings. In other words, at that level, learners would confirm a theory or a set of findings, with the help of activities such as experiments. The second level is structured research. At that level, learners are also asked a question. They would use data given to them in order to reach pre-determined findings. However, they are given the flexibility to select the methodology, they would use. The third level is guided research. At that level, the learners are asked to plan by themselves the methodology and activity they would implement, in order to access the necessary data and answer the question given to them, so that they would reach results, which are not pre-determined. Finally, the ultimate and desired level is open research. At that level, learners should also point out the question they should answer to explain a phenomenon of everyday life. As soon as the question is pointed out, learners would have to plan research activity to hypothesize, gather data, implement methodology and present the answer. As learners, move from one level to a higher one, they develop deeper skills relevant to scientific inquiry and adopt more stable attitudes towards science, the nature of science and scientific process (Eastwell, 2009; Přinosilová, Mechlová, & Kubicová, 2013).

Current pedagogy stresses also the effectiveness of computer assisted science inquiry. Information and communication technologies (ICT) are justified to contribute significantly to the promotion of learning. By providing access to information and opportunities for observing, hypothesizing, gathering data, analyzing, engaging in discourse and constructing knowledge, ICT serves as a useful tool in science teaching (Sun, Looi, & Xie, 2014). Virtual simulations are an example of ICT applications, which can help learning through experimentation and inquiry process as they can accommodate all the skills and tasks that inquiry learning requires in an attractive way. Conducting inquiry-based simulation laboratory experiments, or combining hands-on laboratory experiments with the use of relevant simulations, can enhance learners' understanding of science concepts, processes and nature (Zacharia, 2003).

Involving Simulations in Inquiry-Based Science Teaching

So teaching science through a computer-assisted inquiry-based approach has plenty of benefits. It promotes and requires development of important knowledge around science concepts and phenomena, skills such as critical thinking, involvement in discourse and development of friendly attitudes towards science both as sum of information and as process. Implementation of inquiry-based science teaching requires involvement in laboratory activities, which assist the active participation of learners in the learning process and in the inquiry tasks.

Simulations can help inquiry-based science teaching. First, they provide grounds for experimentation. By using them, learners can hypothesize, gather data, test, analyze and construct knowledge. It is quite convenient that this experimentation can be easily repeated, so that more accurate data for analysis can be gathered. Second, they expand the selection of contexts for inquiry learning. Promoting inquiry learning and discourse in topics such as astronomy, anatomy and the microworld would be out of question otherwise. Third, simulations are justified through research to promote positive attitudes towards science and science processes (Zacharia, 2003). This is important, especially in the higher levels of guided and open research, where there is focus on planning and questioning (Eastwell, 2009; Přinosilová et al., 2013).

The challenges of simulation use should not be neglected though. It is still not clear if simulations can assist learners' ability to engage in discourse and investigate questions and fields of study, which are important skills in inquiry (Chang et al., 2008). There is also the risk of developing an oversimplified idea of experimentation and the applications of experiments. Moreover, there is the challenge created by the need for careful planning (Jakkola & Nurmi, 2007; Pinto et al., 2004).

Planning the Research

This research examines benefits of using simulations to effectively implement and promote inquiry-based science teaching. Having in mind the potential of simulations in that direction, a series of science teaching interventions was carried out.

The Research Context

During these sessions, the inquiry-based approach was followed and simulations were used. The context of this study was a primary school in Greece and more specifically the Science Club, where learners who share interest in science take part. The main reason for the selection of this context was the fact that teachers who are working in the clubs have the opportunity to select which approach to follow, with no restriction from any pre-designed curriculum or syllabus (Law 3966/2011).

Confirmation research. The learners of the clubs got involved in activities around science topics, such as ecology, human anatomy, states of matter, electromagnetism. There were activities addressed at the confirmation research level. During these, learners would use the simulations, in order to confirm a hypothesis. This would be done by testing values of variables, for example, how the color of subjects affects temperature. These tasks were predesigned in detail. Learners would be given instructions about what to do. All information, such as values was selected for the learners well in advance. The findings are known too. By following all the instructions and information given, learners would confirm a pre-stated hypothesis and become familiar with simulations as means for experimentation (Přinosilová et al., 2013).

Structured research. There were activities addressing structured research. During these activities, learners would use simulations to confirm hypotheses, but they would also explain their actions. They would be presented with a question and be explained how to answer it. They would be asked to evaluate the instructions given to them and explain their importance. They would have to describe why the values they would measure were appropriate to answer the question. After carrying out the instructed experiment, they would explain what and how they did. In some cases, they would be asked to identify alternatives, for example, different values that they could give in the simulations or different contexts. In short, learners would work as in the confirmation research level, but more critically (Přinosilová et al., 2013).

Guided research. There were activities addressing guided research. During these, learners would be presented with the question and hypothesize, but they would be given flexibility to plan the experiment they would execute. After selecting the simulations, learners would engage in discourse to find out what values to use. Then they would carry out the experiment and evaluate their plans. In case the initial question was not answered, learners would repeat the experiment with new values. Learners would have to justify each action decided and its' link to the starting question or hypotheses (Eastwell, 2009; Přinosilová et al., 2013).

Open research. There were activities that addressed open research. During these, learners would be given stimulations to plan investigations, by observing or discussing a phenomenon. Learners would identify what exactly they would investigate and what question to ask. Afterwards they would plan the experimentation, with the selection of the suitable simulation from those known, used or seen before. In some cases, it was also done, by explaining and deciding what this simulation could be like and by searching simulation sites online to find an appropriate one. Precision of variables would follow, along with carrying out the experiment and evaluating the process (Eastwell, 2009; Přinosilová et al., 2013).

Through these sets of activities, the basic features of inquiry-based learning would be promoted. Initially, there would be emphasis on carrying out experiments, analyzing data and making conclusions in confirmation research tasks. Then there would be emphasis on searching for information, sharing and communicating findings in structured research tasks. There would be emphasis on designing and carrying out investigations in guided research tasks. Finally, in open research tasks there would be emphasis in deciding and asking questions, along with creating artifacts (NRC, 2000). By paying attention to these features with the help of simulations, learners would develop knowledge constructing, skills and positive attitudes towards science process, which is expected and promoted by science learning through inquiry (Zacharia, 2003). At the same time, there will be benchmarking with challenges that may arise due to oversimplification or demanding planning required (Jakkola & Nurmi, 2007) or lack of promotion of discourse and investigation skills (Chang et al., 2008).

Forming the Research Questions

Implementation of inquiry-based science learning is known to have many advantages in science teaching, as it promotes more profound learning about science content knowledge, skills, processes and attitudes through active engagement of learners in science real-life topics. It evolves across four levels: confirmation research, structured research, guided research, open research (Eastwell, 2009; Přinosilová et al., 2013). Simulations are justified to assist science learning, as they are an attractive application that can help carrying out experimentation in many ways, as well as data analysis, science discourse, problem-solving and knowledge construction, which are important elements of inquiry-based science learning (Zacharia, 2003).

The research was planned to evaluate the assistance of simulations in inquiry-based science learning. Bearing in mind the levels of inquiry based teaching, to accomplish this evaluation the following research questions should be answered:

1. Did the use of simulations assist in confirmation of theories?
2. Did the use of simulations assist in evaluation of experimentation?
3. Did the use of simulations help in planning research projects?
4. Did the use of simulations help in identifying questions and topics of research?

Methodology

This research is of qualitative nature. The topic of this research is to evaluate if the use of simulations assists inquiry-based science teaching. The selection of the appropriate methodology for this evaluation has to take into consideration two different dimensions. The first is the evaluation of the inquiry-based learning. The other is evaluation of simulations used in each experiment (Cohen, Manion, & Morrison, 2011).

Evaluation of inquiry-based learning can be based on both formative and summative assessment. The former is done throughout the course. While learners are working on inquiry-based tasks, they demonstrate their knowledge, skills and attitudes about science processes and inquiry. Learners can present their ideas about using simulations. It is possible this way to prove if they can use them effectively and understand their importance in experimenting, engaging in discourse and learning science. By observing or interviewing them, it is possible to get data about their progress, give feedback and conclude about learners' achievement. The latter is done probably by the end of the course or periods of the course. It includes methods such as revision tests and note-portfolio. Revisionary tests provide important data, however they can be distorting unless planned at appropriate time and way. Moreover, since inquiry refers to processes, it is not easy to identify the kind of tests that can examine accurately inquiry features in learners. On the other hand, a portfolio of notes about learners' work, completed gradually throughout the course shows important information about learners' performance and use of simulations in inquiry tasks. A combination of interviews with learners, observations of the tasks and analysis of learners' portfolio of notes, includes both formative and summative assessment approaches and can give accurate data about the way learner, approach, treat and use simulations to carry out inquiry investigations (Harlen, 2013; Worth, Duque, & Saltiel, 2009).

Evaluation of ICT applications, such as simulations, in education should be based on the appropriate selection and use of relevant indicators. For this research these indicators should emphasize the output of teaching, which refers to learners' knowledge, skills, attitudes and confidence in using and understanding the necessity of simulations. In this case as well, the most appropriate information can come from continuous interviews with learners, observations of the way they use simulations and from self-reports, which can be included in a portfolio of notes (Wagner et al., 2005).

In short, the most appropriate methodology for this research includes interviews, observations and notes. So, an interview and observation guide was formed. The interviews and observations were transcribed and analyzed. Afterwards they were coded, in other words they were given labels, relevant to points of the research questions. The codes were grouped to nodes (Cohen et al., 2011).

To answer the first question, there was emphasis on hypothesizing, analyzing data and drawing conclusions with the help of simulations, such as "What are you going to do now?" "What do you think will happen?" "Which data will you use?" "What does the result mean?" "Did you expect that?" The codes that were used for this research questions, under the node CONFIRMATION, were *hypothesis, analysis, concluding*, and *data explanation*.

To answer the second question, there was emphasis on using simulations for explaining and evaluating the instructions, describing the process, proposing alternatives, such as "What does this step mean?" "Why do you think this is necessary?" "Does this help us find what we are looking for?" "Do you think this can be done in another way?" The codes used for this research question, under the node EXPLANATION, were *description, evaluation, alternative*, and *necessity.*

To answer the third research question, there was emphasis in using or selecting simulations, planning the research project, analyzing the initial question, identifying variables, such as "What does our question have to do with?" "What topics [concepts] we are working with here?" "What simulation should we use?" "What number [value] should we use here?", "Do we answer our question like that?" The codes used for this question, under the node PLANNING, were *simulation selection, variables, value identification, question understanding, planning,* and *evaluating.*

To answer the fourth research question, there was emphasis on using or selecting simulations for identifying question, evaluating question, clarifying the relevant topics, evaluating their plan in coordination with the initial question as set by the learners, applying their findings, such as "What do you observe here?" "What does the simulation show?" "Can we explain that?" "What can we do to explain that?" "Will the simulation help?" "So what do you think you have learnt from that?" "Do you think the initial observation was now explained?" The codes used for this question, under the node TOPIC IDENTIFYING, were *questioning, explaining questions*, *clarifying topics*, and, *simulation using.*

The codes reflected the basic skills and characteristics of inquiry-based learning and simulation use and the nodes reflected groups of them (Eastwell, 2009; Přinosilová et al., 2013; Zacharia, 2003). By identifying the nodes in the interviews, observations and notes, it was possible to conclude whether these characteristics are developed appropriately or if the challenges mentioned in literature, actually arose (Chang et al., 2008; Jakkola & Nurmi, 2007; Pinto et al., 2014)

Findings

The findings, as shown from interviews, observation and learners notes, were generally positive. It was shown that using simulations helped, at least to an extent, the promotion of inquiry-based learning in science.

1st Research Question

With regards to the first research question, learners showed that they were able to use simulations to confirm theories. All learners were observed to conduct the experiment and follow the instructions given to them with ease. They were able to use the data and explain their findings, after carrying out the relevant analysis and construct new knowledge as expected. These findings are compatible with those of relevant research projects stating that generally simulations and virtual experiments can promote skills relevant to justifying theories (Zacharia, 2003). In fact, they kept asking with apparent enthusiasm "Are we going to use the simulation?" demonstrating that indeed simulations are attractive means for learners (Jakkola & Nurmi, 2007). There is only one side of the findings, which is not so positive. There were learners that omitted hypothesis as part of the experiment. During interviews, when asked about hypothesizing, many learners gave responses such as "We need to do the experiment before knowing what happened," showing that they do not attribute to hypothesis the appropriate importance, which is crucial for inquiry learning and scientific work (Eastwell, 2009). This negligence might be attributed to inappropriate design (Pinto et al., 2014). It can be concluded, therefore, that the level of confirmation research has been well conquered with the help of simulations, as most relevant skills such as experimenting, analyzing data were developed (Harlen, 2013; NRC, 2000; Worth et al., 2009).

2nd Research Question

With regards to the second research question, it can be stated that participants (learners) did become familiar with evaluating experimental tasks and instructions given to them, as required in structured research. Firstly, all learners were able to describe the instructions given to them and explain their importance in relation to the initial question set to them. Secondly, there was also apparent familiarization of learners in disseminating, communicating and explaining the results of their experiments. Thirdly, learners realized the assistance of simulations in such tasks, as it was seen by responses such as "We can see what molecules do, when we heat the water in the computer… but we cannot see it with the eye."

The data indicates support in using simulations to help learners develop skills of critical thinking towards experimentation (Zacharia, 2003; Worth et al., 2009). The only concerning point is that learners had difficulty in giving alternatives whenever they were asked. In fact, the only kind of alternative they could provide was at the level of giving different values to variables. It was difficult for learners to suggest other activities from other contexts. This might be attributed to the oversimplification that simulations are known to provide, which was seen as easy and convenient for learners and understand and explain and does not let them link phenomena with real-life situations

(Pinto et al., 2014). Overall, however, it is indicated that learners benefit from the use of simulations in carrying out experiments and explaining, justifying their actions towards answering the initial question (Harlen, 2013; NRC, 2000; Worth et al., 2009).

3rd Research Question

With regards the third research question, the findings were partly encouraging. Some skills of planning research were found to be sufficiently developed; however, others not. On one hand, most learners showed that they were able to analyze the question as set to them to understand the variables used in the experiment. This also helped them identify appropriate simulations that they could use in order to answer the question. This is compatible to the research finding that simulations can be helpful in terms of providing grounds for discourse (Jakkora & Nurmi, 2007), which is essential part of inquiry-based science learning (Eastwell, 2009; Harlen, 2013). On the other hand, learners demonstrated difficulty in describing what they would do with the simulation and the variables, which created challenges in identifying values for the experiment. When learners were asked in interviews how they were going to use the simulation, the answers given were sometimes too broad, or answers such as “We are going to play with that,” demonstrating that learners would treat the simulation more as means for amusement than as a learning tool. Such responses demonstrated that learners did not have the appropriate understanding that the simulation may be in fact referring to authentic real-life situations where scientific phenomena are applied (Chang et al., 2008; Pinto et al., 2014). In short, data suggests that with the use of simulations learners managed to develop some skills linked to guided research, such as analyzing questions and identifying experimental tasks. However, the planning process remained challenging for most of them (Harlen, 2013; NRC, 2000; Worth et al., 2009).

4th Research Question

With regards to the fourth research question, findings indicate that learners were challenged to identify questions and fields of investigation. On one hand, when they were observing the phenomena on the simulation, they had ease in linking it with the concepts of science, which are relevant. When investigating the greenhouse effect, they immediately linked it to concepts such as *light*, *energy*, *temperature*, *transparent material*. They were also able to note precise relationships between these concepts and use simulations to demonstrate them, for example, “Too much light means higher temperature.” Such skills are necessary for the implementation of inquiry-based learning (Harlen, 2013), and the use of simulations favors it, as also seen from research (Zacharia, 2003). On the other hand, learners had some difficulty in identifying the question (hypothesis) that they should form and the experiment they would carry out to answer it. The precise understanding of concepts seemed to be done rather fragmentary. When it was needed to combine concepts in order to form the problem to investigate, there was little response. When in interviews they encouraged to combine them, most learners would simply repeat the same concepts and fragmented links. In some cases they would give repetitive answers such as “We can see it in the simulation.” These do not show deep understanding of the concepts. This is not so positive for the promotion of inquiry learning (Eastwell, 2009; Harlen, 2013). This challenge might be attributed to the stated disability of simulations to promote investigation skills of learners (Chang et al., 2008).

Conclusions

This research aimed to identify the possibility to use virtual simulations in inquiry-based science teaching. Virtual simulations are known by research to assist knowledge construction, experimentation, skill and attitude development (Zacharia, 2003). Inquiry-based learning is justified to assist profound understanding of science, not only as sum of information, but also as process (Eastwell, 2009; Harlen, 2013). A combination of these two approaches could be beneficial, since research has identified that some (but not all) simulations assist particular skills required in inquiry (Chang et al., 2008; Jakkola & Nurmi, 2007). A study was carried out to verify that. The research was qualitative with data collected using interviews, observations and learners' notes (Cohen et al., 2011).

Learners were involved in focused activities using simulations on tasks and skills relevant to inquiry: to confirm a theory, to experiment critically, to plan a research, to form questions (Eastwell, 2009). The findings showed that learners used effectively the simulations to confirm a theory and experiment critically. However, there were challenges in research planning and question forming. The main conclusion was that simulations can assist inquiry-based learning in primary school science. Probably though there is need for more careful design and concern about the development of several skills mainly those linked to science discourse (Chang et al., 2008).

It is acknowledged that this research, which examined a particular group of learners involved in inquiry-based learning with the help of simulations, in a particular period of time limits generalizing the findings (Cohen et al., 2011).

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USING ICT TO DEVELOP UNIVERSALLY DESIGNED EDUCATIONAL MATERIALS FOR STUDENTS WITH DISABILITIES

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Abstract

The Institute of Educational Policy, seeking to realise inclusive policies and practices planned the project: "Design and Development of Universally Accessible Educational Material." Its objectives are the development of universally designed digital educational materials for nursery and primary school students with disabilities or special educational needs. The project focuses on developing new open source digital educational material and software for special education in Greece, adopting and using the popular platform OpenEdX of asynchronous e-learning that allows the organization of Massive Open Online Courses (MOOCs), aimed at distance learning and training of the teachers of general and special education

Keywords: ICT, Universal Design For Learning, accessibility, disabilities

Introduction

This paper intends to present a significant education project whose results are to be delivered to the educational community in Greece concerned with the design and development of digital educational material for teaching students with disabilities. In seeking to realise inclusive policies and practices, (UNESCO, 2006), the Institute of Educational Policy, has organized the following project: "Design and Development of Universal Accessible Educational Material," whose deployment is still in progress. The project objectives are the development of universally designed print and digital educational material for primary schools (nursery schools and from the third grade to the sixth grade of primary school) for all students with disability or special educational needs. Students of the Special Education School Units (SMEAE) and the Special Vocational Education and Training Workshops (EEEEK) of Secondary Education can also use this specific material. Through this material, students with disabilities can access the National Curriculum and maximize their participation in school. This way, equal rights to education for students with disabilities are ensured.

The project is a continuation of the action "Design and development of accessible educational and visual material for students with disabilities" (http://www.prosvasimo.gr/el/) where all school textbooks for the subjects of the first and second grade of primary school were adapted to become accessible to students with disabilities (Kourbetis, 2016). These materials concern the education of students with: (a) visual impairments (blind and amblyopic students, (b) hearing problems (deaf and hard of hearing students), (c) mobility problems, (d) intellectual disability, (e) autism spectrum disorder,

(f) special learning difficulties, and (g) problems of attention and concentration.

This particular project focuses on a) the development of new digital educational material, b) the recording of the existing educational material and software for special education and c) the creation and use of the asynchronous e-learning popular platform, OpenEdX.

The developing education materials can be also used by students with general educational difficulties or by students of the general school and will be developed in print and digital form. These education materials will be widely available to teachers, parents and students. All the material and information concerning the project and its progress are available on http://www.prosvasimo.gr.

Since this material will become a supportive tool for the education process, it is imperative that the publicity of the project should be a priority in order to keep teachers and everyone involved in the educational process informed.

Theoretical Framework

The project design and development are based on the principles of Universal Design for Learning (UDL) and on the fact that ICT has become a major means for the education of students with disabilities. In parallel, the general and educational characteristics of students with all kinds of disabilities should be considered.

Basic Principles of the Universal Design for Learning

Universal design means that all educational contexts (natural, social and educational) are designed in such a way that empower all learners, irrespective of specificity and identity, to become able to participate as much as they can in the education and learning process (Izzo & Bauer, 2015). The design presupposes and concerns overcoming obstacles inside the artificial environments (the resources infrastructure), the curriculum, the educational material and the teaching methods. UDL was created in order to allow students with disability to access the curriculum. Universal design is related to introducing into the teaching process inclusive elements during the stage of planning and not adapting already existing conditions. It draws on the following basic principles: (a) multiple ways of representation as there does not exist a single way for everyone to understand and interpret information, (b) multiple ways of expression as students react to learning stimuli differently, and (c) multiple ways of involvement as students are motivated or involved in learning in different ways. The term *universal* recognises the fact that every student is unique and so there is the need to include all specificities while designing the learning process by creating opportunities for participation (Rose & Meyer, 2002).

According to CAST (2011) the guidelines and principles of design that developing digital educational materials abide by, are:

- *In relation to the multiple means of representation:* (a) the provision of alternative choices in order to facilitate perception, such as the presentation of varied pieces of information (audio, visual information concerning language, mathematical expressions and symbols, etc.), (b) the clarification of vocabulary, symbols, syntax and structure, and the support in order to decode texts, mathematical expressions and symbols, etc., and (c) the provision of alternative choices to assist comprehension, such as the activation-supply of a cognitive background, the highlight of patterns, important notions and relations, the guidance so as to process information, the visualization and handling, the maximization of transferring and the generalization of learning.

- *In relation to the provision of multiple means of action and expression:* **(**a) providing alternative choices for physical action, varied methods of responding and navigating in addition to maximizing access to tools and supportive technology, (b) the provision of alternative choices for expression and communication such as the use of multiple means of communication and tools in order to structure and compose learning, and the provision of graded support for practical training and performance, and (c) the provision of alternative choices to activate executive functions, such as guidance, support for the development of strategies and the handling of information and sources, and also the ability to monitor progress.
- *In relation to the provision of multiple means of involvement:* **(**a) the provision of alternative ways to attract attention, to develop opportunities for personal choices and autonomy, to eliminate threats and distractions, (b) the provision of alternative choices so as to assist student effort, such as the promotion of the importance of goals, the provision of multiple challenging sources, the strengthening of collaboration and feedback, and (c) the provision of alternative choices for self-regulation, such as the promotion of expectations and concepts that enhance encouragement, the facilitation of personal skills and strategies to deal with difficulties, the development of self-evaluation and reflection.

The Contribution of ICT to the Education of Students with Disabilities

The dynamic relationship between universal design and ICT comprises a powerful means towards inclusive education as technology supports accessibility and differentiation of context, materials and the educational environments (Smith & Throne, 2007; UNESCO, 2011). Within the context of new literacies (multimodality, multiliteracies), ICT present an alternative view of literacy, teaching and evaluation, and by being multimodal, they assist communication, the exchange of information in multiple ways, language development, knowledge, thinking, and the acquisition and enhancement of various skills. In addition, they encourage dialogue, reasoning, and the expression of questions, while also strongly promoting oral communication, social networking and collaboration. The use of ICT can enable increased student participation and motivation in different ways to create interest for children, who for various reasons do not participate in the traditional educational process. As long as the new technologies are critically handled under the guidance of teachers, especially in the case of very young children, these new kinds of literacies can allow the students to have many choices to broaden their cognitive horizon. Scientific studies render technology the role of *literacy server.* The contribution of ICT is multiple as it supports students, teachers and generally everyone involved in the educational process (Istenic

Starcic & Bagon, 2014; Passey, 2013**;** Smith & Throne, 2007; UNESCO, 2011). In the case of students with disabilities or special educational needs, the utilization of ICT can often be the only solution for them to access knowledge, information, the General Curriculum and the learning process (UNESCO, 2006). Despite the contribution of ICT in promoting inclusive education, its improper use may lead to a further widening of social inequalities and the creation of a 'gap,' if not all students, without any discrimination, properly utilize ICT.

Methodology

The project has followed the principles of universal design for learning not only for the initial design of educational material, such as the 5th grade Mathematics of Primary School, the Social History, etc., but also for adapting the existing educational material of general education, such as the textbooks.

A mixed-method approach has been employed because of the nature and magnitude of the project. It exploits elements of qualitative and quantitative methodology (Creswell, 2012). In addition, it utilizes elements of the emancipatory research as it involves disabled students in the development and evaluation of material (Barton, 2005). The content of the materials resulted from day-to-day educational actions after its pilot implementation in the classroom by its initiators. In order to choose the best material, expert teachers recommended samples of educational material where the best was chosen in accordance to measurable and objective evaluation criteria. Elements from the methodology of "Design and development of accessible educational material" (Kourbetis, 2016; Gelastopoulou & Kourbetis, 2014) are used, while at the same time additional new features are introduced according to the needs of the project, such as the revision of the specifications applied to the previous project, the exploitation of new methods and approaches for the development of the material (social histories, etc.). A specialist group of scientists-consultants was put together to provide scientific and pedagogical validation, while experience gained by the already existing and accessible educational material was employed to develop new resources. The specific software, and the digital educational material for all students will be compatible with the platform of the Digital School (The Greek online repository for educational materials & learning designs, http://dschool.edu.gr/p61cti/) and open for upgrading. What is also expected within the context of the project is the pilot implementation of the material, the provision of training for its use and its evaluation from expert consultants.

Project Description

This particular project, comprising universally designed digital and print educational material, not only caters for the development of supportive technologies for the education of students with disabilities, but also for the training/education of the teachers and others involved in the educational and learning process. What follows is a brief description of the basic pathways of the project: (a) New universally designed educational material **and (**b) Adapted education material for the general school.

New Universally Designed Educational Material
These materials (adapted, digital textbooks, teachers' guides, resources for cognitive, emotional, social and life skills development) concern students with disabilities and special educational needs of the third and sixth grades of the primary School, and students of the EEEEK, while, for the first time, it provides the development of accessible material for the nursery school. A brief description of the materials follows. Depending on the disability involved, the materials will be developed in alternative, multimodal modes. Indicatively, the modes concerned are audio (performed by a human speaker), visual, tactile, braille code, simplified text, etc., a sample of which is illustrated in Figure 1.

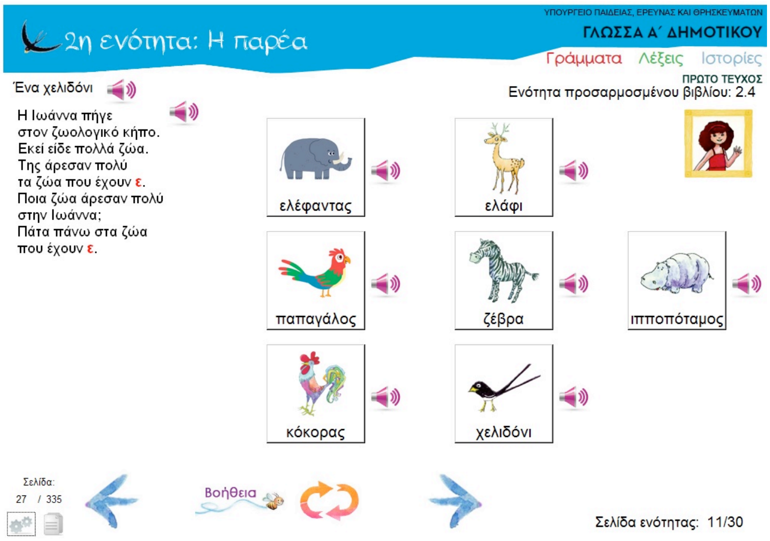

Figure 1. Multimodal sample (audio, visual and simplified text).

Educational material aiming at sensitizing all stakeholders involved in matters related to the acceptance of disability and diversity and also for the development of inclusive culture in schools. The stereotypical and deeply rooted views and prejudices that concern matters of accepting diversity and how disability is perceived, as well as the long established traditional teaching practices used by teachers together with the lack of appropriate training constitute a basic hindrance in the implementation of inclusion and the realization of the UN International Convention for the Rights of People with Disabilities (2007).

Overcoming prejudice, changing attitudes, sensitizing everyone involved in inclusive education towards a development of inclusive culture constitutes doubtlessly a vital necessity for the creation of "One" school for all students. The developing material (used inside the classrooms and everywhere else at school) will concern teachers, students, parents and society at large. The pursued objective will be reached through (a) fairy tales, stories or other literary texts concerning diversity and disability in the afore-mentioned modes, (b) the arts and experiential activities, and (c) music-mobility activities aimed at the sensitization and acceptance of diversity.

Educational material for the development of social, emotional skills and skills related to everyday life and autonomous living in the form of social stories. This material (to be developed in all the afore-mentioned modes) is related to personal and social development and the understanding of social conditions, and to the management of dangers and crises for the safety and health of students with disability. The social stories constitute a contemporary approach for the teaching of social attitudes in order to facilitate children to adopt the appropriate attitudes, behaviour, and social skills, and as such to manage social interaction and create relations with their peers or other people and so integrate in the social context (Gray, 2010).

Illustrated conceptual dictionary for students with disability and comprehension problems for the teaching of core concepts and themes that are taught at the Nursery and Primary General School. The development of educational material in the form of an illustrated conceptual dictionary, having an alternative and multimodal character supports the understanding of basic notions, the teaching of thematic units and the development of vocabulary, values, attitudes and knowledge of students with disability. It consists of a printed and digital material for personal and social development in the Sciences, ICT, Mathematics, the Environment, History, and Physical Education as well as in Language and the Arts. The content of the dictionary and its vocabulary, besides adopting an appropriate pedagogical structure, will be accompanied by images, sounds recorded by a native speaker, video animation corresponding to the theme and the relevant vocabulary when needed, video in the Greek sign language, a presentation with the use of large size letters and Braille.

An educational guide for students with Autism Spectrum Disorder (ASD): Appropriate practices for their school inclusion. It is a digital educational material, currently under development, that concerns appropriate practices (alternative modes of communication such as pictograms, images, sketches) for the education of students with ASD and case studies of primary school students with ASD. An early sample is illustrated below (Figure 2).

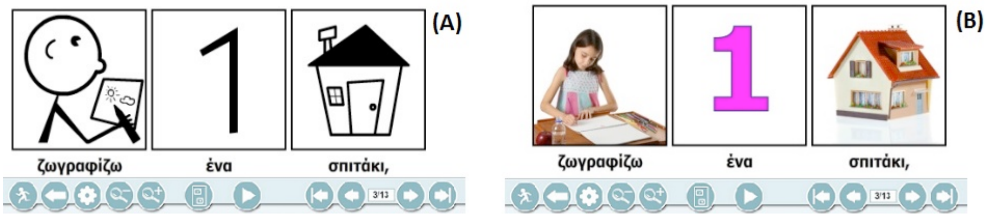

Figure 2. Alternative modes of communication (pictograms and images).

Printed and digital material of educational interventions for students with Attention-Deficit/Hyperactivity Disorder (ADHD): Teacher's guide for ADHD students' school inclusion. It concerns digital educational material (currently under development) that refers to suitable educational guidelines for students with attention and concentration deficit and to case studies of relevant primary school students.

Accessible material for students with mobility problems. It concerns multimodal applications of educational material in the afore-mentioned modes. It includes various kinds of activities for the 3rd to the 6th grade of primary school, currently under development, such as self-care, emotions, traffic education, sequencing time, observation skills – concentration-attention focus, visual perception, cause – effect, social life and exploring the environment.

Art educational material for primary school students with disability. These include multimodal art activities and visual exercises, individual or group projects (currently under development) that can creatively link various educational sectors and concern all the visual and applied arts, such as painting, sculpture, etching, ceramics, plaster arts, animation, origami, etc. Students with disabilities will approach the curriculum aims and objectives through these arts.

Universally designed digital education resources for Mathematics for the 5th grade primary school students of general and special education. The book will be available in the following formats: plain text, rich text format, accessible mark-up-XML, DAISY, audio support, Braille-ready text, Braille raised text, large-print-ready, large-print books, tactile (raised) shapes, and videos with subtitles in the Greek Sign Language.

Digital education materials for students with visual impairment. The knowledge and use of the Braille code by visually impaired people is a decisive factor for the development of basic and functional literacy, which will allow them to acquire a comprehensive school education and have equal opportunities for participating in lifelong learning and education. It is an educational material concerning the curriculum of teaching blind students Braille reading and writing and exposing them to Mobility Education, Orientation and Daily Living Skills (see Figure 3).

Figure 3. Initial text (A) and adapted in audio and Braille code (B).

Material for the tactile sign communication for blind students with multiple disabilities and deaf-blindness. This is the first time that tactile sign communication material has been under development in Greece. It is a dictionary of tactile sign language and an evaluative list of communicative vocabulary. The structure of the book includes: grouping concepts in units that will be printed in different volumes, depicting each notion with a tactile sketch and the meaning in tactile form, writing down every notion in both sighted people writing and Braille writing, and offering instructions of how to express every tactile meaning. At the same time, the total number of notions and tactile concepts will be also available in electronic from (videos), while guidelines for the teachers and parents will be included.

Digital education material for students of the 3rd and 4th primary school classes with hearing impairment for the teaching of the Greek Sign language as a first language. It concerns the creation of multimedia eBooks for all school subjects in addition to digital and printed textbooks for the teaching of the Greek Sign language as a first language to the 3rd and 4th classes of primary school.

Adapted General School Education Material for Students With Disabilities

In this category the existing school textbooks will be adapted in order to be accessible to students with disabilities. More specifically the following will be developed.

Accessible digitalised and printed material (easy to read texts for all students) from the textbooks (3rd and 4th primary school) – enriched, adapted and modified (simple text structure, simple vocabulary, visualized text, avoiding abstract notions etc.) according to each case. The adaptations follow the principles of the method easy to read (ECIE, 2009) for the reading comprehension of students with intellectual disability or reading difficulties. This method is illustrated in Figure 4.

Figure 4. Simple text structure, simple vocabulary, visualized and audio text.

Accessible digitalised material for all subjects of the 3rd and 4th grades of the primary school with the use of the Greek Sign language. All the textbooks of these two classes will be adapted and delivered in the Greek Sign Language by sign language native speakers through video as shown in Figure 4.

Accessible audio material recorded in natural speech for all subjects for the 3rd and 4th grades of the primary school. This material will support the education of students with special and general learning difficulties and disabilities, and also students who according to their learning profile receive and understand information easier through auditory learning (Gardner, 1999).

The open source platform of asynchronous e-learning OpenEdX. The creation and use of the popular platform of asynchronous e-learning OpenEdX allows the organisation of massive open online courses (MOOCs) aiming at developing distance learning and training for the general and special education teachers in order to assist them with their professional enhancement. Distance learning is defined as the education process where a substantial part of the learning process occurs from a distance, and as such it is quite flexible and happens in areas that are not traditionally connected with formal education. Therefore, it is an educational process that depends on education material that can be accessible anytime and anywhere. The project provides tuition through a MOOC course that offers video seminars, quizzes and regular assignments.

This platform has been written in Python with Django as the web application framework and it uses many tools of the latest technology such as Ansible, Vagrant in order to facilitate the development and its installation on a large number of machinery. OpenEdx was developed by the non-profit organisation edX, founded by the universities of MIT and Harvard, and it is the platform behind the popular service https://www.edx.org. The OpenEdX is an Open Source Software (OSS) and is available with a double license AGPL and Apache. Yet a platform with the technology, which covers the functionality need and aesthetic form of OpenEdX, sets by itself high demands of education quality from the course subjects it hosts.

Conclusions

The contribution of ICT in defining inclusive practices and ensuring accessibility is indisputable. Taking for granted the rapid growth of technology, the school ought to create the necessary conditions that will allow every student to understand the role of new technologies, use them, exploit them as much as possible and have access to them. The use of the above-mentioned digitalised material creates opportunities to widen the use of information and communication technologies and familiarises students with them. Furthermore, it provides teachers with training activities on the suitable use of technology in the classroom and promotes accessibility and inclusive education.

The effectiveness and sustainability of the project is associated with the fact that it contributes to all stakeholders involved in the learning process of students with disabilities (students, parents, teachers and others), with its durability and with the possibility to upgrade it. Moreover, it has a major contribution to the realisation of the international convention of the UN for the rights of people with disabilities and to the promotion of the principles of inclusive education.

Note: The project “Design and Development of Universal Accessible Educational Material” under the code (MIS) 5001313 is implemented within the context of the Operational Programme Education and Lifelong Learning (ESPA 2014-2020) and is co-funded by the European Union (European Social Fund – ESF) and national resources.

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A MULTIDIMENSIONAL ICT- MEDIATED PROJECT ON TEACHER TRAINING AND ENVIRONMENTAL SUSTAINABILITY IN EXPERIMENTAL SCHOOLS IN GREECE

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Abstract

This paper presents a 4-year project, including an online teacher-training course, the creation of school-gardens across Greece, publications and the application of ICT tools in teaching for sustainability. The project aims at bringing together the physical and the digital world in educational settings and making learning fascinating via online courses and communities, ICT tools, augmented-reality and hands-on environmental awareness projects at schools as well as printed and e-publications. It is embraced by its participants, teachers and pupils, and has received merit on a EU Teachers' Contest. Currently, the 5th stage of the project is piloted and will be implemented soon.

Introduction

Current high-tech knowledge-based society has made lifelong learning a prerequisite of the contemporary global market. Similarly, new technologies have infiltrated all aspects of human activity, including education, thus setting new paradigms. Teachers need lifelong training to remain up-to-date, avoid professional downgrading and develop their social skills (Gkountouma, 2014). Also, they need to combine the physical and the digital world creatively to make teaching attractive for their students. Along with these challenges, they need to work with United Nations' Sustainable Development Goals 2030 and participate in a global call for environmental awareness and sustainability.

In Greece, teachers' training is mostly initiated by them and can be accessed via attending courses provided by private institutions or universities at a cost, Massive Open Online Courses (MOOCs) and trainings organized by the Greek Ministry of Education. The latter teacher-trainings are not systematic; they lack continuity and organized planning, whilst the places available are limited, and the topics are often repetitive or non-representative of the teachers' needs. As to teacher-trainings on Information Communication Technologies (ICT), though an extended public program has been implemented, seat availability is limited, the content often becomes obsolete, and, due to funding restrictions, official certification is not always available.

Environmental Education Centres (EEC) are the main public teacher-training providers on environmental awareness topics, but their work is also segmental due to budget restrictions and staff cuts whilst other limitations such as red tape and rigid policy adherence do not allow massive teacher-trainings. In addition, though there is a wide variety of ICT tools employed in Environmental Education (EE) projects at schools, EECs greatly oppose the use of ICT on environmental projects, and, also, there is a lack of systematic research on the way ICT is used and contributes to raising environmental awareness (Fauville, Lantz-Andersson, & Säljö, 2014).

In this context, the project presented in this paper was designed and implemented. It is a multidimensional 4-year project, currently piloting its 5th stage. In detail, it started with a facilitated-led e-learning teacher-training course on EE and school gardening, addressed towards educators in Experimental Schools around Greece. In its 2nd stage, participants created school-gardens all over the country, monitored their progress and outcomes and self-evaluated how they implemented what they had learned in the course. Materials of this stage were uploaded on an online community of practice, where participants shared their experiences, ideas and tips. On the next 2 stages, the course's facilitators published a *Handbook on School Gardens: A Distance Teacher Training Course* (2015) whilst the participants are currently preparing for publication an *Activity Book: A Guide to School Gardening* (2017). Soon, the project will enter its final stage, which involves an augmented reality application on outdoor environmental activities, thus making a full circle of the goals set for this project: teacher-training, bridging the gap between the digital and the physical world, raising environmental awareness and making learning fun.

Literature Review

During the design and analysis of the project, consideration had to be taken into account as to what the project can add to the existing literature and what can it really offer to all stakeholders. Thus, besides an initial call of interest and a needs analysis of the teachers willing to participate in the project, there was a literature review that helped towards understanding the needs of the stakeholders, defining the goals of the project and selecting the tools used.

The Professional Development of Teachers

Among other factors, swift changes in the job market and the limitation of jobs due to technological advances and skills mismatch, have made lifelong training an imperative for every person wishing to pursue a career or even just maintain his/her current job post. Lifelong learning programs not only certify skills' acquisition but also provide feasible job opportunities (Kelpanidis & Vrynioti, 2012). A look at classic theories of participation would also add that people participate in lifelong learning programs because they wish to satisfy inner needs of self-esteem, self-actualization and an intrinsic urge towards constant learning (Houle, 1961; Maslow, 1947), social needs of belonging (Miller, 1967) or other needs such as financial gain (Rubenson, 2007).

However, to deliver a program, tailored to participants' needs, the barriers to participation must be examined, as well. So, in the needs analysis stage of the project, barriers to participation were also explored based on Cross's (1981) Chain-of-Response model. This model explores situational, dispositional and institutional barriers that inhibit adult participation in lifelong training whilst considering access to information about learning opportunities, attitudes about education and life transitions. What is interesting, as Cross (1981, p. 97) suggests, is that “motives differ for different groups of learners, at different stages of life, and most individuals have not one but multiple reasons for learning”, which can be applied to teachers attending lifelong training and to students in formal education settings.

Distance Teacher Training Courses

Online, asynchronous lifelong learning programs have met the needs of busy adults and vastly changed education deliverance by placing ICT in the centre of education, changing teaching practices and learning habits and creating a more active, engaging, participatory setting for all stakeholders (Gkountouma & Kouklatzidou, 2013). The availability of Learning Management Systems (LMS), embedding Web 2.0 tools, forums and chat rooms, has broken down time and space by bringing traditional elements of the education process into a digital space (Arbaugh & Benbunan-Fich, 2007). User interaction, peer work, feedback, project-based and inquiry-based learning build up a set of skills that not only enhance participants’ learning and teaching profiles, but also reshape their identity (Chatzisavvidis & Alexiou, 2012).

ICT in Education

ICT integration in education has gradually become a standard practice in most schools in countries in the European Union and other developed countries. Web 2.0 tools have created a new teaching and learning paradigm by promoting user interaction and collaboration, shifting participants’ roles from passive students to active, critical content makers and delivering personalized learning (Jimoyiannis, 2010; McLoughlin & Lee, 2010; Redecker, 2009). Similarly, digital storytelling offers authentic educational environments where students re-evaluate their learning strategies, acquire new roles and re-shape their identities (Coventry, 2008). Even video games are now considered powerful learning tools, as they promote user participation, communication and collaboration on complex tasks that boost various skills whilst incorporating many educational principles (Gee, 2003; Prensky, 2001).

Though ICT integration in education has gone a long way over the past two decades, its pedagogical use is still dependent on various personal, institutional and technological factors (Buabeng-Andoh, 2012). In must be noted that teachers often lack skills, confidence, time or willingness to embed ICT tools in their practices. In the meantime, there is a lack of high-tech up-to-date equipment in Greek schools to meet the demands of 25-30 students at a time whilst occasionally headmasters, parents or even students are unprepared to accept alternative practices of learning, collaborating and being evaluated.

Environmental Education and ICT

EE is now considered the primary instrument of promoting the United Nations’ Sustainable Development Goals and creating generations of people who will make informed decisions regarding the sustainability of the planet and the human race. Similarly, since technology has infiltrated all aspects of human activity, its integration into the curriculum is not limited to the traditional school subjects but extends to every school activity, including interdisciplinary EE projects (Willis & Weiser, 2005). The Internet and Web 2.0 tools are extensively used mostly in the initial stage of EE projects when students are searching and collecting information and in the final stage when the project is presented. Google search, wikis, website design, videos, Prezi and PowerPoint presentations, Google maps, digital storytelling software are just some of the tools employed (Payne, 2003). Still, nowadays, EE is becoming even more enriched with interactive kiosks, geospatial technologies, videoconferencing, drone coverage, virtual learning environments, simulation games and augmented reality applications. Most of them are collaborative, promote soft skills, enhance motivation and enthusiasm and help students understand both the physical and the digital world, by making comparisons, combining them and, in the end, standing critically towards both (Carvalho de Sousa, Sevilla-Pavon, & Seiz-Ortiz, 2012). Of course, such a development does not come without problems. Many teachers as well as the staff of EECs feel concerned and resist ICT integration in EE either because they lack education technology preparation or because they feel that ICT destroys the natural real-life experience when taking EE outdoors (Aivazidis, Lazaridou & Gustav, 2006; Willis, Weiser & Smith, 2016).

Description of the Project

To bring together the physical and the digital world whilst teaching about ICT and environmental awareness, along with other school subjects, a project on ICT and school gardens was designed and implemented. The designers and facilitators of the distance-training course had been experimenting with ICT in EE for a few years before designing this project, so instead of a pilot they chose to bring together their experiences and user-feedback. The project began during the 2014-2015 school year and was addressed towards teachers working in Experimental Schools around Greece, who were interested in creating a school garden.

Aims and Objectives

Most of the aims and objectives for each stage of this project derived from discussions with interested teachers, filling-in online surveys and needs-assessment questionnaires, etc. Many of the goals changed during the project; new ones were added. The overall aims of the project were to facilitate teacher-participants and, in the long run, their students towards becoming accustomed to using ICT in EE projects at school, learning how to create and sustain a school garden, designing learning scenarios and employing various means of cognitive interaction and learning. In addition, participants were expected to gain new skills or enhance their pre-existing sets of skills on identifying and working around hot environmental issues, participate in learning communities, both online and offline, manage and organize their time and resources effectively and practice on using ICT tools and working in virtual environments. Finally, participants were expected to gain awareness of global environment issues and sustainability, acquire a more sensitive set of values towards environmental protection, realize that learning is a dynamic, collaborative process and embrace ICT and our era’s technological advances.

Training on ICT and Gardening

Some project aspects required specialized knowledge and skills, e.g., knowing how to grow a garden, how to use new software and applications, etc. To meet these demands all stakeholders made use of their academic knowledge, non-formal learning and work experience. Also, external experts, such as agriculturists, municipality workers, information technology technicians, etc., were called upon to provide guidance, advice or manual labour.

Facilitators. In order to design the entire project the facilitators combined their academic knowledge and degrees in ICT in Education, Adult Education, Pedagogy and Communication for Development with their hands-on work experience at schools and the Environmental Education Centre.

Teachers-participants. All the teachers-participants in the project had experience working with EE projects at schools, though most of them had never grown a school-garden before. As to their ICT skills, all of them had acquired a State Certificate in ICT, level A (MS Office), and some of them had a State Certificate in ICT in Education, Level B or similar qualifications. So, though they were not accustomed to using ICT in EE projects, they had employed ICT in their teaching practices before and were not beginners.

Students-participants. As students were also involved in the project, most of the ICT skills needed were gained during the ICT subject at school whilst the gardens were grown during a flexible teaching zone added in the curriculum.

Profile of the Teachers - Participants

As mentioned before, the project was addressed towards teachers working in Experimental Schools, both primary and secondary, across Greece. Experimental Schools were chosen because they represent a unique type of public school, highly challenging and competitive but also open to new practices, partnerships and researches. The teachers employed in these schools are selected on a competitive basis and work on a seconded job post for five years, which allows projects to unfold and expand on a full scale. During the first stage of the project, 27 teachers from all over Greece were enrolled, but after the second stage 4 left the project because they quit working in Experimental Schools in Rhodes and Patras, which was a prerequisite. Out of the 24 participants, 19 were female, and only 4 were male. The group consisted of 13 primary school teachers, 3 physical education teachers, 2 kindergarten teachers, a music teacher, an art teacher, an English language teacher, a mathematician and a religious studies teacher. In terms of geographic distribution, the appointed teachers were in schools in Thessaloniki, Athens, Ioannina and Alexandroupoli. During the next stages of the project, other teachers expressed interest in joining. Therefore, even though they missed out on the e-course, they read the material, found support in the community and joined the project.

Stages of the Project

The project started during the school year 2014-2015 and consists of five stages. In detail, it started with an online teacher-training course on EE and school gardening. In its 2nd stage, participants were asked to create school-gardens all over the country, monitor their progress and outcomes, and self-evaluate how they implemented what they had learned so far. Materials of this stage were uploaded on an online community of practice, where participants/educators shared their experiences, exchanged ideas and tips. In the next two stages, the course's facilitators published a *Handbook on School Gardens: A Distance Teacher Training Course* (2015), whilst the participants are currently preparing for publication an *Activity Book: A Guide to School Gardening* (2017). Next school year, the project will enter its final stage, which involves an augmented reality application on school gardening, currently designed and piloted.

Stage 1. Distance teacher training course. The idea of designing and implementing a course on school gardening was not new to the facilitators. However, to prepare for it they conducted an online survey to find out whether there was interest in it and exactly what teachers would like to learn. The answers formed the course's content and structure. It lasted 25 hours (reading and chatting time only) and was implemented within 7 weeks via the free LMS Open e-class, supported by the Greek Universities Network (GUnet).

The course modules were:

- Week 1. Historical background -- Theoretical background of school gardening
- Week 2. A proposal: Its formation, logistics and other considerations
- Week 3. Design, growth and sustainability issues
- Week 4. Selecting crops -- Vegetables and herbs
- Week 5. Activities in the school-garden
- Week 6. Activities around and about the school-garden
- Week 7. Discussion, dissemination, evaluation

Every week, participants were requested to complete compulsory and optional group and individual tasks (e.g., multiple choice quizzes, lesson plans, participation in a forum problem-solving activities, etc.). By the end of the course, the teachers had created a useful database of lesson plans and scenarios and a well-organized community forum, which included many topics and further ideas. The course was evaluated via an online questionnaire, which explored the teachers' motives of participation in the course, their opinion about its design and content and optional open-ended feedback.

Stage 2. School gardens. During this stage of the project, teachers were expected to plan and grow a school-garden with their students. Some started it during the online course, to have side-by-side theory and practice whereas others started it after the end of the course. Teachers used the lessons plans and scenarios created during the first stage, employed techniques they had learned so far and collaborated with experts they met during the course, to bring the school closer to the neighbourhood, the parents' association, some universities and the job market. Most of the teachers also joined a National Thematic Network on Herbs (http://mvotana.weebly.com/), developed and sustained by one of the facilitators, Maria Gkountouma. Via the network, teachers received support, retrieved academic and other material (flashcards, picture dictionaries, etc.) and showcased their work whilst they visited the EEC and implemented outdoor programs on herbs with the staff.

Stage 3. Handbook on delivering a distance teacher training course on school gardening. Meeting the requests of the teachers-participants but also other teachers of the National Thematic Network on Herbs who were not allowed to take part in the course, the projects' facilitators wrote a *Handbook on School Gardens: A Distance Teacher-Training Course* (2015), which in eleven chapters presents all the core-material used during the course and contains an appendix with activities, reflection questions, evaluation tasks etc. The e-Handbook is Open Accessed, under Creative Commons Licence, so it may be retrieved and used by all interested teachers and other stakeholders.

Stage 4. ICT-mediated teaching scenarios on herbs and plants, for primary and secondary education. To disseminate the community's activities and practical experience, interested teachers responded to a call for the *Activity Book: A Guide to School-Gardening* (2017). In 200 pages, 19 teachers shared their ideas on how to approach EE in an interdisciplinary way and combine ICT and the digital world with physical outdoor activities. Teachers and their students, designed and maintained websites, wikis, blogs and social media pages on EE, collected their work on Google Drive, Dropbox and Blendspace, created digital stories and comics via Storybird, Comic strip creator and Movie Maker, video-recorded recipes, made e-flashcards, combined environmental and physical education and music from YouTube with folk culture, played an interactive "Who wants to be a millionaire?" self-made game, created an interactive map of herbs found in the Greek countryside via Google maps and even used the Bee-Bot programmable floor robot to learn about art and EE.

Stage 5. Taking learning outdoors via augmented-reality applications. Inspired by the frenzy over Pokémon Go and its infiltration in younger people, the facilitators are currently piloting a real-world treasure hunt via the mobile application *Action Bound*, which is for playing digitally interactive scavenger hunts. With the use of GPS coordinates and pre-placed QR codes, a scenario following a timeline of events will invite participants to follow directions, investigate clues, check out photos and videos and solve mystery quizzes, to achieve a final goal. The app is currently used in the outdoor setting where the EEC is located, and, as of next school year, it will be available to teachers and students visiting the EEC. Still, the aspiration is to train and inspire the teachers of this project and the members of the Thematic Network on how to use the app in any given settings, by making minor adjustments, mostly around the GPS coordinates and the QR codes' physical location.

Discussion

When participants entered the project by attending the online course, they mentioned that their motives were mainly focused around their professional development and their personal interest in gardening. Still, as soon as they realized that the project was more open and not confined to attending an online course and delivering a project (a school-garden) they got enthusiastically engaged in it. What happened, in their own words, was that they found a safe space and willing people with whom they could have a continuous, well-designed collaboration and alongside make unexpected friends. Evidently, there are a lot of eager and creative professionals in education who would like to have a more stable, organized network of colleagues, whom they could summon immediately when they want to propose new ideas and projects and find direct and fast responses.

So, in this context, participants started taking initiatives for further actions, events, partnerships, etc. As the project progressed, new needs arose, new ideas were proposed, so its structure, length and profile changed; more people wanted to join, outside Experimental Schools, so handbooks had to be published for their support, and a larger database of ideas and material needed to be created. As it turns out, though currently the project is in its last stage, core and peripheral participants keep sustaining previous stages, by repeating them with new students, enhancing them or disseminating parts of them. Currently, it could be argued that the project is not acknowledged and certified, in the sense that newcomers can't actually attend the online course and receive a certificate for it. Still, participant certification and guided facilitation are not goals or incentives for this project anymore anyway.

The project managed to achieve its goals, as participants' overall satisfaction reaches 95.7%. Besides carrying on an ever-shifting project, a noticeable change of attitude appeared among participants, as most of them, nowadays, have become quite extroverted, gladly sharing materials and not feeling exposed to express themselves on platforms, reach out to other people for help and showcase their work. In addition, as the participants were high-profile, well-educated professionals, they not only tried new strategies and tools, but are also very eager to do research on the field of ICT in EE and explore new methods of teaching, included augmented reality, robotics or even drones.

Of course, these changes did not come without significant doubts over teachers' abilities and students' responses; many teachers were stressed over growing a garden, maintaining students' interest by constantly coming up with engaging tasks and evaluating the project. Colleagues and parents expressed concern in relation to how ICT and EE can be combined and feared that new technologies are overtaking all activities children do, thus alienating them from the natural environment, social interactions, etc. Still, over time most barriers have been successfully overcome, as teachers feel more empowered to defend their work and gradually shifted from the traditional teaching and grading process to more flexible, creative and up-to-date practices.

A key aspect of the project discussed off-the-record among members, but not yet researched, involves the ways in which ICT pedagogical use in EE has feasible, measurable effects on students. Throughout the project, facilitators and teachers-participants were brought together, felt inspired, collaborated extensively, created pedagogical material, made friends, and were transformed as people. But there is a lack of research on what happened with students. Of course, teachers observed students' keen interest to engage in school gardening and work with ICT tools. Some students started their own herbal businesses at school (producing, packaging and selling their own products). Others called for more ICT clubs within Experimental Schools or started taking part in robotics, coding summer schools and contests. But remaining unanswered is what knowledge students exactly acquired from participating in this project and the degree and fields in which they really benefited from it.

Finally, though most stakeholders enjoyed the combination of the digital and the physical outdoor world and made fruitful use of both, what remains to be seen is whether this experiment has indeed contributed towards a long-lasting environmental awareness and an actual transformative shift towards the protection of the environment and the need to pursue sustainability goals.

Conclusion

The need to make the best out of the physical world around us and make good use of the digital tools we are deluged with was the main incentive of this project. Following the flexible ever-changing era we all live in, the project has managed to gain and retain the interest of hundreds of people involved, by having a dynamic structure and content, open to suggestions, ideas and new challenges. Throughout its stages, a noticeable shift of attitude towards ICT in EE, environmental awareness and soft skills has occurred, encouraging all stakeholders to continue coming up with new ideas, proposing new events and partnerships and maintaining a network of innovative professionals who willingly interact and engage in collaborative projects.

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A MUNICIPAL IMPLEMENTATION OF A NEW LEARNING MANAGEMENT SYSTEM IN K-12 SCHOOLS: THE TEACHER PERSPECTIVE

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Abstract

Municipalities continue to seek ways to enhance communication, information and documentation for teachers, students and parents through the implementation of learning management systems in schools. In this paper, the launch of a system for K-12 schools in a municipality in Sweden is studied from the teacher perspective. Survey comments submitted by the teachers (N=470) were analysed using a modified version of Koole's (2011) Framework for the Rational Analysis of Mobile Education. The findings show possibilities such as communication and documentation, as well as challenges related to usability, access and resistance. Lessons learned regarding the implementation of the system are presented.

Introduction

This paper focuses on the implementation of a new Learning Management System in a municipality in Sweden. The expectations for the uptake and use of Information and Communication Technologies (ICT) in schools have been high in policy both for teacher use and student learning (EC, 2010; OECD, 2012). The expectations regarding teachers' uptake and use of ICT are enhanced learning outcomes, increased student engagement, administration that is more efficient and the organization of learning (Penuel, 2006; Perrotta, 2013). However, these expectations appear to be difficult to see in practice in schools (cf. Cuban, 2001, 2013). Teachers often receive the blame for not integrating ICT in their teaching (Hixon & Buckenmeyer, 2009) including challenges such as lack of time and training (cf. Håkansson Lindqvist, 2015; Olofsson, Lindberg, Fransson, & Hauge, 2015; Vrasidas, 2015). Thus, teachers may also be considered to be a challenge, or a barrier, instead of the force of change, which they could be (Underwood & Dillon, 2011).

Research on ICT in education reveals that although teachers are gradually starting to integrate ICT into their teaching, significant differences are observed in the ways ICT is integrated in the K-12 classroom (cf. Tondeur, Cooper, & Newhouse, 2010). There also appear to be differences in how teachers take up ICT in their teaching. Sipilä (2014) reports that teachers with advanced ICT competence tend to use ICT frequently, while the majority of teachers do not have the skills or knowledge to use ICT to promote learning to a full extent. This may also be true for school leaders in their task to lead teachers in this work. School leaders are considered to be key actors in this process. However, they most likely have little training or competence for making the move to a transformative framework for teaching and learning with ICT (cf. Kampylis & Punie, 2013).

The use of ICT in schools, instead of opening up new opportunities for teaching and learning, has “bent technologies to extend existing pedagogical, curriculum delivery, and assessment practices” (Halverson & Smith, 2009, p. 52). According to these researchers, schools’ experiences of ICT can be described as a “revolution in technologies for measuring and guiding learning” (p. 53). For many teachers, Learning Management Systems (LMS) are used to achieve administration that is more efficient and organize students’ learning. These systems also provide a base for communication with students, other teachers and parents. In line with the uptake and use of ICT in the classroom, the use of an LMS also demands time and professional development.

In the context of K12, Lochner, Conrad and Graham (2015) studied K12-teachers’ concerns regarding the implementation of an LMS including awareness, information, personal, management, consequence, collaboration and refocusing concerns. These researchers’ results showed a lack of awareness among teachers as well as strong concerns regarding the management of the LMS implementation. This also involved personal abilities to adopt the LMS including information regarding the effects of the LMS on their teaching practices (Lochner et al., 2015). Cheok and Wong (2015) discuss “flexibility, interaction, perceived usefulness and perceived ease of use” as aspects, which are important in the implementation of an LMS, and which must be considered. Further, teachers’ attitudes, anxiety and self-efficacy will influence the efficiency of the uptake of the LMS, and therefore also the need for training and support. Thus, “the system, the teacher and the organization, need to work hand-in-hand in order to make the LMS in schools a success” (Cheok & Wong, 2015, p. 215). In this paper, a case from a municipality in Sweden is used to understand how teachers in K-12 experience the implementation of a new LMS.

Purpose

The purpose of this paper is to gain an understanding of how K-12 teachers in a municipality perceived the implementation of a Learning Management System (LMS) and to gain insight into the possibilities and challenges they experienced as end users.

Context

In the municipality studied, LearningRoom (LR) was chosen as an LMS for all public K-12 schools in the municipality by the school authorities. This top-down initiative was preceded by an evaluation, which took place at a central unit responsible for ICT in the municipality. The reasons for implementing LearningRoom according to the municipality were among others: creating structure for both educators, students, school leaders and parents and facilitating communication with parents on what happens in school such as plans, schedules, development, and children's learning in order to make them more involved. This involved having everything at the same place in one system, with hopes to reduce teachers' workload in order to provide more time with the students. The system was based on the needs of the school and replaced systems with expired contracts. During the spring of 2014, the first schools started using the system, and it was rolled out to all the schools in the municipality in the following year. The school leader at each school was seen as a key actor and was responsible for the implementation at their school.

Method

The data used in this study was gathered through a survey sent to all 2,524 teachers connected to the system. The data used in this paper was collected from three optional free text fields in the online survey from the answers from 470 respondents (teachers) (N=470) from 49 different K-12 schools in the municipality. Questions in the survey concerned the following themes: respondents' background, prior experience with learning management systems in general, and experiences from using the specific system LR. All data from the free text fields were imported to NVivo and were classified according to the framework for analyses presented below. Each answer was processed as one single entity, and therefore the analytic unit for the coding. Each unit received a specific number, which follows the comment in parentheses.

Framework of Analysis

In order to conduct the analysis of the free text fields, or comments, in the survey, a framework based upon Koole's (2011) model Framework for the Rational Analysis of Mobile Education (FRAME) was applied. The FRAME model is a heuristic model, which was used as a lens in the analysis of the data, in order to provide structure during the categorisation of the collected data. The FRAME model consists of three circles which contain the *Device Aspect, the Learner Aspect* and *the Social Aspect*. In this paper, three main categories were used in the model representing different aspects of the system implementation. *System Characteristics* takes into consideration the features, properties and usability of the system (LR). *Teacher Needs* focuses on the individual teachers' characteristics and needs such as emotions, knowledge, learning needs, history and the ability to utilise the system. *Social Aspects* considers social processes, information sharing, collaborating and communication between teachers, students, parents and other stakeholders in the system as shown in Figure 1.

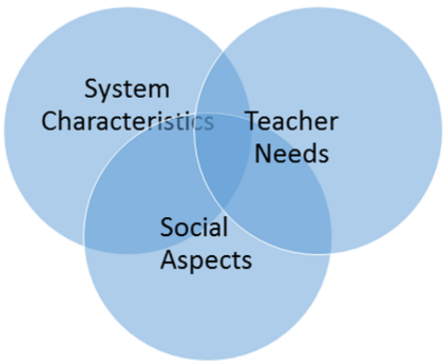

Figure 1. Koole's (2011) FRAME model adapted to System Characteristics, Teacher Needs and Social Aspects.

The different analytic entities, System Characteristics, Teacher Needs and Social Aspects to some degree overlap each other as illustrated in Figure 2. According to Koole (2011), these occurrences are of interest since they can provide additional information in the analysis.

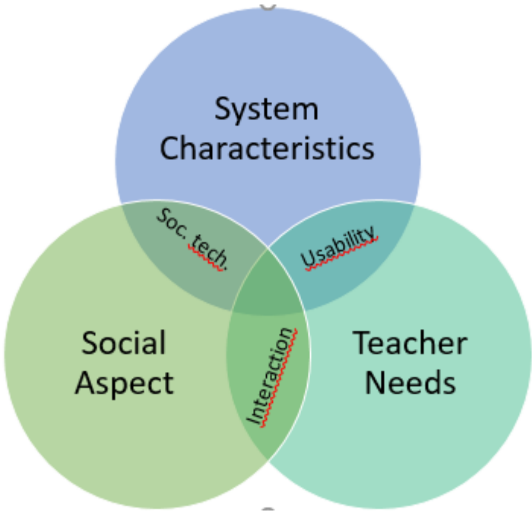

Figure 2. Koole's (2011) FRAME model adapted. Overlap between the categories.

The intersection Between System Characteristics and Teacher Needs provides information about *Usability* such as the teachers' thoughts of and feelings when using the system. Between Teacher Needs and Social Aspects there is an overlap that refers to the *Interaction* between Teachers Needs and Social Aspects. In the last area, between Social Aspects and System Characteristics, is *Social Technology* that refers to in what way the social aspects and the system characteristics interact and support or restrain action and integration within the system.

Results

In this section, the results are presented as follows: System Characteristics and Usability, and Teacher Needs and Interaction and Social Aspects and Social Technology.

System Characteristics and Usability

A majority of the teachers had difficulties using LR, finding the system hard to work with since it requires many clicks. It is hard to navigate in the system, since the paths are not intuitive for the teachers: *Many clicks-not good for my health (1)* and *It is tedious to get to the right place and difficult to have an overview of activities (2).*

One teacher describes the situation as: *It's insane that you cannot print all submitted works for a given submission. As it is now, I have to click on each individual student and click my way to work and then print. From the side of the "work" when the actual work (with the list of students) is front, so it is four (5!) clicks per job to be replaced. In a class with 30 students, it will be a damn clicking. Incredibly time consuming and especially primitive. Now it is 2016, for God's sake! (127).*

Some teachers also find LR unstable and do not trust the system. This makes them use alternative strategies to overcome the perceived problems and increases their workload*: The system is not sufficiently stable to be able to trust. You have to always have a back up in the form of information on a blog or something, which implies more work (42).*

For entirely different reasons, several teachers feel that the system is more time consuming than prior work practice. However, there are a few who feel that some of the functionality in the system eases their workload: *If LR was easier to use, I would probably use it more, since I think that it is an advantage both for me and the students to have everything collected in one place. Right now, I feel that the system is both difficult and time-consuming (71)*. *LR collects many different tasks under the same umbrella, but there are all too many steps to go through with clicks and links in order to complete certain elements and feel that it saves time. It does not feel like we are aligning our work to find the most efficient ways but instead are adapting us to existing technology, apps, etc. (80)* and *I have used LR for almost a year, but it started to take more and more time, so I tried to redirect as much as possible to other platforms (90).*

There are also teachers that find parts of the system to be better than the systems they have used in the past, although they feel that the administrative parts of the system take too long to use: *What has gotten better since we implemented LR is documentation regarding student development. The system is easier than the previous system. On the other hand, I do not feel that the system is any better concerning registering absence, contacts, etc. It still takes as long (93)* and *I think that the greatest advantages have been communicating with the students and a way to move away from paper that is just lost. I think that there should be a part of LR that could be used for students' practicum instead of paper, e-mail or documentation, which cannot be accessed by colleagues (118).*

Teacher Needs and Interaction

The majority of the teachers have educational requirements related to LR. They want features in LR that enhance their teaching, including features that are based on their needs and their current teaching situation: *Since I used Google Apps before, LR is rigid and difficult to work with when I want to work formatively. As things are now I can now follow the students' creative process, which is very important for me (25)* and *LR needs to be more efficient. To write assessments and to be able to easily save and see old assessments is a problem. That you cannot decide yourself when assessments are published for a single class is also a big problem (8).*

A very common theme is that the workload for the teachers increased with LR. They feel that administrative tasks take longer time and are more complicated than before. There are several reasons for this, one being that they state that they lack sufficient education and training in the system. Another contributing factor seems to be that teachers feel they do not have control of the system.

Who can provide information about all of the features? Right now, every teacher is sitting and trying by themselves – not a bit time-saving (33), You cannot put a new system in the hands of the people without education in the system (69) and *My workload has become much heavier with LR and the feeling of not being in control, knowing if I have missed information, etc. (17).*

The statements from the teachers provide a picture of a situation where the teachers themselves are struggling and trying to master the system. Where education, interaction and exchange with others does not happen or is not planned or organized in any significant way. Another difficulty raised by teachers is that everyone has access to the same functionality in LR, regardless of the stage or the subject they teach, or if they have an additional role such as the class mentor, or if they work in multiple schools. *I have to use both LearningRoom and Google Drive because I have private school pupils. This means that the school administration has not been reduced for me (131)* and *The bad thing was that the platform does not support a different language. It would be very good if you could write in languages other than Swedish directly in the platform (128)*.

Social Aspects and Social Technology

A major feature available in the system is the possible to communicate with parents, students and other teachers as well as with school leaders. Unfortunately, this did not work in practice according to the teachers since not everyone uses or checks the system due to various reasons. This was as one of the teachers put it: *Many parents have had problems logging in and they can't log in LR on their phone. Since my students don't have their own computer, I don't communicate with them in LR to any greater extent (10).*

A frequently described problem is the security solution called Bankid, i.e., an identification system that connects through to the users' bank, which was necessary to use in order to access the system. Here, the system is described as hard to use and very secure: *The parents are angry about LR (Bankid for parents who don't even have a computer at home). I do not have contact with school leaders and colleagues in LR, this takes place through e-mail. Before LR, I used Fronter and the contact with the students on the platform has not increased in connection to the change to LR, just the opposite so far (74)* and *It is too difficult to find LR on the web and to log on with their Bankid. All of our parents do not have a Bankid or knowledge in Swedish, which makes it difficult for them (51).*

For the teachers, this means they must work with parallel systems in order to maintain contact with their students and parents. Something that creates frustration. Contacts with colleagues and parents are mainly handled through e-mail: *Since a logon is needed, with several clicks before you are in LR, it feels easier to use e-mail, Further, e-mail is easier to use on your mobile or your tablet than LR, which is very difficult (55)*, *We have good rooms where we share things, but we lack structure, because there are still things that we do in Drive and in LR, which makes it all confusing (88)* and *I have used LR for almost a year, but it started to take more and more time, so I tried to redirect as much as possible to other platforms (90).*

As a side effect, the technical problems lead to increased contact with the parents in other channels for some teachers: *The contact with parents has increased, but this is due to parents contacting the school in frustration over how difficult LR is to use. The contact does not take place in LR (52).*

Regarding collaboration, the implemented system LR has not been used for collaboration to any larger extent. Instead, the teachers have kept their current work practice, systems and tools in order to collaborate: *I think that Google Drive is what my colleagues and I use and which facilitates and helps us with administration and collegial development (5).*

The motive to maintain the use of other systems instead of the desired LMS seems to be the lack of functionality in the new system as well as comfort in using well-tested tools that have worked before. The teachers in the survey are not prepared to abandon solutions that they know work in their teaching and in their contacts with parents: *Before LR, we already had a well-functioning blog in Wordpress, which we continue to use to share information and provide information about the students' school day. Here, the possibility to inspire and make things interesting is much greater (6).*

Another recurring theme is the lack of information from school leaders to the teachers in how the new LMS is supposed to be used in the collegium and in fact, how it can be used to facilitate their work: *I have not received any indication that the platform was expected to be used for collaboration between teachers. Not that I can remember (66).*

Discussion

The purpose of this paper is to gain an understanding of how K-12 teachers in a municipality perceived the implementation of an LMS and gain insight into the possibilities and challenges they experienced as end users. Here, teachers who have worked with the system on a day-to-day basis appear to see some possibilities and many challenges with the new LMS. Overall, the hopes that the system would provide a new platform for communication, information and documentation do not appear to have been the result of the implementation. However, for teachers, new systems create new training needs and take time (cf. Håkansson Lindqvist, 2015; Olofsson, et al., 2015; Vrasidas, 2015).

While there appear to be many teachers who have not started to use the system, there are experienced and knowledgeable teachers who are frustrated over the lack of user-friendliness and usability and cannot be seen as barriers (cf. Underwood & Dillon, 2011). These teachers already had found and integrated system solutions to support their pedagogy through other systems (cf. Sipilä, 2014; Tondeur, Cooper & Newhouse, 2010). Overall, the system characteristics appear to be far from teachers' needs in regard to pedagogical use. When implementing LR, the municipality appears to have overlooked the need for a mapping of the existing pedagogical systems in use. It also appears that the municipality may have underestimated teachers' ICT skills and ability to critically evaluate the system. Thus, the implementation of the LMS reflects the many different levels of ICT skills among teachers, different levels of use and tools (Means, Toyama, Murphy, & Bakia, 2013; Schoonenboom, 2014). It also appears that teachers had found ways to combine different systems for different roles and supporting these roles. It is perhaps somewhat too optimistic to expect one system can support all the many uses by teachers. Further, the instability of the system has involved extra work for many teachers (cf. Lochner et al., 2015).

Collaboration is difficult if there are several or unclear points of access to and dissemination of information. It is difficult for teachers to speak in favor of a system for communication with students and parents, while colleagues and school leaders use an alternative system. It is also difficult to demand that teachers disseminate information through LR if parents do not have access to the system, but still have the need to access the information provided by the teacher. Moreover, the municipality was not aware of the systems that already were in place and in use and frequently used by teachers for pedagogical goals and design, information to students and parents, and collaboration with colleagues (cf. Cheok & Wong, 2015).

The municipality's intentions of one overarching system became perhaps too complex for certain teachers as users and too simplistic for other teachers. This resulted in frustration in both groups, the system itself became a barrier for these teachers to enter and initiate work. For the teachers at the other end, the system became a barrier due to usability issues and frustration regarding being provided with a system that did not provide the same level or better usability compared to the previous systems without gaining efficient work methods (cf. Penuel, 2006; Perrotta, 2013). This is an interesting finding as this shows that many teachers are clearly ICT-competent and have the ability to critically evaluate LR, based on previous use and experience. However, it also supports the idea that many teachers also need time and professional development to take on a new system (cf. Håkansson Lindqvist, 2015; Olofsson, et al., 2015; Vrasidas, 2015).

Regarding collaboration, it appears that the goal of the implementation of increased collaboration was not achieved, according to the teachers. The teachers appear to have found alternative solutions outside the system for contact with students, parents, teachers and school leaders. There appears to be little support for the school leaders as key actors in supporting the implementation of LR (cf.. Kampylis & Punie, 2013).

One additional question is of interest to explore. The work in schools as organizations is complex. Thus, it is close at hand to expect that the demands on one system for all of these teaching and learning activities, including information, documentation, assessment, collaborative forums with teachers, internal groups and external groups is perhaps an all too utopian an idea. When implementing a system such as LR, it is perhaps necessary to build upon systems that teachers already have chosen based on pedagogical decisions and design and support this use in practice (cf. Cheok & Wong, 2015). This would include involving teachers, their ideas and thoughts for system use to support and adapt systems. As in this case, one solution for all teachers is perhaps a bit too optimistic; there is a different in practice between

K and 12 and teachers' needs. A ready system or product implemented from top-down is perhaps the soundest financial solution for the municipality, but as this case shows other approaches could have benefited the user experience.

Finally, in regard to lessons learned, it is important once again to stress the importance of the initial mapping and study of teachers' existing pedagogical practices related to System Characteristics and Social Technology, Teacher Needs and Usability as well as Social Aspects and Interaction before an LMS is implemented. These aspects all appear to be key factors, according to the perspectives of the teachers in this study, if their work with collaboration, documentation and information is to be supported through the implementation of an LMS.

Conclusion

The aim of this paper was to explore the implementation of an LMS in K12 schools in Sweden from the teacher perspective. While the findings are specific for the case studied in the Swedish context, certain findings may be of interest for K12 schools nationally and internationally. First, the implementation, which involved one system for all users from K to 12, appears not to have been able to provide support for specific needs in the different schools' levels. Secondly, the system was implemented according to a top-down decision, which did not consider existing systems and solutions that already were in place and working in teachers' practice. Finally, the technical characteristics in the system appear not to have offered opportunities for different user levels, from novices to experts. In conclusion, the findings in this paper are in line with previous research, stating that the implementation of an LMS takes time, requires professional development and to be successful is best based on needs from the teacher perspective.

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ICT USE BY SCHOOLS IN EASTERN INDONESIA

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Abstract

This paper examines ICT use and access and students' beliefs about ICT in learning. The study focuses on schools in eastern Indonesia. Data used is in the public domain (Analytical Capacity Development Partnership, 2015) and was collected over 18 months using surveys and focus groups. Student data (3,000+) was drawn from primary and lower secondary classes. Teams of trained enumerators collected the data in a number of regencies (sub-provinces). The broader data also considered the views of teachers, principals and parents, although in this review only the voices of students are considered. Student voice is often regarded as one that historically has not been considered. Current research has shown the validity of student voice, which here is loud and clear about changes needed to improve learning in classrooms. This includes ICT access, quality of teachers and how teachers use ICT. A shift in teacher mindset and quality is suggested as a way for change to occur.

Introduction

This paper is based on data collected in an Analytical Capacity Development Partnership (2015) Project that evaluated information communication technologies (ICT) use in Education. The data analysis seeks to fill a research gap in understanding how ICT is used in Indonesian schools, including frequency of use, student attitude towards learning and ICT, and the nature of activities undertaken using ICT. Students in primary and lower secondary classes participated in two data collection activities: a paper-based survey and focus group discussions based on clarifying issues of interest identified in surveys. The research used a mixed methodology, where the data collected from the survey was both closed (qualitative) and open response (quantitative). Focus group discussion (FGD) questions were developed from analysis of survey responses. The sample size was approximately 3,000 students. Survey data were analysed using a data collation tool designed by Universitas Kristen Satya Wacana (Open Source) and SPSS (IBM), while text analysis was completed using Leximancer (University of Queensland).

The research questions investigated using the data were:

RQ1: *What are the attitudes of students towards ICT use and learning?*

RQ2: *What does use of and access to ICT look like in schools?*

RQ3: *How do students view the changes required to improve use of and access to ICT in schools?*

The Literature About Learning and Teaching with ICT

Research in ICT generally supports the notion that ICT has the potential to allow teachers to develop different teaching approaches, which in turn are reflected in pedagogical changes. In work by Hunt (2007), it was noted that certain pedagogical advantages exist for students when ICT use is included in classroom programs and practices. These include:

- Access to information, people, places and events
- Opportunity to make thinking visible to oneself and others
- Collaboration opportunities that can enhance understanding
- A desire to continue learning: life long learning.

There is also some emerging evidence in the Programme for International Student Assessment (PISA) suggesting that students who use computers at school, as well as at home, are more successful on PISA (OECD, 2011). The benefits of incorporating technologies into teaching and learning in Indonesian schools has been recognised for some time. In 2002, Yuhetty argued for the integration of technologies into school education in order to build the international competitiveness of the nation. This notion of competitiveness within and beyond Indonesia is a recurring theme in schools noted in conversations held with Indonesian teachers, students and parents. (Palekahelu, Hunt & Thrupp, 2016). In 2014, the debate about integration into the curriculum continued, with schools expected to formally integrate ICT across the curriculum. Use of the Internet in certain ways can encourage teaching approaches such as inquiry-based or problem-based learning, collaborative learning, personalised learning, self-directed learning, project based learning and problem solving (Harasim, 2012; Laurillard, 2012). Whilst this literature focuses heavily on teachers and ICT use, it has been noted that teachers who do not use or encourage the use of ICT risk creating a disadvantage for students. Key ideas coming through in the literature thus far point to advantages through the use of a range of technologies (and disadvantages when use of ICT is prohibited or discouraged). In considering the use of ICT, this analysis seeks also to investigate and understand the ways in which students use ICT.

The Literature About Student Voice and Use of ICT

This analysis is about students and their learning with ICT, and it thus was necessary to explore the literature around *student voice*: why is the data collected from students more relevant, or as relevant, as that derived from teachers and principals? Historically, findings about children and their access to and use of ICT, and specifically ICT for learning, have been based on data collected from parents, teachers (Primrose, 2003) and commentators in the field (Prensky, 2002). Limited research has produced findings from data provided by children. This approach to data collection is known as *giving voice to children and students, student voice* (Thrupp, 2008). It has been reasoned by researchers that children are unable to contribute valid data. Fromme (2003), however, argued for the need to see childhood as based in a social and cultural milieu. Consequently, to understand ICT as an element of this social and cultural milieu, it must be acknowledged that the children are the experts (Fromme, 2003). Data collected from children using techniques that acknowledge that children provide relevant and valid information (Appleton, Hunt, Heldsinger & Thrupp, 2006; Downes, 1999; Fromme, 2003; Mojica-Casey, 2015; Somekh et al., 2002; Thrupp, 2008) is important. Jervis (2003) and Somekh et al. (2002) used drawings and concept mapping. Moreland and Cowie (2003) and Appleton et al. (2006) used cameras for data collection about children's ideas about technology. This technique was supported by interviews in studies by Thrupp (2008) and Mojica-Casey (2014), who used student voice to collect data about access to and use of ICT for learning. These techniques acknowledge the distinctiveness of gathering consistent and clear data from children and the need to capture the "social, cultural, situational and contextual" reality of children (Stake, 2005, p. 452)

The following research questions, focused on student voice, were investigated.

RQ1: *What are the attitudes of students towards ICT use and learning?*

RQ2: *What does use of and access to ICT look like in schools?*

RQ3: *How do students view the changes required to improve use of and access to ICT in schools?*

The Methodology

The research used a mixed methodology, where the data collected from the survey was both closed (surveys that included open and closed response questions) and open (using focus groups). The methodology was designed by two experienced researchers from Australia (with research experience in Indonesia) and validated by Indonesian counterparts. Language discrepancies formed a large part of this validation. The focus group discussion (FGD) questions were developed from an analysis of the survey responses, with FGDs conducted in a subset of the total school sample. A sample of 220 schools was comprised of schools that represented primary and lower secondary, with further sampling representing schools in urban, peri-urban areas and remote areas. A further requirement was that the schools sampled include private schools and others operated by charitable foundations. All surveys and focus groups were conducted in the national language. A rigorous validation process was followed to develop age appropriate instruments, using Indonesian teachers and researchers. Research ethics approval was not required as this paper used data from the public domain. Further, ethics is not a requirement for research in Indonesia.

The Data Collected and Analysed

The data collected fell into six broad areas: demographics; access and use of ICT at school; capability and attitude towards ICT use and school; other ICT use (at home); where computers are used and frequency of use; and "what do I wish for to improve my ICT skills and learning?"

1. Demographics: Stories in the Data (n=3,128)

Students in the survey ranged in age from 7 to 16. By class, students were drawn from Class 4 to 9 (primary and lower secondary, or Middle Phase of

Learning), whilst by gender there were 1,675 females and 1,453 males, relatively balanced in terms of gender representation.

2. Access to and Use of ICT at School: The Stories Told

The stories in these data are not particularly encouraging. Access to laptops and computers at school is low, a story similarly repeated when examining data about the use of digital cameras, text messaging and the Internet. This is not surprising in a nation that remains dependent on foreign aid for areas including health, education, infrastructure and good governance.

Table 1

Access to and Use of ICT at School

- 72.1% stated that they did not use ICT at school.
- 85% never used a laptop at school.
- 93% never used a digital camera at school.
- 90% did not use text messaging for learning at school and 2.4% used text messaging for learning on a daily basis.
- 73% did not use the Internet at school, 7.5% used the Internet 2-3 times a week and 3.9% used the Internet one or more times each day.

3. Stories About Capability and Attitude Towards ICT and School

Despite the many challenges of access to ICT, students remain very positive about using ICT for learning and school generally. Responses to questions in this field indicated a strong positivity towards using ICT and learning at school. Some open responses stand in contrast to the earlier questions: while students could clearly identify benefits of using ICT, they also identified numerous barriers or challenges.

When asked if the teacher used a range of ICT in class*,* 82% of students either agreed or strongly agreed. When asked if Using ICT at school helps students learn more, 85% of students either agreed or strongly agreed. In focus groups, students were quite negative about the quality of teachers' use of ICT and suggested that better teacher preparation to use ICT would create better learning for them.

Table 2

Attitude Towards Using ICT and Towards School

- 83.3% Strongly Agree or Agree that they enjoy using ICT for learning and 7.8% stated they have no ICT access.
- 96.0% Strongly Agree or Agree that they like being at school.
- 96.1% Strongly Agree and Agree that they learned a lot of new things at school.

When asked further about how ICT was used at school, most students reported that they [students] did not use ICT at school, using such comments as: never, because we have no electricity, we cannot learn with ICT, or at school there was no means of ICT. A small number of students reported using ICT such as

Internet, SMS on hand-phones (smart phones) and accessing the Internet using phones and modems.

Asked about learning at school, students reported a lack of access to ICT, together with a range of negatives: *no ICT ever; no electricity; no ICT teacher; lots of damaged computers that do not work.* On a more positive tone, a smaller number of students suggested that ICT: *increased knowledge, made learning easier and faster; in order to be smart; clearer and easier to understand; and can complete the teacher tasks quickly.*

This map (Figure 1) illustrates the connections between one concept (*Information*) and the many other ideas offered as responses, including *learning, knowledge, faster, study, science and insight*

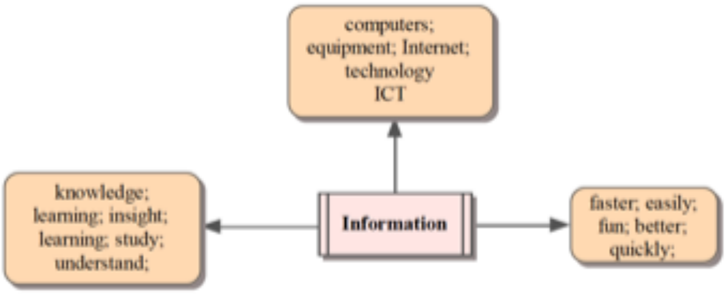

Figure 1. Map of ideas associated with the concept of *Information.*

When quizzed about *the challenges of using ICT at school,* as noted elsewhere, common challenges identified included: *absence of ICT, restricted access to ICT, no electricity; no ICT teachers; no computers or damaged computers; no laboratories; and lack of Internet.* It was noted in focus groups with teachers that if Internet access was not available, there was no point in using computers. Computers were associated here with online activity only.

4. ICT Use at Home: A Story of Differences

Data here suggests, as noted elsewhere, that students' access to ICT at home is richer than at school. Students have elsewhere suggested (in FGD and interviews) that these phones provide Internet access. The high ownership of personal phones, together with their relatively low cost, might be considered in developing a way forward. The high ownership of televisions at home also suggests that this might be way to reach informal learning at home.

Table 3

ICT Used at Home

- 62% indicated that they had their own mobile.
- 23.1% indicated that they had Internet access at home.
- 84.2% indicated that they had a television at home.
- 26.5% indicated access to a gaming machine at home.

In an open response question probing other ICT available at home, mention and frequency are illustrated in Table 4.

Table 4

ICT Mentioned and Frequency of Mention

ICT Mentioned	Percentage of Mentions/Cohort
Laptop	32.86
DVD	22.76
Radio	14.99
Tablet computer	12.78
Computer	12.75
Digital camera	10.39
Printer	8.88
Smartphone or HP	8.05
Modem	4.66
Parabola (satellite dish)	3.83

5. Stories About Location and Frequency of ICT Use

As shown in Table 5 below, schools are not rich in opportunity to use ICT. As has been noted in other educational jurisdictions, the home often provides richer opportunities to access a range of ICT.

Table 5

Frequency and Location of ICT Use

- 70.6% never used a computer in the classroom and 10.4% used a computer one or more times a day.
- 74.5% never used a computer in a school lab and 13.2% used a lab once a week.
- 77.7% never used a computer in a school library.
- 31.8% used a computer at home one or more times a day and 9.4% used a computer at home 2-3 times a week.
- 67.9% never used a computer in an Internet shop or public space.

6. Capability in Using ICT

Data here indicates that 52.9% of students reported that they were very capable or capable in the use of ICT. This must be viewed against other data that suggests experiences with ICT are often not available. However, when considered against the data from other questions, this may explain responses about capability, that is, the home is where the capacity is built. This sits comfortably with the PISA suggestion that a home-school ICT environment can produce better results in the PISA testing (OECD, 2011). When asked explicitly about capability in using, students responded as shown in Table 6.

Table 6

Capability in Using ICT

	Percentage
I do not like using ICT	2.9
Not at all capable	43.8
Capable	41.6
Very capable	11.7
Total	100.00

7. A Wish List to Improve ICT Use and Access: Stories from the Mouths of Students

Data collected here were via open responses. Analysis of the data fell into three broad categories: additional ICT students would like; why students would like a *particular piece/s of ICT;* and *what they would do with it.*

The map below illustrates one theme presented and ideas associated with the idea of *Laptop*.

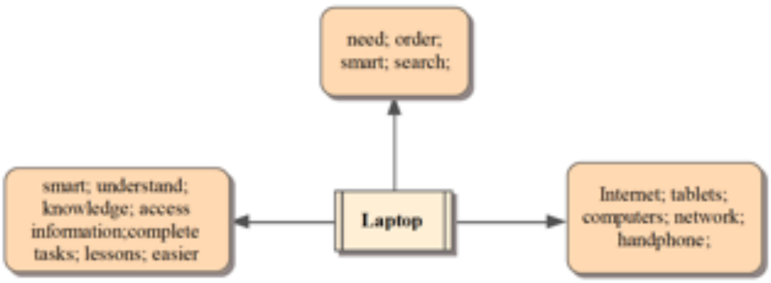

Figure 2. Map of ideas associated with *Laptop.*

Ideas commonly proffered by students relate to capacity to learn, nature of learning and content of learning, including:

- Computers make it easier to have lessons in the classroom.
- HP [hand phone], to calculate the multiplication / division.
- Email, computer, tablet, camera, Internet, SMS because I love to learn.
- Computers because it is very easy to learn; because it (computer) makes me smart.
- Our school needs a computer so that we can be smart.
- Never use HP (hand phone) as teacher forbid.
- I want schools to have electricity, computers, photocopiers, Internet; computer, to search for the task and learn about ICT.

What Did the Data Tell with Regards to the Research Questions?

RQ1: *What are the attitudes of students towards ICT use and learning?* Students show a remarkably positive attitude towards ICT and learning at school. This is regardless of the absence in many instances of access to ICT at school. From the focus group data, students suggested that ICT could assist in better learning: making them smarter and more knowledgeable and more competitive nationally and globally. In FGDs with parents, the notion of international competitiveness was also raised. Students willingly proffered ideas as to how ICT access and use could be improved: increased access to working computers and labs, trained ICT teachers, enhanced infrastructure (power, networks and Internet) and less reliance on lessons taught from a book with little or no hands-on components.

RQ2: *What does use of and access to ICT look like in schools?* Use and access to ICT needs to significantly improve to meet the aspirations of students (and teachers and parents): most students surveyed have little or no access to computers, laptops or tablets. From observations in classrooms and in interviews and focus groups with students, it appears teachers are not well prepared to teach using ICT and rely heavily on the use of textbooks (a substitute for hardware). Use of textbooks is common in all subjects, and it has been frequently observed that science classes are conducted in rooms with no scientific apparatus but a shelf full of aged books. In one vocational school, students were taught plumbing from textbooks with no hands-on experiences.

Understanding of ICT and its uses, including how computers function and Microsoft Office suite can be used, are completed in a rote manner and with a textbook focus. It could not be anything else when hardware is virtually non-existent. The Internet is not widely accessible. Yet, students are clear that it can help them to achieve better learning outcomes: communicating with teachers and peers, accessing current information not available in textbooks, and providing a level playing field with learners elsewhere. Use of computers at home by students is significant and suggests that programs such as Bring Your Own Device (BYOD) might work, although the notion of a *device* needs to be clarified and might mean a hand-phone or similar.

RQ3: *How do students view the changes required to improve use of and access to ICT in schools?* Many students (62%) have their own mobile phones, which might be seen as a substitute for computers in a BYOD program. Students told of quite limited use of the Internet and Messaging using these devices. Ideas commonly proffered by students to improve ICT in learning strongly suggested improved access to hardware and infrastructure. In support of this, students articulated a compelling range of reasons for developing programs that better access would lead to, including: (a) because it (computer) makes me smart; (b) I hope there is electricity and computers in order to learn; (c) computer so that I can know the news /information from abroad that relates to a lesson; (d) I want to learn to use a computer because I want to go forward like others; and (e) computers, as easy to write and increase of my knowledge. Although students do not have significant experience with ICT at school, they appear acutely aware of the benefits and uses possible. They appear to have a view of ICT (and computers) that shows they are not shielded from the outside world.

Discussion

What We Know

Students have spoken and described a picture of what is happening in learning at school and what could happen to learning at school. There have been both positive and negative stories, and this section endeavours to describe a way forward to allow students to have learning opportunities that are maximised through the use of ICT. Students have suggested that learning from books is limiting. Whilst this is an artefact of limited access to ICT hardware, recognition should be given to different learning styles: book learning is typically auditory/didactic, whilst ICT and computers thrive on visual/spatial activity. This will require a pedagogical shift for teachers, but it has been shown in other education systems that such a shift can be used to grow learning outcomes. Teacher education institutions will need to be at the forefront of this, with support from education authorities.

The Future

Better access to ICT and access to a broader range of ICT is a requirement evident in the responses of these students. The challenge is to frame a response that includes funding. How can a response to this be framed and funded? What are the competing priorities for the funding bodies? Is education seen as an investment in national economy and competiveness? Students (and teachers and parents) suggested improved access to a range of hardware and infrastructure (computing devices, electricity, and communications access including the Internet). With the advent of such hardware as Telco in a Box (Cosseboom, 2014) and small, inexpensive solar Power Banks, a solution may not be so distant. Some schools had been entrepreneurial in their acquisition of ICT hardware and infrastructure. These should be identified and robust case studies of ‘what works’ shared widely. Most of this is applicable to the broader context of learning in eastern Indonesia. To achieve a sustainable pedagogical shift, ICT leaders will need to be developed in schools; this might require that an ICT Competency Framework be developed, possibly based around Puentedura’s SAMR (2014) model of ICT adoption. This suggestion is a response to the students’ notions of the quality of ICT teachers in schools. To build on student enthusiasm for learning and a desire to be ‘smart,’ or to achieve any or all the above, ICT budgets and ICT plans will need to be developed and implemented. These small ideas are a package that together can make a difference. There is a plethora of research in both developed and developing countries to show that these notions can make a difference. If the education sector improves, it follows that other government infrastructure sectors will follow: health, roads, water, electricity etc. An investment in tomorrow’s citizens pays dividends for individuals and the nation.

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TOWARDS MEASURING TPACK IN INDONESIAN ELEMENTARY PRE-SERVICE TEACHERS

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Abstract

Technological and Pedagogical Content Knowledge (TPACK) has, in recent years, been the focus of considerable research, particularly in subject specific domains. This paper explores the ideas of TPACK and its relationship to Indonesian elementary pre-service teachers. Links are drawn between Hunt's (2015) use of graphic organisers to explore *teaching practices, curriculum connectedness*, *attributes of the teacher* and *use of ICT artifacts* and a theoretical planning tool, TRIM, the Technological Reflective Integration Matrix (Setiyanti & Hunt, 2016). The outcomes outlined here are preliminary, but encourage the researchers to improve the TRIM model as a way to capture a broader picture of TPACK in a domain not well researched -- elementary pre-service teachers.

Introduction

Considerable attention has been given in recent times to the notion of Technological and Pedagogical Content Knowledge (TPACK). Whilst this lies in the ideas of Mishra and Koehler (2006), its origins are much earlier in the work of Shulman (1986, 1987), Pedagogical Content Knowledge (PCK) and Pedagogical Reasoning and Action (PRA). Recent attention (Koehler, Shin, & Mishra, 2012; Harris, Grandgenett & Hofer, 2010; Abbitt, 2011) has focused on exploring the TPACK capacity of teachers and pre-service teachers, most frequently in subject specific domains. This paper is focused on TPACK and elementary teachers who are required to have a much wider Content Knowledge (CK).

In 2015, Hunt used graphic organisers to determine the ideas and beliefs held by pre-service teachers around perceptions held of ICT teachers. This led to a framework based on: first, *teaching practices*: Pedagogical Knowledge (PK); second, *curriculum connectedness:* (Pedagogical Knowledge (PK) and Content Knowledge (CK)); third, *attributes of the teacher* and *use of ICT artifacts:* Technological Knowledge (TK) and Technological Content Knowledge (TCK). The framework of this earlier work (Hunt, 2015) is combined with Hunt's theoretical planning tool, TRIM, the Technological Reflective Integration Matrix. This is another graphic organiser designed to focus on the integration of technology in learning and reflection on teaching practices. TRIM was developed in October 2010, but has not been published.

It is investigated here with a cohort of 35 Indonesian pre-service elementary teachers in their fourth year to identify its potential to 'measure' TPACK in elementary pre-service teachers. Whilst the outcomes are preliminary, they provide encouragement to the researchers to focus on how to improve the TRIM model as a means to capturing a broader picture of Pedagogical Knowledge (PK), Content Knowledge (CK) and Technological Knowledge (TK). This is important for academic staff that need this information to build and deliver courses based on known needs, in this instance, the development of Content Knowledge, which is problematic for elementary teachers.

Literature

The Technological Pedagogical and Content Knowledge (TPACK) framework derives from Shulman's (1986) idea of pedagogical content knowledge (PCK), the integration of Pedagogical Knowledge (PK) and Content Knowledge (CK). In using TPACK in planning and thinking, teachers bring together knowledge of subject matter, what is good for learning, and technology (ICT). The framework also relies on Shulman's Pedagogical Reasoning and Action (PRA) work (1987*). Content Knowledge (CK)* is the knowledge of subject matter, whilst *Pedagogical Knowledge (PK)* is about knowledge of the processes or methods of teaching. TPACK (Mishra & Koehler, 2006) has added a further dimension to the work of Shulman, resulting in a broader set of knowledges that are integrated. Diagram 1 illustrates this notion.

Diagram 1. The TPACK matrix.
(Image source: http://tpack.org)

A wide range of researchers has tried to measure TPACK (Koehler et al., 2012; Harris et al., 2010; Abbitt, 2011). Expert teachers are now considered those who can bring together knowledge of subject matter, what is good for learning, and technology (TTF, n. d.).

Researchers have used a range of strategies to determine TPACK capability, most often with pre-service teachers; the types of approaches used have included:

- Semi-structured interviews (Harris, et al., 2010; Niess, 2006)
- Analysis of teachers' lesson plans using a rubric (Harris, et al., 2010)
- Questionnaires, open-ended responses from open questions (So & Kim, 2009)
- Self-report surveys (Schmidt et al., 2009)
- Observation protocols (Harris, et al.,2010)
- Graphic organisers (Hunt, 2015; Relmasira, Thrupp, & Hunt, 2016)

This research has particular interest in exploring the TPACK of elementary teachers, whereas previous research has tended to focus on subject specific instances with pre-service secondary teachers in mathematics, science, languages and social history. Knowing the TPACK of pre-service teachers enables courses to be developed in areas of need, placing tertiary educators in a better position to respond to areas of perceived weakness. In pondering the use of self-reporting surveys, an example of such a device attempting to 'measure' Content Knowledge is shown (Table 1): the researchers are not confident that these four questions alone can address the domain of CK. This is a reflection of concerns about closed questions.

Table 1

Typical Self-Reporting Survey Questions about Content Knowledge

CK1 I have sufficient knowledge about my teaching subject.
CK2 I can think about the content of my teaching subject like a subject matter expert.
CK3 I am able to gain deeper understanding of the content of my teaching subject on my own.
CK4 I am confident about teaching the subject matter.

Note: Adapted from "Surveying In-service Preschool Teachers' Technological Pedagogical Content Knowledge" by J. C. Liang, C. S. Chai, J. H. L. Koh, C. J. Yang, & C. -C. Tsai, 2013, *Australasian Journal of Educational Technology*, *29*(4), 586.

Elementary teachers require a different set of knowledges, particularly in the domains of CK, PCK and TCK. This requires different strategies to produce a rounded view of TPACK. The researchers have been encouraged by the development of a rubric (Harris et al., 2010) to analyse teacher TPACK, together with the work of Hunt (2015) and Relmasira et al. (2016) in using graphic organisers. This decision is based on belief (that is to be tested) that a single tool cannot identify the breadth of TPACK capability: a solution is thought to lie in combining the rubric (modified and presented as a TRIM (Hunt, 2010, unpublished) and graphic organisers (Draw a teacher/classroom, Hunt, 2015; Relmasira et al., 2016).

Research Questions

RQ 1: Can elementary pre-service teacher TPACK be measured more effectively using a blend of tools as opposed to a singular survey?

RQ 2: How effective are graphic organisers and rubrics in identifying the seven domains of TPACK?

Methodology and Data Collection Instruments

This research uses a mixed methodology and is both qualitative and quantitative. Data were collected during a 90 minute Master Class with pre-service elementary teachers, using pencil and paper activities and an online environment. The instruments are research based and included analysis of teachers' lesson plans (Harris et al., 2010; Niess, 2006), open-ended responses from open questions (So & Kim, 2009) and graphic organisers (Hunt, 2015; Relmasira et al., 2016).

Participants were given four tasks to complete. The first required them to draw a picture of a classroom they would like to have, showing this from a bird's eye view. The second task asked them to use an online tool (TodaysMeet) to describe what a contemporary teacher looks like, sounds like and feels like. Third, they were asked to enter another TodaysMeet Room to identify the tools used by contemporary teachers. Fourth, they were walked through how to use a Technological Reflection Integration Matrix (TRIM) and to design a lesson plan using this model. The TRIM is at the heart of the Master Class and is described here in its original and unpublished form (October, 2010). See Table 2.

Table 2

What is a TRIM?

Setiyanti &Hunt, 2016

A ***TRIM*** …

- is a form of graphic organiser.
- is a visual representation. In this instance, the visual consists of a matrix (the ***trim*** organizer) and words that tell the story.
- helps to organise thinking, in this situation, thinking about ICT Integration.
- has four organisers --
    1. The Task: open-ended questions are best.
    2. The Technologies: what is available?
    3. The Pedagogies: class organization, use of collaborative and cooperative activities, embedded Higher Order Thinking.
    4. The Advantages for Learners: Is it - inclusive, accessible, connected, rich in intellectual quality, and does it recognise difference?

The matrix encourages teachers to *reflect* on the quality of ICT *integration* in a lesson or unit.

An example of a TRIM completed by a participant is shown in Table 3.

Table 3

A Sample of a Completed TRIM From a Participant in the Master Class

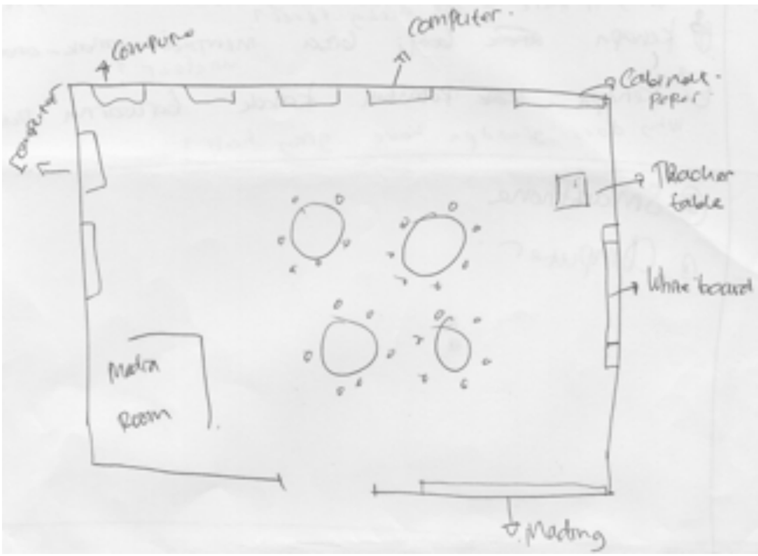
The Task	How can we make crafts using natural materials? (CK, PK)
The Technology proposed	LCD projector (TK, PK) Speakers (TK, PK) computer and Internet (access to information) (TK)
The Pedagogies to be employed	Small group research (collaboration and cooperation) (PK) Groups reporting back to class and sharing (PK) Knowledge construction (PK mediated through PK, PCK, TK and TCK
The Advantages for learners	Shared knowledge (PK) Relevant and connected curriculum (CK) Rich in intellectual quality (PK)

This matrix is not dissimilar in form to the rubric of Harris et al., (2010). It differs in that it seeks to identify the TPACK dimensions in each row of the TRIM Matrix, shown by the annotations attached.

Data Collected and Analysed

Task 1 (n=35): *Draw a picture of a classroom from a bird's eye view.*

In response to this task, 35 students submitted drawings of an ideal classroom layout. Of these, 27 reflected traditional classroom designs that might be termed teacher-centric: the teacher was placed at the centre or front of the class, and desks/seating were arranged in rows or as a half-moon (semi circular). The remaining eight showed a rather contemporary view where desks were arranged in clusters of four to six and randomly placed around the classroom. Some respondents suggested spaces be made for computer use or practicing presentations.



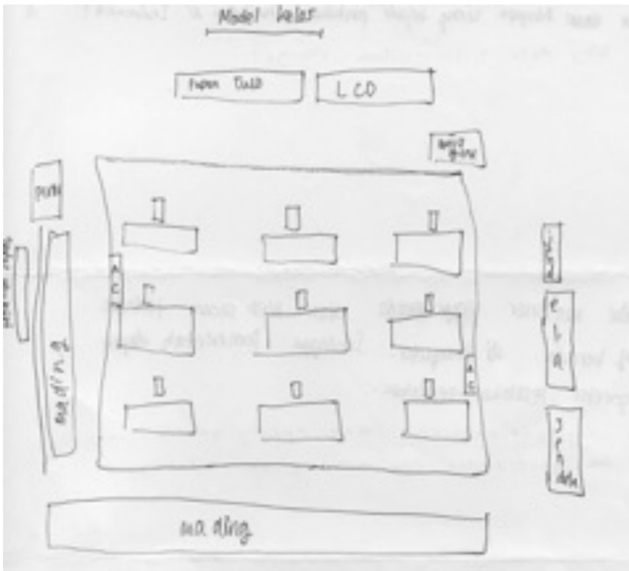


Diagram 2: A contemporary classroom (first) and a traditional classroom (second).

This activity probed PK in particular and could be used by teacher educators to focus on classroom organization and thinking/sitting behind different ways of organizing a classroom to maximize learning. Aspects of TK and TPK were evident in the students' pictures where space was allocated for computer use. In both images, the teacher (guru) is placed at the front of the class; the differences lie in class organization and the tools of teaching. Both have placed an emphasis on the use of LCD (data projector).

Task 2 (n=35): *Using TodaysMeet, describe what a contemporary teacher looks like, sounds like and feels like.*

Common responses to this task included notions such as: friendly, good, fun, open minded, understanding, delivering learning, feelings (empathy) for students, always there and supportive. This activity provided a further insight into PK, particularly ideas such as supportive, friendly, open minded and understanding.

Diagram 3: Word cloud of common responses to Task 2.

Task 3 (n=35): In *TodaysMeet, identify the tools used by contemporary teachers.*

In response to this task respondents offered ideas such as: media (YouTube), creativity, hands on materials, real data, thoroughness, visual materials/aids, books, stories, cooperation, experiments, attractive animations, technologies, the environment, new and modern tools such as computer and the Internet, videos to elicit student thinking, and LCD (data projector). This task and its analysis added to understanding of TK, TCK and PK.

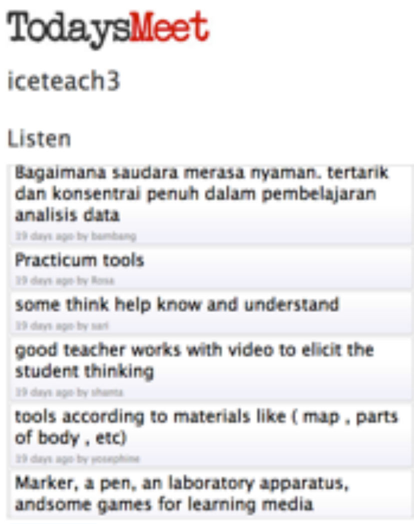


Diagram 4: Screenshot of the conversation thread related to the above task.

Task 4 (n=35): *Develop a Technological Reflection Integration Matrix (TRIM).*

The matrices developed started with a TASK description, a question to ask, a topic to discuss or a research problem to investigate. Some students focused on topics close to their studies, including: Why does the curriculum change so often? What are good strategies to improve your English? Why do we have to shower twice a day? What does nationalism mean to Indonesians? What are your aspirations and Why do we need to go to school? to How can we remove corruption from Indonesia? These ideas are relevant contexts for the students and give an insight into their Content Knowledge (CK), or a desire to enhance their CK. More importantly, they show open-ended questions likely to stimulate Higher Order Thinking (PK). This relevance to the students' lives is also indicative of a curriculum connectedness and context for learning. The open nature of the tasks suggested is also inclusive and encourages all students to participate and have a voice.

The use of technology integration (TK, TCK) was also canvassed in the second row of the matrix and drew such ideas as: use a computer, use the Internet, use video clips for learning (most referenced), make voice recordings, show pictures and lessons using an LCD (data projector), use a national database of teaching plans, and use Hand Phones (HP) to communicate and find information The range of ideas proffered, whilst not as wide as perhaps in a developed nation, shows an understanding of what is available in schools.

The third row of the TRIM sought ideas mainly around Pedagogical Knowledge (PK) and included ideas such as: small group discussion in a practice or quiet space in the classroom (most common idea); develop a group paper/presentation, group analysis and discussion of video clips; working in groups to share ideas, working and thinking together; having group sharing sessions; problem based learning; collaborative and cooperative learning. Working in small groups was most common in the TRIMs analysed, followed by collaboration and problem based learning. The final stage of TRIM asks students to identify Pedagogical Advantages (PK, CK) for learners. When examined as part of the broader TRIM matrix, it is possible to make links to the domains of the TPACK framework (as illustrated in Table 3). Responses included:

- Growing and sharing knowledge about an idea.
- Students work on areas of interest to them.
- Students understand better when working together in groups.
- Teamwork leads to deeper understanding.
- Students improve social skills when working in a group.
- Students construct (facts) though knowledge sharing.
- Students develop deeper thinking.
- In groups, they can share the technology available.

Discussion

The use of these four tasks has provided an insight into the TPACK of the cohort of elementary pre-service teachers who participated. If the teacher educators at the university were to examine artifacts such as these, it would provide direction for the re-development of Pedagogy and Curriculum courses taught. An analysis of these artifacts, a result of a quick 90-minute workshop, shows where minds need to be re-focused. A simple graphic of a classroom provides information about classroom design and layout; questions about the qualities of teachers tells about the self-perceived qualities required of teachers; and the question about the tools teachers use indicate notions of teachers who are seeking to teach as they were taught and those who seek to make a pedagogical difference.

In considering the four tasks given, the matrix in Table 4 shows how each task has contributed to understanding TPACK.

Table 4

Matrix Illustrating the Visible Aspects of TPACK in Each Row of TRIM

The Task	The information in this section provides an insight into participants understanding of content (CK) and context. When examined further, it is possible to identify aspects of higher order thinking (PK and PCK).
The Technology	Whilst this is limited by the context of the classroom (Indonesia), elements of TK and TCK are evidenced.
The Pedagogy	This row provides examples of PK, PCK, and TPK.
The (Pedagogical) Advantage for Learners	These tasks enable learners to: share knowledge, work with a connected and relevant curriculum, and complete tasks that are challenging and rich in intellectual quality

Note: The claims above are dependent on (a) the quality of the task (b) access to a range of technologies and (c) the use of collaborative and cooperative classroom strategies. These are a part of an ongoing learning process for students.

In the next paragraphs, the research questions are discussed.

RQ 1: *Can elementary teacher and pre-service teacher TPACK be more effectively measured using a blend of tools?* The use of these four tasks has provided a measure of pre-service teacher TPACK. Singularly, they do not provide a rich view. Understanding prior knowledge and beliefs is important, for both pre- and in- service teachers. However, knowing a TPACK profile alone does not change practice but it can inform measures to be taken to move forward from past practices. Knowing what they (students) already know or bring to the party underpins constructivist practice.

RQ 2: *How effective are graphic organisers and rubrics in identifying the seven domains of TPACK?* The domains of TPACK can be seen in most of the samples provided, although the balance is rather erratic. Many students are using traditional classroom organization and do not make explicit the use of collaborative and cooperative strategies. Technology use is limited, and an artifact of the general situation in many Indonesian schools and educational institutions. Having said there, it has been observed in other studies by the researchers that this is an area that is improving rapidly. TRIM is a tool for reflection on practice, and it might be expected that, over time, a better balance will be evident across the four themes of TRIM.

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FROM BOOK CULTURE TO DIGITAL CULTURE – CHALLENGES POSED BY ICT TO YOUNG ARAB READERS

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Abstract

Relying on **t**he data of the Galilee Society, **t**his paper discusses cultural issues regarding book culture and the implications of ICT culture on reading books among Arab Palestinian youth in Israel. The data show clear reduction in book reading among this population, while computers and Internet service are on the increase among Arab families. The accelerated development in ICT dominates the Arab youth life intensively. Therefore, they do not find a meaningful place for books in their everyday life. As educators, who lived through book culture and ICT culture, our big challenge is how to get students to enjoy reading books.

Introduction

Culture is the beliefs, customs, arts, values, attitudes, meanings, religion, etc., of a particular society, group, place, or time, that are passed along by communication, teaching and imitation from one generation to the next (http://www.learnersdictionary.com/definition/culture).

Culture refers to a set of phenomena relating to quality of life, customs, and so on, expressed in broad circles of society and affecting the quality of life directly and indirectly. It "determines what is acceptable or unacceptable, important or unimportant, right or wrong, workable or unworkable. It encompasses all learned and shared, explicit or tacit, assumptions, knowledge and norms, as well as behavior, dress, and language" (http://www.businessdictionary.com/definition/culture.html).

The book, in its various forms, has always been a source of religious knowledge, information and emotional experience. Book culture has evolved as a result of the use of written language. It relates to cultural texture that is made-up within a specific society, based on knowledge and basic skills of writing and reading. The book represents a complete system of information technologies that were foreign to the educational and cultural values prior to the printing of the book. Over the years, the development of the printing press replaced the human labor and the printing technologies enabled the mass distribution of the book knowledge (Givon, 1995).

Usually the term *technology* is associated with devices. Givon (1995) argues that this is a limited and misleading meaning of the term. *Technology* is any knowledge organized for practical purposes. Therefore, math, writing and reading are also technologies, regardless of the devices we use in performing these actions. However, devices play a major role in technological applications.

Printing was invented based on the invention of writing technology in purpose to find an easy, quick and inexpensive way to distribute written products to the masses. Printing allowed written materials to all. Eisenstein (1983) argues that the invention of printing brought about the greatest Cultural Revolution in the history of the human kind. This revolution is expressed in the ways in which knowledge was preserved, used and passed on to the succeeding generations. However, printing could not take effect if the masses did not know how to read. Reading and writing are the cultural basis that contributed to the printing machine taking a place as a significant factor in the culture of humanity.

The computer was invented on the basis of developing calculations that were formulated throughout thousands of years. The computer enables the masses to know the processes of calculations and their products. ICT culture has evolved as a result of the development of computerized information languages.

Similar to book culture, ICT culture could be a cultural texture that is open to anything, and based on personal use of computerized information systems. ICT culture is a new cultural factor that is manifested in the ways in which man uses ICT systems to create, to process, to represent and to transmit the information as a factor that contributes to the quality of the human beings.

The rapid expansion of ICT to all areas of life since the ' 90s of the previous century raised the questions about its contribution to improving education, especially in light of the fact that some of ICT properties correspond to learning principles and are appropriate for improving learning.

In recent years, information consumers have faced a rapid growth in accessibility to digital text and spread of online textbooks, newspapers, encyclopedias and journals. In this context, it is important to distinguish between three kinds of reading: (a) academic scientific reading, (b) learning reading (school), and (c) literary reading. Scientific reading that requires a certain topic is easier to search on the Web as well as is all kinds of articles and learning materials. On the other hand, literary reading from a book for enrichment and enjoyment is more convenient and easier. The book enables consistent leisurely reading, relaxation and improves focus and concentration (Da'eem & Younis, 2007).

This shift, from print towards digital reading is especially critical in higher education and the school systems, where learning from digital texts becomes increasingly more common (Cargill, 2011). Reading from digital displays poses a wide range of challenges for readers (Altonen, Mannonen, Nieminen, & Nieminen, 2011), mainly, because of the large reading distance from a computer screen as opposed to the short reading distance from a printed book, the long lines of text on the wide computer screens and the problem of shifting the eye gaze from line to line while reading (Evans, Charland, & Saint-Aubin, 2009). In addition, text fragmentation, associated with the nonlinear nature of hypertext, results in a decrease in text coherence (Ozuru, Dempsey, & McNamara, 2009). Reduced text coherence in digital displays creates disorientation, presents readers with a high cognitive load (Ackerman & Goldsmith, 2011) and harms text comprehension (Chang & Ley, 2006). Consequently, many studies report that text comprehension from digital displays is inferior to comprehension from print (Ackerman & Lauterman, 2012). Ackerman and Goldsmith (2011), claim that differences between print and digital comprehension are mainly a result of differences in self-regulated learning that are dictated by these two media.

The recent abundance in learning from digital displays and the accumulating evidence on the inferiority of comprehension from digital raises the need for a better understanding of the role that learning strategies and active learning tools play in digital reading. Studies on printed text suggest that a reader can improve monitoring of the learning process by utilizing learning tools such as annotation, highlighting, writing keywords, summaries and reflection (Pressley, 2000).

Examining the difference in students' attitudes towards reading between those using e-readers and those students not using e-readers during guided reading instruction, Long & Szabo (2016) found that the e-reader participants had a negative gain, while the traditional text group had a positive gain in attitude toward reading.

The findings of Ben-Yehudah & Eshet-Alkalai (2014) suggest that employing an active learning strategy during reading from print is effective mainly for deeper processing and understanding of the text, and not for learning that is based on memorization of facts. For the digital reading condition, highlighting did not improve comprehension at all.

On the other hand, Leutner et al. (2007) found that a computer-based training program designed to improve readers' use of text highlighting and self-regulation led to greatest improvements in text comprehension, relatively to other training programs.

Reading habits of young readers are acquired through exercise and imitation (Sobrino, 1994). Undoubtedly, the dilemmas that accompany the Arab reader are universal dilemmas, since they are the direct result of the post-modernist world. Twenty-first century students are surrounded by technology that brings the world to their fingertips and many have been surrounded by technology since they were babies (Derene, 2013).

However, we cannot ignore the unique nature of the Arab society in Israel, as an indigenous minority in a multicultural society. This entails and steers the youth on the path of reading and influences the product. The technological development enables accessibility to digital books more than in the past, and the percentage of people who can read is larger. However, not all books are of a good quality and not all those who are able to read do indeed read. Using the reports of the Galilee research association on reading among Arabs in Israel between the years 2004 – 2014, this paper tries to estimate the effect of the abundance of digital texts on reading printed books among Arab youth.

Reading

Reading is an acquired cognitive mental and linguistic ability that allows the reader to interpret texts and construct through them meaning and identity. Reading in its broad meaning is a form of cultural consumption, a decoding process of a lot cultural products, cultural works, plays, newspapers and so on.

Literary reading is a process in which the readers absorb the message and the meaning of the literary work in a manner that suits their own perception. The transactional theory of reader response (Rosenblatt, 1978) supports the idea that readers understand or "make sense" of their reading based upon their personal experiences. Every time a person reads, there is a transaction between the reader, the text, and the context. Reading motivation is correlated with how much time a child reads (Morrow, 1992). Children, who read more tend to be better readers, perform better on standardized testing and develop into lifelong readers (Wang & Guthrie, 2004).

Reception Theory, focusing on the reader's reaction and his interaction with the literary work, argues that there is a dialog that take place between the writer and the reader, who constitutes two factors interacting outside the literary work and the text, assumes a life of its own during the reading process (Iser, 1978).

Readers use reading not only as a source of pleasure but also as a process for identity formation and as a tool to gain cultural capital. The cultural value readers place on cultural products such as books, and works of fiction in particular are dependent upon not only what they learn from parents, but also through what they learn through school and university, work and social networks (Ross, McKechnie, & Rothbauer 2006).

Learning to read and write in Arabic constitutes a significant challenge for readers mainly because it is based on a unique social context called *diglossia.* One of the essential linguistic features of diglossia is the considerable linguistic distance between the spoken language of children, which is acquired as a mother tongue, and standard Arabic, which is represented in writing and is acquired mainly in formal teaching of reading.

The orthography of the Arabic language has its own unique characteristic. The Arabic language has 29 letters, which have 119 forms. Each letter has three or four forms: at the beginning of the word, in the middle of the word, at the end of the word, connected or not connected (Abu-Rabia & Taha, 2006). This aspect constitutes a triple challenge of reading and writing the same letter accurately, in all its forms and wherever it occurs.

Reading Books Among Arab Youth in Israel

The data about the percentage of reading in the Arab society in Israel relies on a socio-economic survey of the Arab population in Israel that has been conducted four times in the years 2004, 2007, 2010, 2014 by Galilee Society Research Association & Rikaz - database (Mohammad & Rezek, 2015).

The Galilee Society correlated reading interest and proficiency with larger patterns of academic, economic, cultural, and civic achievement among Arabs of all ages. The following table highlights basic data relating to individuals and households characteristics.

Table 1

Basic Data: Technologies in Household, Education and Media Culture Among Palestinians in Israel (ages 10-19), 2007, 2010 and 2014

Per year	**2007**	**2010**	**2014**
Total amount of families participating in the survey	3270	1931	1689
Housing Unit			
Computer in Household	49.6%	59.5%	65.3 %
Internet Service in Household	33.8%	55.2%	74.4 %
Telephone Line	62.7%	53.7%	53.5 %
Home Library	42.8%	39.8%	41.4 %
Education, Media and Culture			
Literacy Rate (15 Years and over)	95.1 %	94.2 %	96.1 %
Educational Enrollment Rates	41.2 %	39.2%	39.2%
Drop-out Rate (Population Age 5 years and Above)	22.5%	21%	19.2%
Computer Usage (10+)			
Always	23.1%	38.5%	42.9%
Sometimes	13.2%	17.9%	16.7%
Internet Usage (Persons Age 10 years and Above who use a Computer)	52.9%	90.6%	90.4%
Email (Persons Age 10 years and Above who use a Computer and the Internet)	49.5%	66.5%	72.4%

The table shows that purchased computers and Internet service are on increase among Arab families. In 2014, 65% of the families had computer and 74.4% had Internet service, compared to 50% and 34% in 2007, respectively. However, acquiring a phone line is on the decrease: 53.5% in 2010 and 2014, compared to 62.7% in 2007. We can associate the reason with the development of Smartphone technology that allowed access to the media anytime and anywhere. About 40% of the participants in average reported they have home library.

The findings show no notable differences in educational data from 2007, 2010 and 2014. Most Palestinians in Israel (15 years and above) are literate (96.1% in 2014). The education enrollment rate is 39.2%, and the general dropout rate of Palestinians in Israel aged 5 years and above is 19.2% in 2014, compared to 22% in 2007.

In 2014, 90.4% of computer users aged 10 years old and above used the Internet, 43% of them always used it, compared to 52.9% and 23% respectively in 2007. In addition, the use of email is in significant increase in comparison between the years 2007 (49.5%), 2010 (66.5%) and 2014 (72.4%).

The following table highlights several findings from 2004, 2007, 2010 and 2014 relating to reading among young people in the 10-19 years age group.

Table 2

Reading Practices of Arab Youth (ages 10-19) in Israel, 2004, 2007, 2010 and 2014

Reading practice per year	**2004**	**2007**	**2010**	**2014**
Total amount of families participating in the survey	3270	3270	1931	1689
Do not read newspapers	41.4%	48%	53%	60.5 %
Do not read magazines	57.5%	63%	74%	80 %
Do not read books	70.6%	74%	82.6%	75.2 %
Read one book during the month of the survey	21.1%	14.3%	8.8%	13.4 %
Read two books during the month of the survey	4.9%	6.5%	2.9%	6.2 %
Read three books during the month of the survey	3.3%	4.7%	5.7%	5.2 %
The general population (all ages) – did not read any books during the month of the survey	74.1%	80.3%	82.6%	83.1 %

The table shows a clear reduction in book, newspaper and magazine reading among Arab youth in Israel and in book reading among the general population. In the years of the survey, an average of 75.6% of the youth reported that they had not read a book during the month prior to the survey, and 83% of the general population (all ages) – did not read any books during the month of the survey in 2014, compared to 74.1% in 2004. Reading newspapers and magazines is also declining among Arab youth. In 2004, 59% read newspapers and 43% always read magazines, compared to 39.5% and 20% in 2014, respectively.

The data created concern regarding the younger educated generation. The results imply increased responsibility for the Ministry of Education, the educational and cultural institutions and all the agents of change to publish good quality books and establish a program to encourage reading. Of course, we should not disregard the importance of the family in encouraging reading and visiting book fairs and public libraries.

It is important to mention that the accessibility to books and newspapers is today far greater than in the past and its cost is reasonable, but we have no statistics about reading in the past of this particular population, for comparison.

Discussion and Conclusions

The adaptation of innovative technologies for learning and teaching faces learners, developers and instructors with a wide range of challenges that should be considered for a successful implementation. This paper discusses cultural issues concerning the implications of digital culture on reading books among Arab Palestinian youth in Israel.

The ICT revolution is a deep cultural revolution changing all modes and patterns of our lives and is hence bound to lead to dramatic changes in education. It has a powerful defining impact on all-important aspects of our lives and hence our culture (Aviram & Talmi, 2004).

Language is a significant cultural element. Every nation wants to preserve its culture and transmit it from one generation to the next. For this purpose, people need to acquire language skills, particularly reading, writing and understanding.

Book culture is based on knowledge and basic skills of reading and writing that provide strength and advantage in relation to those who lack them. This knowledge and these skills expand and enhance the individual's ability to perform actions relating to communication, thinking and information processing.

The data of Galilee Society indicate clear reduction in book, newspaper and magazine reading among Arab Palestinian youth in Israel and in book reading among the general population. On the other hand, computers and Internet service are on increase among Arab families.

As a part of the Global village, the accelerated development in ICT including smartphones has dominated intensively people’s life, especially the youth life. The youth do not find a meaningful place for books in their everyday life. Their daily reading habits center on tweets, Facebook and Instagram updates, games or chats. Eshet-Alkalai et al. (2010), argue that most of the innovative technologies are developed for organizational, entertainment, and communication management purposes, and not inherently for educational purposes.

Undoubtedly, in the ICT era changes occurred in book culture, and the books went through some process of renewal. Innovative systems for coding, cataloguing, distributing, and tracking books have been implemented. Still, the price of paper books is relatively high and to achieve them we need to go to a bookstore or library. Moreover, they require storage space, and some of them are heavy to carry. On the other hand, digital storage is easier and can be retrieved from anywhere. In a click, one can get novels, newspapers, dictionaries and all types of information.

In the ICT world, educational activities can be performed online without having to go to the library. Although people saved time and effort, the way to the public library has been accompanied by a walk and face-to-face communication.

However, the buzz of electronic media predominates in this era. Within the incessant flow of twenty-four-hour radio and television, the visual and sonic entropy of digitally enhanced cinema, the dizzyingly connective Internet maze, the kaleidoscopic intensity of digital gaming, and the frenetic pace at which new media of all stripes seem to shape the patterns of our daily lives, it seems difficult to imagine books shouldering much world-historical responsibility anymore.

Reading seemed to be corruptible, and consequently, in need of immediate intervention (Striphas, 2009). In the ICT world, the young generation does not get sufficient advising to read printed books, and their attention is drawn in many different directions at once. During single 5-minutes, average people will divide their time between working on a task, checking email, chatting with a couple of people, keeping an eye on twitter, monitoring their smartphone, and interacting with colleagues.

However, books have played-and will continue to play-an important role in shaping the syntax of everyday life. They continue to serve, sometimes in new ways, sometimes in traditional ones, equipment for living. In other words, books remain key artifacts through which social actors articulate and struggle over specific interests, values, practices, and worldviews. Books are artifacts with a deep and abiding history that belong in and to our own age, no more and no less so than flat-screen televisions, MP3 players, computers, and other so-called cutting-edge technologies (Striphas, 2009).

The value of books lies in their capacity for moral, aesthetic, and intellectual development. While reading a book, the readers' attention is focused on the story for example, and they can immerse themselves in every fine detail they are absorbing. Therefore, the challenge of writers is to write in a correct and rich language, aesthetic and artistic style, maintain the quality and diversity of contents, produce and present in decent, beautiful and creative manner; writing in different levels for different abilities and publishing good literature.

Other parties such as parents, educators, school and public libraries should be involved in cultivating reading habits among children by training and guiding them towards the right choice of books and by maintaining warm relationships between the child and the book. Schools should activate programs for promoting reading such as competitions between readers and provide various reinforcement for this purpose. The challenge of ICT makers is to publish good literature and useful e-books as well.

Book culture and ICT culture are two different faces of the coin; each face has different implications on reading books, some are positive, and some are negative.

As an intermediate generation of educators who lived through book culture and ICT culture, we are aware of the importance of reading books while our big challenge is to get students to read and enjoy reading books. However, we are in a dilemma between ICT culture that takes over people's lives and book culture that is declining among young people.

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21ST CENTURY LEARNING AND DIGITAL LITERACY: PIPE DREAM OR SMOKE AND MIRRORS?

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Abstract

This paper is set within the contexts of changes occurring in higher education institutions (HEI) and hegemonic struggles in relation to an intensification of neoliberalism in society (Berdayes & Murphy, 2016), and social justice and emancipation (Freire, 1968/2005). We discuss bottom up (educators and institutions) and top down (UNESCO and 21st century learning agenda) factors. Finally we critically discuss implications of the changes on pedagogy, focusing on inquiry-based learning (Hutchings, 2007) as a case study.

Introduction

The function of attending university is changing in terms of having graduates meet the short term needs of the state and corporate interests. Central to this is students are constructed as consumers and customers, and qualifications considered to be investment projects for employability (Lawrence & Sharma, 2002). Academic staff become service providers and research entrepreneurs (Hall, 2016). Universities are increasingly corporate, with strategic plans, key performance indicators and cost benefits analyses using metrics (Birnbaum, 2000; Conlon, 2004). We discuss the contested and competing value systems and ideological imperatives that underpin these changes.

In 1998 UNESCO issued its World Declaration on Higher Education for the Twenty-First Century to promote several important principles regarding creativity and critical thinking in higher education, that became known as the 21st century learning agenda. Since its publication, global higher education has undergone dramatic change and enrolments have increased at a rate of about 5% per year. Today, higher education is arguably undergoing an academic revolution, and many countries report having reached universal access status (Blessinger, 2015).

Given the great importance that countries place on higher education to help address a variety of socio-economic issues (e.g., employment, innovation and economic growth), universities are putting greater emphasis on graduate attributes (Daniels & Brooker, 2014; Haigh & Clifford, 2011; Hughes & Barrie, 2010; Osmani et al., 2015). Increased importance is given to knowledge, attitudes and skills that meet the demands of 21st century society that include critical thinking, independent learning, and knowing how to critically manage an abundance of information termed *digital literacy,* which:

> refers to the awareness, attitude and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyse and synthesize digital resources, construct new knowledge, create media, and communicate with others, in the context of specific life situations, in order to enable constructive social action; and to reflect upon this process (Martin, 2006, 19).

Due to the rapid change brought about by globalisation, modern societies are becoming increasingly hyper-connected and interdependent. In an age of open educational resources (OERs), massive open online courses (MOOCs) and the use of learning management systems, digital technology and virtual learning environments (VLEs) impact on the philosophy that underpins what universities offer students as learning opportunities and experiences.

Issues of widening access (Archer, Hitchings & Ross, 2003; Reay, David & Ball, 2005) increased staff student ratios (McDonald, 2013; McMurtry & McClelland, 2014) and its impact on retention and progression (Bowl, 2001; Longden, 2002; Thomas, 2002; Wyatt, 2011) and educators' ability to deliver quality feedback (Boud & Falchicov, 2007) have been extensively researched.

Our previous research examined assessment practises considering changes from students' and educators' perspective. In 2015, we explored students' perspectives and found that, despite clear differences in course content in Brazil and Scotland, students' perceptions of the assessment process using VLEs revealed similarities. Participants resisted several *embargos*, a term introduced by the authors (McPhee & D'Esposito, 2015), which described real and imagined barriers related to student success embedded in teaching and assessment institutional habitus. Barriers to learning and engaging with assessment included students reporting having to work long hours to fund learning, family commitments, and social class based perceptions of academic ability that impact on educational success. In 2016, we turned our focus to the perspective of educators. Assessment feedback remains a demanding task, and despite efforts for innovation and creativity in how feedback is delivered, gaps remain in how and in what way assessment is considered useful in aiding employability and demonstrating subject specialist knowledge (D'Esposito & McPhee, 2016).

Intrigued by these findings, we locate the focus of this paper on those factors that take up a great deal of the time of academics. We discuss the neoliberal agenda both top down (UNESCO and 21st century learning agenda) and bottom up (educators and institutions) that shape academic practices in relation to the nature and function of assessment. We address the 21st century learning agenda and its impact on our understanding of pedagogy and andragogy; the applications and development of innovations in assessment design, focussing on inquiry-based learning (IBL) as a case study. Finally, we discuss the potential impact of pedagogical changes on student learning and staff workload

21st Century Skills and the Pillars of Education

The 21st Century skills agenda is defined by a broad set of knowledge, skills and attitudes considered necessary for success in contemporary work environments. In 2002, the Partnership for 21st Century Learning[1], a broad coalition of financial and corporate interests, educational groups, technology firms, and media content providers [2], defined and illustrated the skills, knowledge, and expertise required to succeed in work, life, and citizenship (Warschauer & Matuchniak, 2010). The framework proposed by 'The Partnership'[3] has impacted on standards, assessments, curriculum and instruction, professional development, and learning environments.

This '21st century learning' agenda aligns with the four pillars of learning proposed by UNESCO (Delors & UNESCO, 1996):

1. Learning to know: cognitive tools required to better comprehend the world and its complexities, and an appropriate and adequate foundation for future learning.
2. Learning to do: the skills that would enable individuals to effectively participate in the global economy and society.
3. Learning to be: self-analytical and social skills to enable individuals to develop to their fullest potential psycho-socially, affectively as well as physically.
4. Learning to live together: values implicit within human rights, democratic principles, intercultural understanding and respect and peace.

These top down factors are noble aims that drive the 21st century learning agenda (Rotherham & Willingham, 2010). Given the current state of dwindling staff resources, cuts to budgets, widening access and its impact on progression and retention, can this 21st century learning agenda create digitally literate critical thinking effective communicators? We will now turn our attention to the factors emerging from educators.

The Dominant Discourses and Practices of Assessment

Boud (2000) writes that assessment is a value laden activity, underpinned by debates about academic standards and as a preparation for employment, as well as a measure of quality and achievement, and incentives for student success and satisfaction.

Dominant views of assessment and particularly summative assessment construe the learner as a passive subject, subjected to the practices of the institutions to confirm learning has taken place. In understanding the dominant discourses of assessment Boud and Falchicov (2007, p. 4) helpfully indicate that:

> …assessment would be less of a problem if we could be assured that what occurs under the guise of assessment appropriately influenced student learning … Commonly, assessment focuses

> little on the processes of learning and on how students will learn after the point of assessment.

Assessment practices are driven by several issues such as quality assurances, confirming learning outcomes are achieved, determining achievement and ensuring confidence in standards and procedures. These practices conform to the needs of bureaucratic procedures over which students have no say, and little control. However, as Boud and Falchikov (2007, p. 4) point out:

> We are now able to step back and challenge the controlling effect of assessment that focuses students on performance of assessment itself, rather than on what studying in higher education is arguably for: that is, providing a foundation for a lifetime of learning and work in which there is little formal assessment or formal instruction.

The dominant discourses and practices of assessment have created an impetus for change from educators to meet the needs of students.

As it has been convincingly argued, in HEI limited budgets, increased staff student ratios (McDonald, 2013; McMurtry & McClelland, 1997) have impacted on the ability of educators to deliver quality feedback (Boud & Falchicov, 2007). In attempting to provide feedback, educators have relied on technology to help. The benefits of technology (VLEs, Turnitin and similar assessment standardised tools) are ways in which busy academic staff can provide assessment feedback.

The Impact of Technology on Education

Recent developments in technology, for brevity labelled *Web 2.0* tools, allow two-way interaction with knowledge creators. Affordable processing power in devices such as tablets, phones and computers, give the end user control (to an extent) over access to, and the creation and sharing of, knowledge.

In education, this creates several factors that impact on staff and student expectations and behaviours. As students are empowered by easy access to knowledge, educators must find ways to innovate traditional ways of altering what universities provide for students and the tensions over control of this experience that occur between staff, students and institutions.

Using technology to provide access to education such as *blended learning* blurs the boundaries between on campus and online modes of study. Class and face to face teaching is reduced, and replaced, in part, by online or face to screen engagement.

Written text can be replaced by interactive learning objects such as TouchCast and similar technologies. Using multimedia is not new. However, the use of technology for its own sake, because it allows free, or easily accessed information, raises issues of quality, appropriate use, ownership of programme resources and measurable learning outcomes.

The education system has been arguably influenced by what Ritzer (1996) termed *McDonaldization*, -- the process by which the principles of the fast food industry are coming to dominate more and more sectors of the world. The author outlines four characteristics of this mechanistic worldview: efficiency, predictability, calculability (quantifiable results) and control. Regarding education, McDonaldization attempts to address perceived inefficiencies in learning. These processes have led to educational experiences at university becoming a commodity that can be digitally packaged, marketed and sold.

Changes to Pedagogy Linked to a 21st Century Learning Agenda

Pedagogy encompasses all age groups and contexts in which teaching-learning processes take place. For Freire (1968/ 2005), it is best understood in the concept of *praxis* (with theory and practice in permanent dialogue) and concrete educational practices (Streck, 2010). We use the term to refer to teaching-learning processes and teaching learners how to learn.

Methods of integrating learning are key components of how HEI aim to develop learning in their students and meet the 21st century learning agenda. One increasingly common method is *IBL*, which is an umbrella term that covers a range of pedagogical approaches widely recognised and advocated in higher education. They are united by the central place given to students' investigative work addressing questions and solving problems, seeking and creating new knowledge and understandings. Problem-based learning, project-work and case-studies, would be examples of these approaches driven by a process of student centred (personalised) inquiry (Hutchings, 2007).

IBL is a student-centred and student-directed process. It excludes teaching approaches that are primarily concerned with the explanation of content or a topic (Aditomo, Goodyear, Bliuc & Ellis, 2013). Using this method, teachers act as facilitators and encourage, providing guidance and support. There is an increased use of technology to deliver teaching and support to assist students to engage with new forms of assessment.

The classroom is no longer the unique epicentre of learning, based on information delivered through a lecture. IBL focuses on knowledge construction by means of an active learning centred process to allow students to acquire experiences in a range of intellectual and social capabilities. These are said to include critical thinking, reflection and self-criticism, teamwork, independence, autonomous thinking and information literacy (Hutchings, 2007, pp. 12-13).

Increasingly, there is a sharing of power between the educators and the learner, which is a welcomed change. However, student expectations have radically altered the interaction between staff and students. Learning becomes a process of staff-student negotiation rather than educator directed. This manifests as a changing teaching role, towards support and negotiation over content and methods, and a focus on developing and supporting learner autonomy. Emphasis is placed on learners supporting each other using social media, peer assessment, discussion groups, and guided online study groups.

It is reported that IBL can help students become more creative, positive and independent learners (Kühne, 1995; O'Shea & Young). It can provide opportunities for students to develop skills that are essential for work, learn to cope with problems that do not always have clear solutions, deal with challenges to accepted wisdom, and shape how solutions are discovered.

Assessment of IBL

It has been mentioned that assessment underpins the student experience, and should in practice align with desired learning outcomes, as Biggs (1999) notes in his model of constructive alignment.

Given the wide range of intended outcomes that underpin the 21st century learning agenda, a range of assessment methods are required to match the open-ended nature of IBL. While it is possible to apply traditional assessment methods to IBL, such as end of module exams or written assessment (particularly to meet discipline or professional requirements in terms of theory and practice), most typically assessments, especially at undergraduate level, often include some form of group task. As Kahn and O'Rourke (2004) note in their guide to curriculum design in relation to EBL (enquiry based learning, a variant of IBL) grading a group assignment is challenging (Bryan, 2004, cited in Kahn & O'Rourke, 2004). If the assignment is formative, then this poses fewer challenges. However, in high stakes assessment innovation such as IBL can pose several challenges (Boud & Falchikov, 2007). In a summative assignment, assigning a grade that matches the efforts and contributions of all contributors is an issue.

A portfolio, for example, allows wide scope in terms of what counts as referenceable material, and this may not include peer reviewed academic texts and research. This raises the issue of what counts as a suitable source of material that can be considered *academic.*

The key to all of this is how it impacts on teaching, learning and assessment. What appears to be missing is research evidence that validates the innovation that leads to measurable benefits for staff and students.

Criticisms of 21st Century Learning

The 21st century learning agenda poses a great challenge to HEI on how to encourage the acquisition of an increasing body of technical and scientific knowledge while fostering the development of key graduate skills and attitudes (Ribeiro, 2011), that underpin the 21st century learning agenda.

The changes posed for educators are about ensuring an environment that develops critical thinking and skills, without disregarding content and subject specialist knowledge. In IBL, learning is posited as self-directed (or self-regulated) through collaboration, creativity and innovation. It remains difficult to see how such interactions improve learning (Rotherham & Willingham, 2010).

IBL in practice requires formative assessment and feedback, which increases staff workload considerably. Peer assessment, for example, which is an IBL suggested practice, impacts on teaching workload as staff acting as facilitators also increases workload (Graham, 2010, cited in Harmer & Stokes, 2014: 23). Therefore, despite radical changes to pedagogy and the use of technology and innovation, staff may continue to gravitate to the use of summative assessment that may be driven by discipline and professional requirements.

While research results can demonstrate teacher satisfaction in relation to IBL, they also point to (a) pedagogical challenges (e.g., finding a balance between need for input and the amount of freedom given to students to explore and experiment, higher class unpredictability, how much support to provide) and (b) a considerably increased time/workload, routinisation, and further constraints to staff autonomy (Ribeiro, 2011).

Impact of 21st Century Learning Agenda on Students

Student learning is a key component of this emerging pedagogy, with their success as the main goal of staff activity. Technology increasingly underpins innovation in teaching and learning. Matching pedagogy, learning objects, subject matter, and student access and success using appropriate technologies, software, and online strategies remains an ongoing challenge in online and blended modes of learning.

The use of technology has the potential to emancipate. However, access to information is increasingly becoming a site of conflict. Curricula, teaching-learning and research is becoming organised to foster creative thinking at every grade level, and creative thinking and critical thinking should enhance and complement each other. The changes in assessment that underpin IBL can create the potential for critical thinking and are relevant to a society that has access to an abundance of information. However, if academic texts are replaced by group exercises such as poster assessments, digi-essays, and other innovative assessments that underpin IBL, will students seek the easiest options, of using Google Scholar or Wikipedia rather than learn how to read and critically understand research papers and academic peer reviewed texts?

Many HEI have implemented changes to learning and teaching, including using IBL to address issues related to learning, linked to employability. Linking the learning experience to employment has altered the function of higher education. Learning is no longer a means of emancipation and empowerment, but potentially a means of reproducing oppression and introducing new modes of surveillance, under the guise of supporting learners, creating workers to meet corporate needs and interests.

Conclusion

We have discussed the changes occurring in HEI, and the top down and bottom up factors that are radically altering the nature and function of the student learning experience, and both staff and student expectations. We have indicated that, in addition to benefits to staff and students in using IBL, there are other strategic, organisational, and corporate benefits to a 21st century learning agenda. In the case study, IBL raises important issues in relation to the relationship between staff and students, and between HEI and corporate interests.

Smoke and mirrors refer to practices of theatre where smoke and mirrors were used on stage, and in early film, prior to special computer generated effects, to fool the audience (consumer) that something was real, when it was not. Pipe dream refers to the dream that opium smokers had when intoxicated. Not based on reality, but fantasy.

Changes in HEI business practices, student debt, poverty, and increased staff workload with fewer resources may prevent the 21st century learning agenda that underpins the four pillars of education becoming realised. Hence, it is potentially a pipe dream, and the process of selling it, or forcing it on HEI uses smoke and mirrors to conceal agendas.

Freire (1968/2005) states that the university embodies both the potential for liberation and domestication, for both transformation and reproduction. Linking the learning experience to employment has altered the function of higher education: learning is no longer a means of emancipation and empowerment, but potentially a means of re-producing oppression, and creating workers to meet corporate interests. This raises issues of who truly benefits from such radical changes to pedagogy.

Perhaps the agenda of 21st century learning is to produce uncritical digital illiterate graduates, and make them fit for an economy with few workers' rights, low wages and zero contract hours. Or perhaps we are being overly critical, and study at HEI will truly emancipate, inform and educate citizens 'fit' for the 21st century.

Notes

1. Formerly the Partnership for 21st Century Skills
2. AOL Time Warner Foundation, Apple Computer, Inc., Cable in the Classroom, Cisco Systems, Inc., Dell Computer Corporation, Microsoft Corporation, National Education Association, and SAP.
3. For further information access http://www.p21.org/

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SOCIAL RELATIONSHIPS AS A MOVER TOWARDS DEVELOPING SKILLS IN ICT/SMART TECHNOLOGIES WITH ELDERLY PEOPLE

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Abstract

The article deals with the research conducted within the elderly people of the Municipality of Hradec Kralove, Czech Republic. The research is a study of ways the elderly reach and develop their IT skills, particularly how social relationships work as movers within this process. The method was a questionnaire distributed to the research sample of 432 respondents – participants in educational courses held by the Municipality of Hradec Kralove and University of the Third Age.

Introduction

Apart from others, the current society is characterized by two important features: (a) weakening of social relations and (b) modern technologies penetrating all spheres of (human) life. Numerous authors have mentioned the former features since 1990 (e.g., Martire, Schulz, Mittelmark, & Newsom, 1999; Shaw, Krause, Liang, & Bennett, 2007; van Tilburg, Aartsen, & Knipscheer, 2000, etc.). The latter characteristics appeared step by step during the last decade, as discussed by, e.g., Ogilvy and Shanghai (2004) and the European Parliament (2015), etc.

If elderly people are under focus, the problem is even more appealing for various reasons. Therefore, this paper aims at presenting results of the research, the main objective of which was to discover ways elderly people acquire work with modern devices and technologies.

Theoretical Background

Having worked during one's whole life, the worker becomes a retired person one day. This fact brings substantial changes into the life, both in the personal and professional areas. The professional career is suddenly or step-by-step closed; in the personal field, social and/or health problems may appear. In the current time of e-society, where latest (smart) technologies play an important role, the disruption or breaking of (often) lifelong relationships is even a more important factor.

The group of retired people, often also called the elderly (which sounds irrational in some cases) has been defined by numerous authors, and various criteria have been applied. As stated by the World Health Organization (WHO), in most developed western European and northern American countries the chronological age of 65 years has been accepted as a definition of the 'elderly' or older person. However, it does not adapt well to e.g., Africa, southern America or eastern Asia. Whereas this definition may seem arbitrary to some extent, in fact it relates to the age at which the person begins to receive pension benefits. Now, the standard numerical criterion agreed on by the United Nations is 60+ years to refer to the older population. On the other hand, although there exist widely accepted definitions of old age, there is no general agreement on the age at which a person becomes old. The calendar age assumes equivalence with biological age. Yet at the same time, these two are not necessarily synonymous. Various approaches have been applied. However, they differ substantially, e. g., in 1875 in Britain it meant any age after 50. Yet pension schemes mostly used age 60 or 65 years for eligibility of old age (Roebuck, 1979). Lacking an accepted and acceptable definition, in many instances the age at which a person became eligible for statutory and occupational retirement pensions is at 60 and 65 years (Thane, 1978).

Moreover, adding to the difficulty of establishing a definition, actual birth dates are quite often unknown because many individuals in Africa, southern America, and eastern Asia do not have an official record of their birth date.

> The ageing process is of course a biological reality which has its own dynamic, largely beyond human control. However, it is also subject to the constructions through which each society makes sense of old age. … In many parts of the developing world, chronological time has little or no importance in the meaning of old age. Other socially constructed meanings of age are more significant such as the roles assigned to older people; in some cases it is the loss of roles accompanying physical decline which is significant in defining old age. Thus, in contrast to the chronological milestones which mark life stages in the developed world, old age in many developing countries is seen to begin at the point when active contribution is no longer possible. (Gorman, 1999)

Within this research, the definition of elderly people follows the cultural environment of central Europe. The elderly are defined as those who have not been active in the working process any more (i.e., they have retired) and draw the old age pension. Even though the retirement age is generally higher, and in recent years it is growing, as mentioned above, in the Czech Republic it used to start at the age of 55 years. Thus, the research group starts at this age.

Whether they can have the same quality of life in this new period is one of the fears of newly retired people, i.e., those who became the elderly when referring to the above presented definitions. The *same* often does not mean *identical* but *not lower* quality. In practice, it means the elderly people are afraid of loss of social contacts, becoming lonely, reaching worse (lower) financial affordances, and, last but not least, not being able to acquire/hold all the technical/technological competences that are/will be necessary for living in the e-society. Therefore, the social relationships are so important for the new life, either in the family, with friends, or in both areas.

From this point of view, this research is expected to discover crucial findings that can help the elderly people to cope with the new life and spend this period fruitfully, without frustration.

Research Objectives

The main objective of this research is to discover how elderly people acquire the latest devices and technologies, particularly what the ways are through which they learn to explore the devices and technologies.

Method

The method used was a questionnaire to focus on selected fields of elderly people´s exploitation of smart or non-smart devices and technologies. The questionnaire included twelve items – questions through which data on respondents were collected (questions 1 – 3) and respondents´ opinions of and answers to related topics were monitored (questions 4 – 12). The feedback was provided in the open answer format, multiple-choice format with one, four or all choices and in dichotomy format (Yes/No). The respondents filled in the printed questionnaire by handwriting immediately on the site, as described below.

Research Sample

The data collected by the questionnaire were processed by the IBM SPSS Statistics software. In total, 432 questionnaires were administered. At the beginning of the process, questionnaires were provided to 437 respondents: five questionnaires were not included in the final amount. Questionnaires that were not fully completed, were considered in two ways. If questions 1 – 3 were answered and only one answer to questions 4 – 12 was missing, it was replaced by the group mean value. In other cases, if more answers were missing, the questionnaire was not included in the research sample.

The questionnaires were distributed within two groups: (a) participants of University of the Third Age courses (U3V) and (b) those in Municipality of Hradec Kralove (MHK) courses. This approach means that only those elderly people who had been interested in self-education were included in the research sample. Reflecting on this, it means the sample is not representative but is a convenience sample – it is limited to (a) active-in-education respondents, (b) dwelling in Hradec Kralove region. The authors are aware of the fact of the limited sample. The research results will be exploited for the purpose of the pilot study towards further research within a representative sample of elderly people in the Czech Republic.

The research sample was considered under three criteria: respondent´s age, age/gender structure and level of education. The sample consisted of 27 % of male and 73 % of female respondents, i.e., 115 men and 317 women. The distribution follows the demographic curve of the Czech population of this age group [10]. Within a detailed analysis of the research sample we can see that the oldest respondents were 87+ years old, the larger number of respondents was born in 1945-49 (32 %), i.e., they were 67 – 71 years old.

From the age/gender structure, the 15 oldest respondents were 85+ years old (12 female and 3 male respondents), and most respondents were of female gender in the 1942-51 age group (n=188), i.e., 65 – 74 years old (Figure 1).

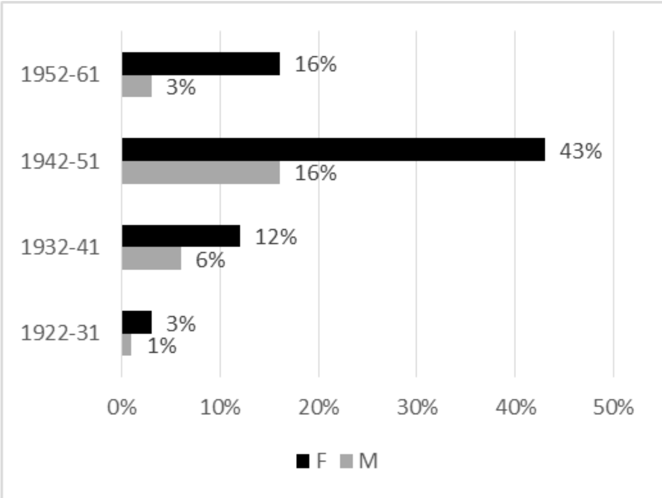

Figure. 1. Respondents: age/gender structure.

This distribution also follows the demographic structure of the Czech Republic (Czech Statistical Office, 2016).

Level of education reached by the respondents was structured into three groups: vocational (i.e., three-year upper level secondary education without school leaving examination, mostly required for working class and crafts professions--13 %, 55 respondents), upper secondary (i.e., four-year education graduating with school leaving examination) and tertiary (i.e., university, higher --21 %, 91 respondents) education. Most respondents reached the upper secondary level of education (66 %, 287 respondents).

Research Results

The collected data show that most respondents own and explore mobile phones (383 respondents; 89 %), followed by PC owners (217; 50 %) and notebook owners (167; 39 %): 59 respondents own smartphones (14 %) and 45 are tablet owners (9 %). Two respondents do not possess any device.

When answering the question what the ways and approaches were which lead to acquiring the competences on how exploit the modern devices and latest technologies, the following movers were detected:

- Self-learning (i.e., respondents acquired the competence by autonomous learning).
- Other people helped them (their children, grandchildren, friends).
- They attended IT courses.

As displayed in Figure 2, most respondents attended IT courses (193; 26 %) where they learned how to use modern devices, PC, notebook, and related (smart) technologies. Authors are aware of the fact the data were (among others) collected also from attendees of these courses, which explains the high appearance of this criterion. However, the role of family members is also important because children and grandchildren helped them substantially (children: 183; 24 %; grandchildren: 78; 10 %). Reflecting the social relationships of the elderly people, friends also played the role of movers in this process, as 131 respondents (17 %) declared them to be those who helped them within the process of acquiring the IT competence (see Figure 2).

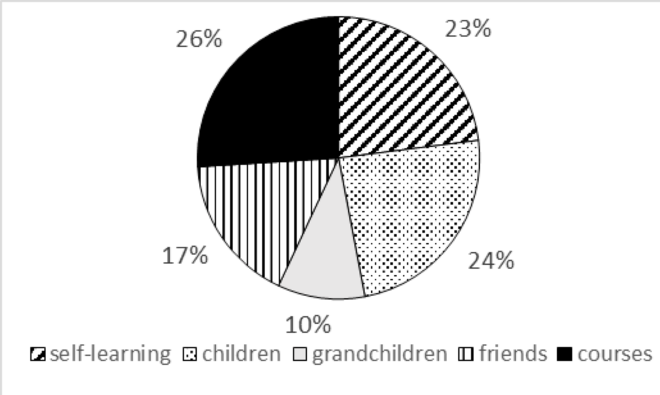

Figure 2. Movers to the process of acquiring the IT competence.

The detailed insight in the structure of movers shows that the friends who supported them were mostly younger than the respondent (83; 63 %). However, friends of the same age also played an important role (42; 32 %) and even older ones helped in some cases (6; 5 %) (see Figure 3).

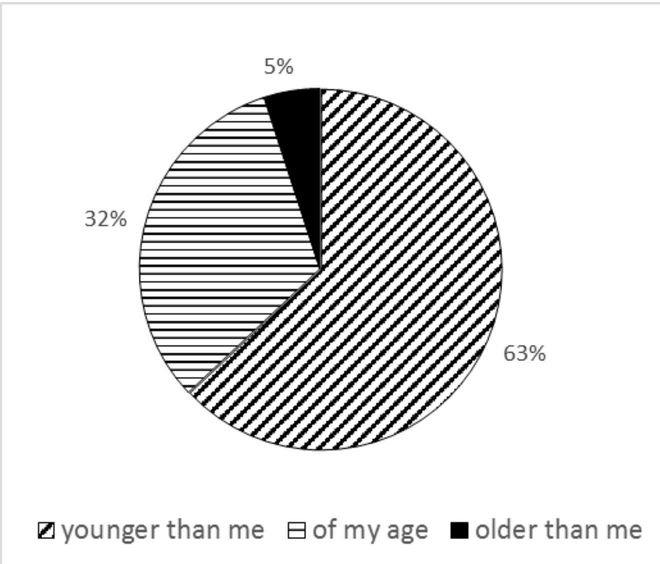

Figure 3. Movers to the process of acquiring the IT competence: respondents' friends.

As mentioned above, IT courses performed the role of strong mover towards the IT competence. They differed from the view of learning content and the organizer. Most respondents (101; 23 %) attended the introductory courses, which focused on basic work with the computer/notebook and the Internet. Several of them continued with the complex courses, which dealt with e-mailing, skyping, participating in discussions, reading/writing blogs, etc. (20 respondents; 10 %), and/or they attended advanced courses, where they learned how to explore MS Excel, PowerPoint, etc. (12; 3 %). A small group of respondents attended the course dealing with digital photographs (Figure 4).

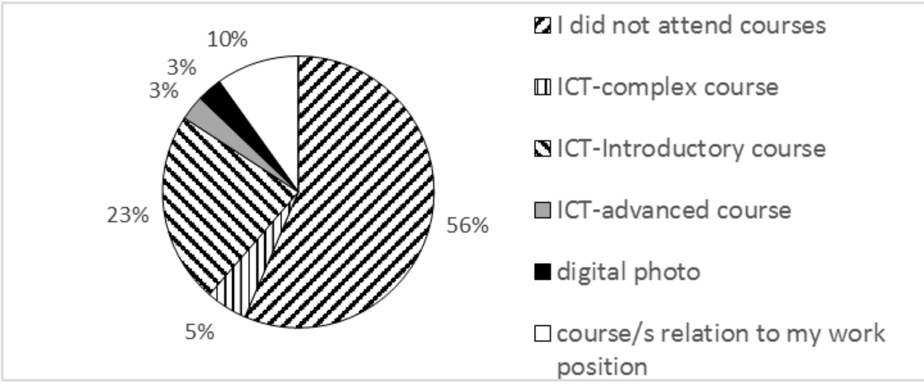

Figure 4. IT courses: content.

The IT courses were held either by the Municipality of Hradec Kralove (123 respondents; 29 %, free of charge), or by the University of the Third Age (22 respondents; 5 %, paid courses). Some respondent also mentioned IT courses held and paid for by their last employer (42 respondents; 10 %).

The length of the courses varied from several to tens of hours. Most courses took from 10 to 19 hours, usually taught two hours per week; these were attended by 14 % of respondents. Some courses were much longer (from 20 to 99 hours; 9 % of respondents).

The efforts of elderly people resulted in the fact that after successful graduation from the courses, self-learning, consultations with family members and friends, they are able to work with modern IT and smart devices. Most of them exploit them daily (53 %), the others once or several times per week (7 %; 4 %; 11 %), or less frequently (9 %; 4 %). This question was not answered by 12 % of respondents; their answers could not be replaced by the group mean (Figure 5).

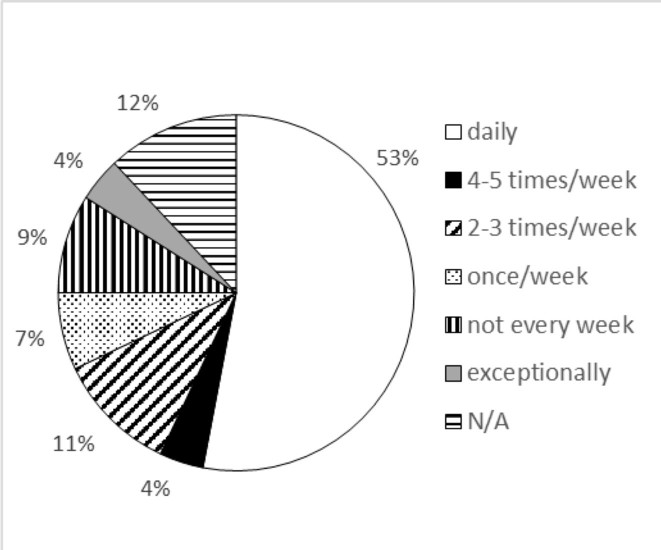

Figure 5. Frequency of working with devices.

Conclusions, Discussions

From the results presented above it is clearly seen that the elderly people have been working hard to develop their IT competence. Their reasons are either identical to many of them, or vary. The list of activities running on IT/smart devices is displayed below:

- e-mailing with not only friends and family members, as expected, but also with institutions (314 respondents; 73 %)
- e-banking (172; 40 %)
- sharing photos (166; 38 %)
- skyping (165; 38 %)
- writing documents (164; 38 %)
- e-shopping (145; 34 %)
- information on health (144; 33 %)
- reading newspaper (108; 25 %)
- gaming (67; 16 %)
- designing presentations (34; 8 %)
- discussions, or blogs, active participation (12; 3 %)

As being in contact with other people belongs to human features, a gratifying correlation was discovered within this research – under the conditions of e-society, which is often considered to be destroying face-to-face contacts and communication, the elderly people´s skills in using IT/smart tools and technologies are being developed with the support and help of family, friends and through face-to-face courses. These results are consistent with those of other authors (e.g., Bujnowska-Fedak & Pigorowicz, 2014; Eneanya et al., 2016; Grigoryeva, Dmitrieva, & Vdovenko, 2015; Liyanagunawardena & Williams, 2016; Modad, Encinas, & Arriaga, 2015).

Reflecting on these works it can be concluded that the quality of life of elderly people, both from the view of social contacts and health state, can be supported through the ICT/smart devices and technologies.

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SELECTED E-LEARNING ASPECTS AND STUDENT COMPETENCIES IN PUBLIC ADMINISTRATION EDUCATION: HOW WELL ARE THEY CORRELATED?

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Abstract

In the present study, we explored the correlations between selected aspects of e-learning in the Moodle environment and the competencies students should acquire during their study. The research was based on two different questionnaire-based surveys conducted among Faculty of Administration students. In the final research, 41 students were involved. We found that the problem-solving competency is highly correlated with the adequacy of e-learning. Our findings also suggest a high correlation between the computer skills competency and the usefulness of e-learning.

Introduction

The development of information technologies has led to emerging applications such as e-commerce, e-banking, e-health, e-government, and e-learning. E-learning systems are one of the most important and advanced web-based applications in the education sector (Islam, 2016). Educational institutions at all levels invest in information systems to derive benefits like increasing the accessibility of education, improving self-efficacy, knowledge generation, cost effectiveness, learner flexibility, and interactivity (Alsabawy, Cater-Steel, & Soar, 2016; Sinclair, Kable, Levett-Jones, & Booth, 2016).

The importance of e-learning systems has been growing in recent years due to their considerable role in academia, industry, and society. This has prompted more scientific studies on the adoption and use of e-learning systems (Aparicio, Bacao, & Oliveira, 2017). Several studies have focused on either factors influencing e-learning (Hart, 2012; Mbarek & Zaddem, 2013; Novo-Corti Varela-Candamio, & Ramil-Diaz, 2013; Tarhini, Hone, & Liu, 2013; Upadhyaya & Mallik, 2013) or the consequences of e-learning, e.g., student performance (Fryer & Bovee, 2016; Hassanzadeh, 2012; Joo, Joung, & Son, 2014; Kassab, 2015; Saba, 2012) or their satisfaction with e-learning (Novo-Corti et al., 2013; Sun, Tsai, Finger, Chen, & Yeh, 2008; Umek, Aristovnik, Tomaževič, & Keržič, 2015), especially with its usefulness (Alsabawy et al., 2016).

Today's societies encounter globalization and modernization where everything is changing fast. Educational institutions face the challenge of educating their students to be well prepared to function in such varying and complex situations. Nowadays, mere mastery of knowledge is losing in importance while the skills learned by individuals and the competencies they acquire are ever more appreciated.

In the last 15 years, education has shifted towards a paradigm focused on students, learning, and competencies. In the context of Europe, the European Higher Education Area (EHEA) regards the concept of competency as the main element of the learning process, and students as the centre of the educational model (Fito-Bertran, Hernandez-Lara, & Seradell-Lopez, 2014). The transmission of knowledge is no longer the primary educational aim as students are expected to construct their own knowledge, search and process information, while the teacher is now considered a facilitator, collaborator, adviser, moderator, and coach in the learning process (Cantoni & McLoughlin, 2004; Ruiz, Mintzer, & Leipzig, 2006).

The new concept brought into classrooms is competency-based learning, ensuring students gain skills that seem important for their adult life and career. In this way, the academic world is coming closer to the professional world (Fito-Bertran et al., 2014). According to Gonzalez and Wagenaar (2003, p. 15), competencies are "…underlying characteristics of a person that are coincidentally related to good or excellent performance at work". The OECD (2005) describes competency as more than just knowledge and skills. It involves the ability to meet complex demands by drawing on and mobilizing psychosocial resources (including skills and attitudes) in a particular context. Many detailed definitions and potential uses of competencies can also be found in Klarsfeld (2000) and Kennedy, Hyland, and Ryan. (2009).

Since competencies are generally obtained during the educational process in different courses, they are related to the educational programme. Instead of credits-based education programmes, in the new competency-based concept, obtained skills, abilities and knowledge –competencies – are measured. Competencies can be divided into two types: specific and generic (Fito-Bertran et al., 2014; Gonzalez & Wagenaar, 2003; Kennedy et al., 2009). The former are specifically related to academic disciplines, with the particular knowledge of a thematic area. Generic competencies are those not necessarily related to a specific subject, such us critical thinking, problem-solving, decision-making, teamwork, logical thinking, finding and managing information, effective communication in the mother and at least one foreign language. Since competencies are generally obtained during the educational process in different courses, they are related to the educational programme. Instead of credits-based education programmes, in the new competency-based concept obtained skills, abilities and knowledge –competencies – are measured. the

The competency-based learning concept requires new and valuable learning tools to allow students to develop new skills and become active constructors of knowledge rather than just passive receivers of contents (Dunning, 2014; Fito-Bertran et al., 2014). In recent years, a noticeable change in higher education institutions is the integration of various learning management systems to support the educational process. E-learning, generally defined as different forms of learning supported by ICT, emerges as this new learning environment and constitutes a new paradigm of modern education. E-learning allows students to learn in a more autonomous environment at their own pace and facilitates interaction between teachers and students without time or spatial restrictions (Barker, 2002; Sun et al. 2008). Dunning (2014, p. 66) concludes that “the delivery of a course, usually by the same professor over many years and in the confines of a classroom, is being overtaken by online delivery of the same course by multiple professors”.

The purpose of the paper is to identify possible relations between students’ opinions on specific aspects of e-learning and their assessment regarding the level of competencies they have acquired. The paper presents the strength of that correlation and suggests how the results could be taken into account when thinking about potential improvements or significant changes in teaching methods of faculty.

Empirical Study

The research presented here was conducted among students of the Faculty of Administration (FA), which is part of the University of Ljubljana, Slovenia. The FA educates students in the field of administrative science. The Faculty offers two undergraduate study programmes (1^{st} cycle) – University Study Programme in Public Sector Governance and a Higher Education Professional Study Programme in Administration. Both programmes are provided in a combination of traditional face-to-face teaching and e-courses where LMS Moodle has been used for e-learning since 2009 (Umek et al., 2015).

The present study aims to analyse two long-running surveys (students’ evaluation of e-learning aspects and their evaluation of the competencies acquired) at the FA and to find links between them. Since both surveys depend on students’ opinions, we added an objective performance measure, namely students’ average grade. For each individual student who participated in our survey, we collected 7 opinions on e-learning, 25 opinions on the level of competencies acquired and the average grade for all exams they had passed.

Data

Our data originate from two different questionnaires; one on competencies and the other on aspects of e-learning. The survey on competencies is based on a questionnaire initially intended for FA graduates. Part of this questionnaire comprises a list of 25 competencies students should acquire during their studies. For our survey, we used the list of competencies shown in Table 1.

The students express their opinions on the competencies they had acquired on a 6-level scale from 1 (“not acquired at all”) to 6 (“fully acquired”).

Table 1

List of Competencies Included in the Questionnaire (S – Specific, G –Generic)

Label		Description
C1	S	Professionalism and practical experience in the field of administration.
C2	S	Knowledge of and dealing with research methods and procedures in the field of social sciences.
C3	G	Ability to analyse, synthesize and anticipate solutions and consequences of a phenomenon.
C4	S	Ability to be critical or self-critical in social issues.
C5	G	Ability to obtain maximum results in negotiations.
C6	G	Ability to keep functioning effectively when under pressure.
C7	G	Ability to take advantage of an opportunity, being proactive.
C8	G	Ability to coordinate activities (in a team).
C9	G	Ability to efficiently use time.
C10	G	Ability to cooperate productively in a team.
C11	G	Ability to motivate people (and move toward a common goal).
C12	G	Ability to speak clearly and be easily understood.
C13	G	Ability to establish own authority.
C14	G	Skills in the use of information (from the Internet) and communications technologies.
C15	G	Capacity to generate new ideas and solutions.
C16	G	Ability to discuss values in approaches, ideas, and solutions of oneself and others.
C17	G	Ability to solve problems.
C18	G	Ability to make business decisions autonomously.
C19	G	Ability to present ideas, arguments, ideas, or reports clearly and concisely.
C20	S	Ability to write reports, records, and documents in the administration.
C21	G	Ability to communicate verbally and in writing in at least one foreign language.
C22	S	Professional knowledge of other countries in the fields of economics, society and the law.
C23	G	Knowledge of cultural differences.
C24	G	Ability to work with people from different cultural backgrounds.
C25	S	Ability to assess acts and practices in accordance with professional ethics in administration.

The second data source is a questionnaire-based survey started in 2014 at the FA (see Aristovnik et al., 2017). Once a semester we ask our students to evaluate several aspects of e-courses in which they are enrolled. In addition to questions about a specific e-course, the questionnaire includes several general statements about e-learning. This part of the questionnaire is therefore used for our survey. The list of these selected aspects is shown in Table 2.

Table 2

Aspects About e-Learning

Label	Description
A1	Working with computers for study purposes suits me.
A2	The Moodle e-learning system is easy to use.
A3	The Moodle system is reliable and stable (it does not crash, submitted tasks are not lost).
A4	I am satisfied with the support and assistance in the event of technical problems.
A5	Working with computers for study purposes is not difficult for me.
A6	E-learning contributes to higher student academic performance.
A7	E-learning is a quality replacement for traditional learning in the classroom.

The students express their opinions on the statements in Table 2 on a seven-point Likert scale from “totally disagree” (value 1) to “totally agree” (value 7). Students can also choose N (“do not know”) or even to not respond at all since survey participation is not obligatory. Missing responses and the value of N in the survey analysis are considered as missing values and are excluded from the study.

During the 2016/17 academic year, 2nd year students of the university study programme were involved in the research. Our population of interest were 84 students, 51 (61%) of them participated in the survey on competencies and 45 (54%) in the survey of aspects of e-learning; 41 (49%) participated in both surveys. Students voluntarily participated in the survey, without any coercion or undue influence. Both questionnaires (competencies and aspects of e-learning) were carried out online. In both surveys, we ask students for their student ID number to help us link the obtained results with various sources. Data from both questionnaires answered by 41 students were analysed. Additionally, we compared the students who participated in the survey to those who did not. The analysis showed no bias in gender, high school final grade and region, but the average grades from university were significantly higher for the students from our survey (mean: 8.05) compared to the students who have not participated in the survey (mean: 7.32).

Methodology and Empirical Results

We calculated 175 Spearman’s correlation coefficients between 25 competencies (C1…C25) and 7 aspects (A1…A7) of e-learning (175 = 25 * 7) and 32 correlations between the average grade (AG) and all competencies and aspects of e-learning (32 = 25 + 7). Altogether, we computed 207 Spearman’s correlations and corresponding p-values. Due to the large number of hypotheses tested, we adjusted p-values using a False Discovery Rate (FDR) correction (Yoav & Hochberg, 1995). For a FDR level of 0.2, we found 27 significant correlations (14% of all pairs we analysed).

Table 3 shows 27 significant correlations (Spearman's r) between analysed competencies (C1…C25), aspects of e-learning (A1…A7) and the average grade (AG) and corresponding significances (Sig.).

Table 3

Significant Correlations (R) between Analysed Competencies (C1…C25), Aspects of e-Learning (A1…A7), and the Average Grade (AG)

Pair		r	Sig.	Pair		r	Sig.	Pair		r	Sig.
C21	AG	0.601	3.29E-05	A1	AG	0.440	0.004	C4	A1	0.396	0.010
C17	A1	0.584	6.06E-05	C16	A1	0.437	0.004	C7	A1	0.386	0.013
C14	A6	0.549	2.03E-04	C16	AG	0.435	0.004	C15	AG	0.380	0.014
C19	AG	0.541	2.59E-04	C18	A6	0.433	0.005	C5	A5	0.370	0.017
C21	A1	0.533	3.37E-04	C6	AG	0.431	0.005	C24	A1	0.365	0.019
C12	AG	0.517	0.001	C4	AG	0.422	0.006	C5	AG	0.361	0.021
C8	AG	0.479	0.002	C6	A1	0.413	0.007	C13	A6	0.359	0.021
C15	A1	0.474	0.002	C21	A2	0.412	0.007	C25	A3	-0.356	0.023
C15	A6	0.454	0.003	C25	A6	0.408	0.008	C24	A5	0.352	0.024

The strongest correlation we discovered was between the competency of "speaking, reading, and writing in a foreign language" (C21) and "average grade" (AG). The correlation coefficient of r=0.601 indicates that students who think their competencies of communicating in a foreign language are good tend to have higher average grades. The correlation is significant (p=3.3E-5).

The second pair indicated quite a strong positive correlation (r=0.584) between the competency of "solving problems" (C17) and the aspect of "suitability of working with computers in the study process" (A1). This means that students who like using computers for studying think they are good at solving problems. The correlation is significant (p=6.1E-5).

The last pair we describe in more detail is the correlation of r=0.549 between the competency "using information and communications technologies" (C14) and aspect "contribution of e-learning to academic performance" (A6). This means that students who think that e-learning contributes to their better performance (i.e., high grades, lower number of admissions to exams) have a higher ability to work with computers and use information from the Internet. The correlation is significant (p=2.0E-4).

Conclusion

The Bologna Process introduced a common European area of higher education, which called for many changes to be made at European universities. Due to the comparability of studies across Europe and the mobility of students and teachers, the focus in learning is shifting to competencies and skills based on knowledge. Knowledge alone is not enough – what is also important is which (professional) skills and competencies a student acquires and how he or she is able to use them. This, of course, has affected educational methods and student performance evaluations. There is no question that education will change in the coming years; the challenge is to ensure this change will positively affect world development. To be able to change the world for the better, e-learning needs to be effective and, to improve its performance, we need to understand the factors affecting it (Aparicio et al., 2017).

In our study, we explored the correlations between the selected aspects of e-learning in the Moodle environment and the competencies students should acquire during their study. The research was based on two different questionnaires administered to Faculty of Administration students. One of the major problem we are facing in voluntary participation in survey research is the low responsiveness of our students, which was evident also in this case. This holds especially for students with lower grades – in the future we will pay more attention to motivate them to overcome potential bias in our sample. On the collected data, the survey results showed that the competency of problem-solving is highly correlated to the adequacy of e-learning. Our findings also suggest a strong correlation between the competency of computer skills and the usefulness of e-learning. Indeed, one of the main pre-conditions for benefitting from e-learning system use is that students have higher abilities in working with computers and using information from the Internet.

Our study's main limitation is the mode of measuring the level of competencies acquired. The recent measurement is based on opinions, which can produce biased results; some students overestimate their abilities while others underestimate them. Future work will focus on more objective measurements. One possible improvement will be to analyse competencies from course syllabuses and to link the listed competencies with grades in various courses. Nevertheless, the results we obtained could serve as a guide for the faculty management when further investigating how to enhance students' competencies while employing modern solutions in the teaching process.

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ENERGETIC LEARNING: A PATH TO KNOWLEDGE VIA THE ENERGETIC MIND

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Abstract

Although extended research has been made for the different learning profiles and the use of technological means for the improvement of approaching teaching, inclusion has not yet been achieved in classes of multimodal learners, and their school performance varies. The purpose of this paper is to suggest a new model of approaching learning that can reinforce the teaching process, through means that are adapted to each learner's profile, in classes with students grouped according to their learning style. The final assessment aims to prove that the students learn more effectively, and a better inclusion of learners with special learning needs with the rest of the group in the classroom can be achieved.

Introduction

Throughout the years, every teacher's or educator's long-term goal was and still is to provide knowledge to children and adults. Providing knowledge is not an easy task since it requires courage, boldness, strength and love for education as well as love for the students. Taking into consideration that every individual is unique in the way that he or she perceives and assimilates information, the challenging task that is always present in the field of education is how teachers and educators can use effective ways in order to guide their students to gain in-depth, long-term knowledge that will not only bring to them a successful academic and professional career, but also a successful life. Following this path, there are many times when students face difficulties on how to become active and autonomous in the process of learning. Although they might daily participate in an interactive classroom, they still miss information since the amount of retained information declines substantially after a short period of time (Hauck & Thomas, 1972). Students try hard to grasp as much information as possible and yet they slightly discriminate the difference between memorizing and assimilation. Is it a matter of learning difficulties, or a matter of missing specific cues and appropriate strategies for retrieval, that will guide them to effective long-term learning? (McKeachie, Pintrich, Lin, & Smith, 1986)

Since students "do not know how exactly the brain is designed to learn" they cannot easily recognize the process of learning (Jensen, 2005, p. 4). From a very early age, they set as an educational goal to receive good grades, and this is achieved through a battle of memorizing a great deal of information daily. The process of learning becomes a process of duty, and from this term it is made really clear the fact that the room for imagination, creativity, and independence is restricted. Although students are expected to take charge of their learning, in reality they hesitate to be autonomous since in order to become self-regulated learners, they need to be self-directive, transforming their mental abilities to academic skills (Zimmerman, 1990). Typically, students do not spend much time on recognizing how unique their learning style is. Their attention is stressed on completing tasks. Self-awareness comes only during the time when they are expected to decide about their professional and career paths. It is mostly during this period of time that they are deeply concerned about how successful their academic life is going to be. In order for them to develop their learning, students need to consider the best way to use their brain, to use their intelligence, reaching their outmost potential. They need to familiarize themselves with their "own ways" of learning; they need to learn how their brain functions, in order to become energetic learners.

This paper is going to define the significance of the learning profile as well as the use and the application of learning techniques. Its goal is to scientifically support that energetic learning is achieved through the recognition and acceptance of the personal learning profile by suggesting a new model of teaching approach for every student regardless of any possible special learning needs. By using the skills that match with the way in which the brain is designed to learn, a student is led to metacognition (Jensen, 2005).

Active Learning and Active Brain - Theory of Constructivism and Neuron Doctrine

Students need to recall and add new information daily for different purposes. In order to assimilate and recall this information, they need to strengthen their memory by learning actively. Learning involves actively constructing our own meanings. In scientific terms this means that the brain creates new synapses between neurons, to connect and store new information. These synapses are the new links that join new concepts and ideas with preexisting knowledge. Based on Geoff Petty (2012), as individuals with reasoning, we invent our own concepts and ideas based on what we already know, and this meaning making theory is called *constructivism*: "New information is linked to prior knowledge, thus mental representations are subjective" (Bruner, as cited in Hall, Hindmarch, Hoy, & Machin, 2015, p. 27). In this way, the student understands preexisting conceptions and is now able to connect them with reality. By questioning every new concept, applying existing knowledge and real world experience, he or she becomes an expert learner.

Through the subjective brain, a unique subjective learning profile is developed. This profile depends on the routes that the brain has constructed to create a new path that is accessible from each individual, in order to achieve learning. Even in cases when there is a learning difficulty, the brain has the tremendous capacity for finding a different route to knowledge (Cottrell, 2013). This suggests that the brain has the potential or the ability to modify functionality based on experience. Therefore, when the process of learning a specific concept becomes difficult, there is the likelihood that the brain develops a different way to learn it (Michelon, 2008). The human brain grows new neurons, which become functional, and they are related with memory (Jensen, 2005). In a number of cases, when many students' performance in class is dysfunctional in terms of how easily they can process and assimilate information due to special learning needs (dyslexia, dys-orthography), or developmental disorders (ADHD –Attention Deficit Hyperactivity Disorder), it has been claimed that their brain works in a "different way" compared to the average student. Left-Right Hemisphere theory claims that each side of the brain controls different types of thinking (Springer & Deutsch, 1985/1981). A dyslectic brain is the one that functions with the right hemisphere as the dominant one (lateralization of the brain). This means that in order for a dyslectic student to learn he or she actually needs to use images, colors, intuition, emotion and imagination (Cherry, 2016). The role of the right hemisphere is lateral, since it is the one responsible for language numbers and reasoning. However, recent research supports that "no matter how lateralized the brain can get, though, the two sides still work together" (Zimmer, 2016, p. 1). The two hemispheres are linked by over 200 million nerve fibers (corpus callosum); there is a crossover effect since each hemisphere controls the opposite side of the body and that side is related to the mental capacities of the other hemisphere (Cottrell, 2013). Under these terms, a question that arises is whether the brain network can be strengthened through differentiated means of incoming messages of information.

State of the Art – Study Skills and Effective Learning

The most effective way for learners to develop and shape their knowledge is to "learn how to learn" (Smith, 1982). Learning how to learn means that students become autonomous thinkers through their self-awareness for the reasons that they learn, the goals that they set and the steps that they need to follow in order to learn. As autonomous students, being highly motivated, they are capable of recognizing their learning needs by setting goals and choosing the study skills which are suitable to their profile and guide them to significant learning (Gibbs, 1999). Taking into consideration the multiple intelligences of a student, active learning involves significant learning through which "the learner seeks for motives, improves his personal achievements and finally reaches metacognition, the active participation of the individual in his or her thinking process" (Stewart & Landine, 1995, pp. 16-20). Higher order thinking involves active control over the cognitive processes of learning. This active control involves activities such as planning how to approach a learning task, to monitor comprehension and to evaluate the progress towards the completion of this task. In order for the students to determine how successfully they learn, it is important to effectively apply their cognitive resources through metacognitive control (Livingston, 1997).

Personal Profile and Approaches to Learning

The first step that can be taken to shape a personal learning profile and the suitable strategies that can be used to gain knowledge and metacognition is to start an individual conversation among students and teachers for the different ways to learn effectively. Since every individual uses the senses to understand and receive information, a multisensory tool, the VARKS Questionnaire, has been designed and used to recognize which is the best way to manipulate information for different purposes. The VARKS Questionnaire is an inventory that is predicated upon information processing modes and can be used in order to observe how the visual, auditory, verbal and kinesthetic learners receive information (Baykan & Nancar, 2007). Learning preferences are not only difficult to detect, but also difficult to change in a school system. These preferences once detected, though, can help the learner use the techniques through which he or she can encode new information that must be represented in his or her memory. According to each learner's learning profile, these codes can be visual, auditory, verbal, kinesthetic and multimodal. Encoding information in several ways assists learners' long-term memory and leads them to knowledge (Cottrell, 2013). A relevant study was performed at the Department of Medical Education of Erciyes University in 2006. The Turkish version of the VARKS Questionnaire was administered to students in the first year of their studies. By recognizing the learning styles of the students, "the instructors were able to develop the appropriate learning approaches, in order to make the educational experience more productive" (Baykan & Nacar, 2007, p.158).

Taking into consideration that such a tool is not a test that measures intelligence or gives a diagnosis for any possible special learning differences; its aim is to strengthen the options learners have and the multiple ways they might not have considered that guide them to knowledge (Atkins & Svinicki, 1992). Applying, for example, this tool in the fifth or sixth grades of primary education could result in classes that are shaped with students who can perform better by using kinesthetic ways or tools for learning (likewise classes with visual, auditory, verbal learners). In such a case, the group would not so easily be able to adapt and perform in an environment where they are expected to stay on the desk and passively listen to the teacher covering material on a theoretical basis. Their body movements would distract them from being concentrated, with the result of interrupting the lesson in multiple ways. As a result, their performance in class and at home would be negatively affected, since they would not know how to deal with these distractions and cope with the tasks that need to be completed. A kinesthetic group includes learners who need to involve all their senses, with a strong participation of their body. These learners could be both diagnosed with or without special learning needs. Therefore, the skills that should be used in the process of learning, for these students, do not depend on any possible individual special learning needs, but on the learning profile of a group as a whole. Approaching learning according to the profile of a group would not result in the categorization or discrimination of the group, but in the recognition of the need for recreating ways that improve and enhance the process of assimilation and metacognition.

Learning Skills in Action

In order for the students to manage independent learning successfully, it is required to use the essential means to recall the information they need. Good recall is linked with attention and awareness during the process of encoding. Study skills assist the students to participate in the memory process, through which they are led to integration by:

- Taking in information through noticing, attending and absorbing.
- Encoding the information by joining it with information in the working memory so that the brain can store it in the long-term memory.
- Retaining the information in their long-term memory.

- Recalling the information by retrieving and remembering information, with or without a purpose. (Cottrell, 2013, p. 210)

Under these conditions, the personal learning profile of a student leads the way to specific study skills that are the means to significant learning. Fleming and Mills defined four sensory modalities of learning: visual, auditory, verbal (read-write), and kinesthetic (Fleming & Mills, 1992). Based on these definitions, visual learners assimilate information by connecting information with visual stimuli. Any information in written form should be interrelated with relevant optical tools (colors, images, videos). According to Fleming and Mills, Visual skills involve mind maps, diagrams, charts, color-coding, pictures, videos, posters, slides, and lessons that use picturesque language. In order for them to encode information autonomously, learners can redraw images from memory, replace words with symbols and transfer meanings on images. For aural learners, information is better assimilated by oral speech. They can better encode information by attending classes, discussions, tutorials and recordings; to convert information independently learners can transfer what they listen in the recordings, in notes (since note taking is not a strategy that can be effective for them), to listen to the recordings many times, read the information aloud and explain the information orally. For verbal learners (learners who prefer reading and writing), intake of information can be achieved through lists, dictionaries, definitions, handouts, textbooks, notes, and manuals. They can autonomously take notes and rewrite them with synonym words, turn their notes in charts, diagrams, graphs and flows of words. For Kinesthetic learners, all senses must be activated during the learning process; body movements (walking, dancing, playing with objects), as well as visual and auditory stimuli are necessary in order to fully concentrate on the process. They assimilate information by lessons in laboratories, field trips, lectures with real life examples, exhibits, and hands' on approaches. Encoding for them involves note taking of the real life examples and possible conducted experiments, illustrated ideas supported by pictures that add information in the notes, case studies and applications that support principles and abstract concepts. In cases, of multimodal learners, learners that do not have a strong preference in any single mode, all the strategies can be combined to reach their optimum potential (Fleming, 1995, p. 3-4).

Approaching Learning Through the Application of Learning Skills

Learning in action through the utilization of study skills can be applied to classrooms from primary years to secondary years of education in parallel with the school's curriculum. A new model of approaching learning can be applied for students of the fifth and sixth grade of primary years, as well as students of secondary years. Applied, for example, at the sixth and seventh grade, the students are separated into two groups that include students diagnosed with special learning needs, and students that are not diagnosed with special learning needs. After being informed from their teachers about the significance and importance of the personal learning profile, the students complete the VARKS Questionnaire. Based on the questionnaires' results, all the students (all blended together) are separated into four groups (visual-aural-verbal-kinesthetic). From the first grouping, it is already known who the students that have special learning needs are; these students are blended with the rest in order for it to be proved that through this approach all the learners can be included in the same class environment. New classes are formed according to the learning profile of every group; new lesson plans and activities through interactive means are applied in the school's curriculum.

For the group of visual learners school subjects such as Languages and History will be taught through a video series in which every chapter will be presented in a virtual reality classroom. Students then participate in interactive activities in which learning strategies are asked to be used. By watching each episode, the visual learners are using mind maps in order to visually assimilate the necessary information; the aural learners will create recordings from the information being heard on the video, and in role play activities, in pairs, they will "perform" that information that needs to be assimilated; the verbal learners will be taking notes in diagrams, bullet points, acronyms, and learn by writing and reading; the kinesthetic learners will be using role plays, by acting out the relevant chapters and use the board in order to write in notes the necessary information; the multimodal learners will choose any of the strategies that are preferable from them according to the subject being taught (mind maps, diagrams, bullet points, Cornell method, acronyms).

For all the groups, activities will be presented in an interactive and written form. Through the written form, learners will be able to self-assess their progress during the completion of their home assignments. Assignments that will be completed at home involve the creation of board games that include:

- For the Visual learners: blind sketches, puzzles, putting sentences in the correct sequence, rebus.
- For the Aural Learners: listening to recordings and songs, made from lectures, and including wrong information that need to be identified.
- For the Verbal Learners: crosswords, cryptlex, anagramism, scrabble.
- For the Kinesthetic Learners: pantomime, singing, role-playing and experiments.

According to this model, students with special learning needs are no longer excluded, since they now recognize which is their learning profile and can autonomously apply the techniques that will help them to learn by participating actively in the classroom. Grouping will strengthen communication and empathy between the students, who will no longer feel any form of discrimination.

At this point, a possible question that may arise is on how this model is going to be assessed in terms of its effectiveness, and if the lesson is student centered, what is the role of the teacher and his/her teaching methods?

In order to document the effectiveness of this model and its learning outcome, the teachers - educators will be using a manual that will assist them in recording the performance of their students during and after the lesson. This manual is going to include:

1. The lesson plan of every chapter presented (information to be assimilated).
2. The chapter's relevant activities in a written form.
3. The evaluation form for the performance of the students (individually and in groups) during the lesson.
4. The self-evaluation form, for the students evaluating their homework activities.
5. The activity booklet that includes the instructions and the relevant learning profile assimilation techniques that will be used from the students.
6. The rubric analysis that includes the grading scale. This scale is going to evaluate each student according to the level of performance in his/her group (visual, aural, verbal, kinesthetic) compared with the performance of the multimodal group.

The model's website includes the subject's video series, tips on how to use the learning skills, extra homework activities, group line in which the students can download and share their work and work online, help line through which the students can ask for advice from their teacher-educator. By the end of every week, the educator is going to measure the average performance of every class and compare the results with the multimodal class.

Learning Skills via Technology in the Classroom

When comparing traditional methods of teaching with modern ones, we realize that a significant difference between them is the use of interactive means, the use of technology. Although many contradictory opinions have arisen for their effectiveness, their influence is major since technology dominates in our modern society. There are many questions that are probed about whether technology can actually support and enhance the learning process. Research has shown that classrooms that are judged as the most innovative are engaged in constructivist, knowledge building practices that integrate ICT into the curriculum and change assessment (Kozma, 2004). Whether an innovation succeeds, though, depends on the extent to which its characteristics fit the school environment. It depends on how clearly it can be implemented within the context and how practical its implementation is within the demands and limitations of the environment (Kozma, 2004). A challenge that is faced by teachers and educators is on how to motivate the students to effectively use the mediums provided in class (Huffman & Huffman, 2012). Modern educational environments include technological means in their curriculum by including interactive activities (projects, portfolios, research papers, power point presentations) during the lessons. New types of chalkboards (with interactive digital screens), online lessons and video chats for students who are not able to be physically present in the class, e-books, and educational games are innovations from the past decade that aim to change the modern classroom's environment (Svokos, 2015). In order to create more direct and significant learning, study skills should be implemented in each new medium, by developing a new school curriculum based on lessons that will have been designed to include study skills in core subjects through interactive means.

Foreseeing the Future

In a period that in every educational system in the world, teachers and educators are seeking to find the best possible ways to include students from different countries, different socio-economic background, different intelligences and unique brains, in the system, it is not a matter of any special needs or a matter of intelligence on how easily or effectively an individual learns. It is a matter of being involved. Involvement means to be able to hear, understand, process, use and assimilate symbols, words, sentences, meanings and ideas that will guide the learner to knowledge. Technology triggers the minds of every individual in any corner; the skills are the keys that open the doors to each self and mirror the ability of every individual by choosing to know how to learn. Having the means as well as having the tools to reach knowledge is the way through which a person achieves self-awareness and metacognition; this is not a matter of receiving good grades and high degrees but a matter of having a successful life as autonomous and spiritually independent minds.

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USING CHATBOTS TO AID TRANSITION

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Abstract

This paper examines how chatbots can be used to support students as they transition into university. We propose that chatbots can be a useful tool for helping first year university students deal with two key issues that affect their motivation and success: navigating the volumes of information that confront them, and feeling socially disconnected. This paper reports the results of applying this tool in a large first year class. Findings indicate that chatbots can play a valuable role in assisting students without increasing the demands on instructors. We conclude with proposed improvements for future chatbot iterations.

Introduction

This paper brings together two streams of research that have been explored separately, and more recently have been combined: students transitioning into first year university, for example Hillman (2005), and the use of information technology in education, i.e., Dahlstrom Walker and Dziuban (2013).

A great deal of literature has examined the difficulties students face when starting university. Briggs, Clark, and Hall(2012) outline a few large studies including Tinto's (1987) seminal work on this topic, which indicated that the causes of attrition can be largely attributed to both social and academic challenges. Among the causes most frequently cited are a sense of being disconnected from other students and from the instructor and the difficulties of navigating a new environment with new expectations and structure (Jones, Edwards, & Reid, 2009). Related to this, but not directly examined, are the significant volumes of information to sort through, absorb, and act upon. A review of the information management literature reveals that high quantities of information may have unintended negative effects such as confusing and frustrating the recipient, leading to information anxiety and diminished performance (Eppler & Mengis, 2004).

Technology has been proposed as a possible tool that can be harnessed to deal with the above issues. In particular, it has been examined as a tool to connect with and assist students both socially and academically (Rau, Gao, & Wu, 2008). The research shows that tools such as e-mail, text-messaging/short-messaging systems (SMS) and instant messaging (IM) can be effective for sharing information with students, answering their questions, and helping them feel connected to the instructor (Lauricella & Kay, 2013; Rau et al., 2008). Their benefits from a student perspective are the potential for a quick response, convenience, ease-of-use and a sense of greater connection with the instructor. However, the problems associated with IM are that it can be frustrating for the student if the instructor is not online, and the student sometimes perceives it as breaching privacy boundaries. For the instructor, it demands greater availability and greater time spent responding to individuals.

A recent technology innovation that extends instant messaging is the chatbot. This is an automated response system that has some limited artificial intelligence capabilities and appears as a contact on the IM system. Its benefit is that the student can navigate through frequently encountered questions using an intuitive, conversation-like approach and locate information as it is needed, when it is needed. The chatbot can also send reminders or be used as a mass communication tool by the instructor to send messages. The fact that it resides on the student's mobile phone makes it convenient and, at the same time, may give the student the sense of being a little less disconnected from the professor, while at the same time not being too close.

This paper examines the literature on student transition, information overload and the use of chatbots to address the challenges from the intersection of these two issues. It is important to do so because student retention is a challenge that all universities confront, and we are constantly seeking tools and approaches that can make student transition and, therefore, student retention more successful. Mobile phones and the use of instant messaging are ubiquitous among university students, some studies showing that over 90% of students own them and frequently use IM to communicate (Jones et al., 2009). They represent an opportunity to reach students "where they live." However, the direct focus on IM in education is relatively scarce (Lauricella & Kay, 2013).

The paper describes the findings from the use of a rudimentary chatbot in a large first year class. It concludes by identifying areas of improvement for future iterations of the tool, as well as other applications.

Literature Review

Student Transition

A significant amount of research has engaged in understanding the challenges of student transition into first year university because the majority of student departure occurs during this time (Jones et al., 2009). The movement from a prescriptive, structured high school system to the independence of a university system makes students feel disoriented, and they often struggle to motivate themselves (Briggs et al., 2012; Harley, Winn, Pemberton, & Wilcox, 2007). They must also adjust to increased academic demands and altered teaching arrangements (Jones et al., 2009). Although information is one of five important aspects of successful transition, they often experience information overload on arrival (Briggs et al., 2012). Finally, they feel disconnected socially from peers and instructors, which also serves to reduce motivation and help-seeking behaviour (Harley et al., 2007).

Successful transition is, therefore, more likely to occur when the student can be an autonomous learner, access and absorb the needed information, and feel socially connected to instructors and peers (Briggs et al., 2012). While supportive university systems and information systems can enable adaptation and good decision making, research has shown that administrative information sessions and online or in-class document provision systems are not sufficient (Harley et al., 2007). These sessions and document systems do not address the underlying cause of information overload, and indeed, may contribute to it. Information overload can lead to feelings of demotivation, frustration, and anxiety, and students must feel comfortable seeking help (Eppler & Mengis, 2004; Er, Kopcha, & Orey, 2015).

Furthermore, students do not take the needed actions to obtain clarification or assistance when feeling lost or confused. Er et al. (2015) examined college students' online help-seeking behaviour and found that students may avoid seeking help in order to uphold a positive social image; they want to avoid being viewed as appearing incompetent. Based on these insights they suggest that students are more likely to seek help if they are able to do so with anonymous identities and will use instructor supports when they are viewed as both useful and non-threatening.

With respect to the social aspect of transition, social presence is consistently associated with student motivation and it is also believed to influence motivation (Rau et al., 2008). Social presence is created by the intimacy and immediacy of interactions (Rau et al., 2008). Similarly, a sense of connection with the instructor, i.e., frequency and quality of contact, is a significant predictor of student persistence in the face of challenges (Tinto, 2002 in Jones et al., 2009).

Scholars have examined the use of text-messaging (SMS) to support transition to university. They demonstrated that the use of SMS has the potential to enhance support provided to students, facilitate the development of productive relationships for those who would otherwise be socially isolated and provide valuable assistance (Harley et al., 2007). Because students receive text messages in a device they consider personal – their mobile telephones – this mode of communication was a way of blurring the distinction between the academic and social aspects of university life, strengthening relationships between staff and students (Harley et al., 2007).

At the same time there are concerns that we want to develop independent learners and ensure they are not dependent on support structures and ensure that instructors are not over-burdened (Jones et al., 2009). From an instructor's perspective, as the number of students increases, it becomes more difficult to connect with students individually regardless of the mechanism. In addition, it is not reasonable to expect that instructors would be continuously available to students even if the technology allows it.

Scholars have noted that it would be a missed opportunity if universities didn't consider tools such as SMS and IM to support first year students given that students are already "conducting a substantial part of their lives" through these tools (Harley et al., 2007, p. 238). Our paper accepts this proposition and examines a new tool – the chatbot – and the role that it can play in supporting student transitioning while addressing some of the concerns associated with SMS and IM.

Technology in Education
Communication technologies such as text messaging, e-mail, and instant messaging have all been examined both as educational tools and for their impact on student-instructor bonding. In all cases it has demonstrated value in enhancing the experience and performance of the student. Lauricella and Kay (2013) examined how higher education students use text and IM for academic purposes with peers and instructors and found that students regularly used it for academic purposes with peers but did not use it as frequently with their instructors (Lauricella & Kay, 2013). E-mail, on the other hand, was rarely used for peer-to-peer communication and students did not report feeling positively about or bonded to the instructor when this technology was used (Lauricella & Kay, 2013). Those that did use IM to communicate with the instructor noted that it was more convenient than e-mail since they always have their mobile phones in-hand and appreciated that it allowed them to get in touch with him/her and get quick answers (Lauricella & Kay, 2013).

A 2009 study by Jones and colleagues showed that over 70% of students were interested in using their phones to receive deadline reminders and over 60% were interested in receiving questions from their tutors. Approximately 40% indicated they would appreciate being able to use their phones to find out information and keep in touch with tutors or asking questions. Students viewed the reminders and announcements of administrative changes that arrived in their phones were an effective aid to time management (Jones et al., 2009). Scholars have consistently shown that SMS is a personal way to reach students and let them know that they should look at materials available online (Rau et al., 2008).

In terms of information overload, research showed that using SMS to communicate with the instructor did not increase student pressure; when students received a message they felt they were being cared for and felt bonded strongly with the instructor and classroom activities. They were motivated to pay attention to information in their email or online when directed to do so in this way (Rau et al., 2008). Scholars propose that text messaging reminders of when assignments are due can help first year students adjust to academic life (Lauricella & Kay, 2013) by helping them manage their new and substantially increased workload. With respect to asking for assistance, students feel more comfortable doing so when using technology because of reduced social cues (Rau et al., 2008).

With respect to social bonding, informal communication is very effective in social bonding and social learning; adoption of informal interaction into education improves student–instructor relationships, promotes student motivation and reduces student pressure (Rau et al., 2008).

Messages are arriving to the student's mobile phone (an object perceived as "personal space")(Lauricella & Kay, 2013, p. 4). Furthermore, IM and SMS are viewed as less formal means of communication and more personal (Rau et al., 2008). As a result, when the instructor communicates with the student using SMS some students feel it made the instructor feel more approachable and friendly (Lauricella & Kay, 2013), and the distance between the two is shortened resulting in a better relationship and higher student motivation (Rau et al., 2008).

On the other hand, some students resented when SMS or IM were used to communicate with faculty because they considered their mobile phones a personal technology and disliked faculty entering into their personal space (Lauricella & Kay, 2013). Students also noted the frustration and limitation of not being able to reach the professor if he/she was not online and that sometimes they simply did not want to appear visible to their instructor (Kay & Lauricella, 2015).

To our knowledge, the role that chatbots can play in addressing some of the above concerns has not been examined. Chatbots reside in instant messaging platforms and can assist with simple questions with basic artificial intelligence as well as providing a more intuitive navigation for finding information. They, therefore, offer the possibility of assisting with a student's information needs while, perhaps, feeling somewhat personal by virtue of being accessible through mobile phones.

Information Overload

Scholars summarizing prior work on information overload point out that there is no universally accepted definition of the term (Edmunds & Morris, 2000; Eppler & Mengis, 2004). It can mean having more information than one can assimilate or being burdened with a large supply of unsolicited information, some of which may not be relevant. However, they concur that overload occurs when supply exceeds processing capability (Eppler & Mengis, 2004).

Information overload is seriously affecting the ability of people to do their jobs and impinging on relationships and quality of life (Edmunds & Morris, 2000). Research has demonstrated that the quality of decision or reasoning has an inverted-u relationship with the amount of information (Eppler & Mengis, 2004). Beyond a certain point, the information is no longer integrated into the decision process, decision accuracy declines, and the individual becomes confused and has difficulty recalling prior information or using it effectively (Edmunds & Morris, 2000; Eppler & Mengis, 2004).

Emotionally and psychologically, overload is usually associated with loss of control over a situation and feelings of being overwhelmed (Bawden & Robinson, 2009). Psycho-emotional reactions of stress, anxiety and low motivation may also occur; as well as a greater tolerance of error, sense of loss of control or a false sense of security (Eppler & Mengis, 2004).

Information overload is caused by a combination of factors including the information (quantity, quality, frequency, etc.), recipient, and technology among other reasons (Eppler & Mengis, 2004). Overload has been exacerbated by two factors: the rapid advance of technology, which allows information to be shared in multiple forms and through a variety of channels, and the fact that our classical methods of handling information may be inadequate for the electronic forms which are prolific today (Bawden & Robinson, 2009; Edmunds & Morris, 2000).

Overload can be reduced by delivering information in the most convenient way for the user, and using intelligent information management systems that enable easier prioritization of information. Examples include simplifying information technology functions and using artificial intelligence search systems (Eppler & Mengis, 2004). Structuring is key to making it more manageable and more valuable (Edmunds & Morris, 2000). Solutions to information overload revolve around the principle of taking control of one's information environment (Bawden & Robinson, 2009).

At the same time, some propose that push technology can be useful because it can reduce the need to search for information or the risk that someone who needs the information might not be aware of its existence. Push technology works by "pushing" notices of pre-selected information to the user, thereby alerting him (Edmunds & Morris, 2000). However, this system is ineffective if the user does not want information pushed to him or if too much information is pushed, once again creating an overload situation (Edmunds & Morris, 2000).

The intersection of the above three streams of research motivate this paper and the creation of a chatbot for a large first year class. The design of the chatbot will be described below, as well as the results of a survey of students who used it. .

BU111 Bot Implementation

Chatbots are automated IM accounts that are programmed with chat-based logic. They appear in your IM contacts as any friend would and are accessed in the same way.

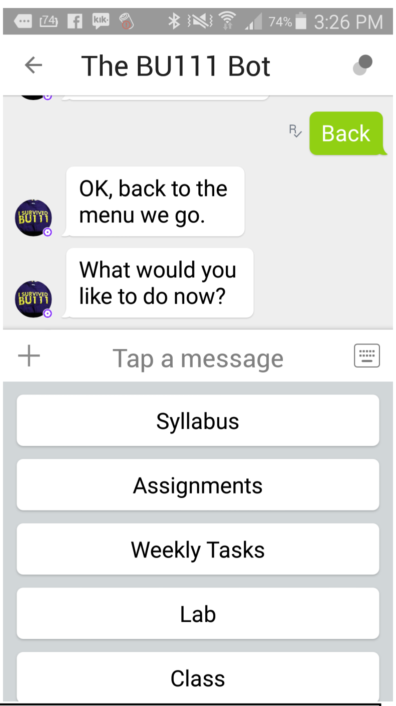
Chatbots have become popular due to two important trends: (a) billions of people worldwide now use IM apps, and (b) the app model of executing activities is problematic because you have to download and learn a new app for each activity you want to perform or you have to access a website. Chatbots offer the potential to provide support without requiring the individual to wander around an app or website, or learn how to use a new interface. For example, a chatbot could ask your criteria and suggest relevant things for you to look at. Bots represent a unique opportunity because many smartphone users find themselves in a state of app-overload. They have too many apps that do too many things and are often hesitant to download new ones, no matter how great they might seem. Bots solve this problem by providing access to new experiences and services from within a familiar and comfortable space: a chat app. Furthermore, the conversational interface that is used to help the user navigate through content or find desired content is very similar to a conversation one might have with another person, and is easier than hunting and clicking on a website.

In designing the chatbot for our course there were several points raised by scholars, in addition to the observations described above, that informed its creation and design:

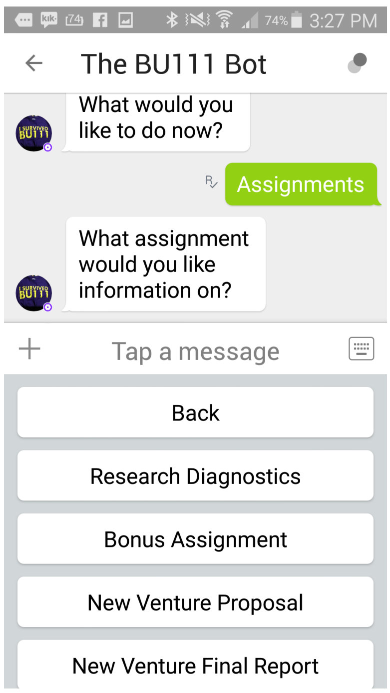
- Humans interact with media in inherently social ways (Veletsianos & Miller, 2007).
- An information retrieval system should be designed so as to reduce the risk of failure by the user and thereby increase his self-efficacy (Wilson, 1999).
- Although there is an abundance of information available it is often difficult to obtain useful, relevant information when it is needed (Edmunds & Morris, 2000).

We were therefore focused on developing a tool that would make information retrieval easy and convenient by enabling it to occur through mobile phones. Furthermore, by using a chat interface the hope was that the search for information would be more intuitive and less frustrating. Finally, by injecting a little humour into its interface it was hoped that the chatbot would feel"friendlier."

Figure 1 below illustrates the BU111 Bot in a user's phone. When the user first connects with the chatbot he sees the Main Menu options shown on the left in Figure 1. The student can choose among Assignments, Help, and other options that are likely to be the key areas of information he might be interested in. The image on the right shows both the conversational response and the options that appear if the user selects "Assignments" from the Main Menu. If the student selects a link that is attached to a document, the document will open in the user's phone.



What the user sees if he selects "Main Menu"



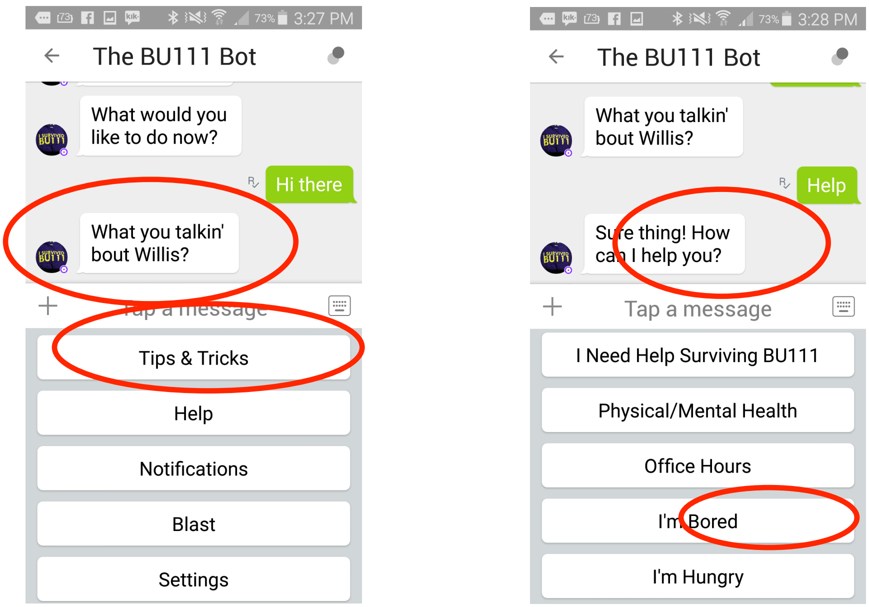
What the user sees if he selects "Assignments" from the Main Menu

Figure 1 – List of main menu (on the left) and assignment menu options (on the right).

The chatbot provides organizational assistance to the student with three important features: (1) the *Weekly Tasks* allows the student to look up what is required in any particular week of the term; (2) the student can opt to receive notifications once per week reminding him of what is required that week, and (3) the instructor can send out "blasts" reminding and sharing information with students. To ensure that the students still developed some independence over time, the automatic weekly notifications changed over the semester from explicit tasks to *check your course outline* to *what should you be doing right now?*

The *blast* feature available to the instructor allowed her to send notifications, reminders, and words of encouragement to anyone who was using the BU111 Bot. From time to time this feature was used simply to send jokes, particularly during times when the instructor knew students would be feeling very stressed.

Figures 2a and 2b show some small personality elements that were in the bot. If a command was entered which the chatbot could not understand then the message *What you talkin' bout, Willis* appears. This is a well-known expression from a popular television series in North America. The *Tips and Tricks* option shown in Figure 2a is a collection of advice that was gathered from upper year students on how to survive the course, first year, and university in general. Each time a student selects this option he receives two random tips out of the collection. Notice that the conversational style of the chatbot is casual rather than formal, *Sure thing! How can I help you*" (Figure 2b).



Figures 2a and 2b – Elements of humour, "personality" and assistance

The *Help* categories illustrated in Figure 2b provide the students with some non-academic information. The *I'm Bored* option connects the students with student clubs and the athletic complex.

The BU111 Bot operated on the Kik messaging platform. It was created by two students of the business program. It was implemented in a large first year business class teaching roughly 1,900 students. The format of the class is two 1.5 hour 300-student lectures per week. In addition to lectures, students were required to attend weekly labs and prepare specific assignments and activities for the labs prior to attending. Course requirements are two exams, one online assignment, one individual case analysis write-up requiring extensive research, one large group project requiring the identification and validation of a new venture opportunity, as well as two group presentations (one case presentation and one presentation based on the new venture project).

Findings

A voluntary survey was conducted of the students who chose to use the chatbot. Approximately 1,700 first year students registered with the chatbot, and 315 responded to the survey, providing an acceptable response rate of 18.5%. Students were asked to answer questions and consider the impact of the chatbot in comparison to their other classes where no chatbot was used. It was also possible to view usage through a dashboard that is built in with the chatbot.

By using the dashboard it was possible to see that *Weekly tasks* was the most frequently used feature, followed by *Assignments*. Approximately 1,700 and 1,500 students used each feature frequently at the beginning of the term. Use declined over the course term, which was expected given that the assignment instructions were also available on a course website. The survey results validate this information, indicating that many students used the *Weekly tasks* feature throughout the term (see Table 1a).

With respect to student transition, the chatbot appears to have been valuable both directly and indirectly. Tables 1a and 1b show the features that were most valuable and most often used. Not surprisingly, *Assignments*, *Weekly Tasks* and *Notifications* were most frequently selected. The *Assignments* and *Weekly Tasks* features allowed students to look up the assignment requirements for each of their assignments, while the weekly tasks listed the requirements for their lab preparation each week. It should be noted that this information was always readily available on the course website and on the course outline. This suggests that the convenience of accessing the information on their phones as well as being able to find it more easily than searching through a website was of value to the students.

Table 1a

Chatbot Feature Use

Please indicate how often you used the listed chatbot features				
Answer Options	**Never**	**A few times over the semester**	**Weekly**	**Response Count**
Syllabus	101	200	13	314
Assignments	62	205	47	314
Weekly Tasks	53	181	78	312
Lab	134	140	39	313
Class	184	108	20	312
Tips and Tricks	150	147	17	314
Help	183	117	14	314
Notifications	86	141	87	314
Other i.e. formation of a group chat	227	66	17	310

Table 1b

Chatbot Feature Value

Which three features of the chatbot were the most valuable to you?		
Answer Options		**Response Count**
Syllabus	95	95
Assignments	189	189
Weekly Tasks	235	235
Lab	81	81
Class	15	15
Tips and Tricks	65	65
Help	28	28
Notifications	139	139
Other, i.e., formation of group chat	9	9

In terms of helping students meet course requirements, Tables 2a and 2b show that over 60% of students felt that the chatbot, at least somewhat, helped them meet lab preparation and course assignment requirements. Given that the chatbot only provided access to information on what should be prepared, it would be safe to assume that the students were reflecting the ability to easily find the information they needed and ensure that they had all information needed.

Table 2a

Assistance in Meeting Lab Preparation Requirements

Did use of the chatbot assist you in meeting the lab preparation requirements?		
Answer Options	**Response Percent**	**Response Count**
Yes	34.3%	106
No	38.2%	118
Somewhat	27.5%	85

Table 2b

Assistance Meeting Assignment Requirements

Did use of the chatbot assist you in meeting the course assignment requirements?		
Answer Options	**Response Percent**	**Response Count**
Yes	43.6%	134
No	30.6%	94
Somewhat	25.7%	79

The Notifications feature allowed students to opt to receive push messages on Sundays that reminded them of weekly tasks that were due in the upcoming week. The notifications evolved over the course of the term in order to encourage students to become autonomous rather than relying on others – at the beginning of the term the notifications provided a detailed list of what should be completed. Within a few weeks, the notifications reminded students to look at their course outlines for what was required, and at the end of the term they were simply messages to the effect of, *shouldn't you be doing something to prepare for BU111?*

Tables 3a and 3b show that over 50% of students found the chatbot aided them with time management in some way. More importantly, approximately 84% of students indicated that the notifications prompted them to work on course requirements, and in Table 2c we see that 18% of students perceived the notifications as "something I must attend to." Furthermore, as shown in Table 3c, 46.7% were relieved to be reminded, suggesting that the tool helped alleviate some of the stress of managing academic demands. Survey comments further confirmed that students appreciated the push notifications however, some expressed frustration at the fact that they became more vague over the term, and they wanted them to be more specific and prescriptive as they had been at the beginning of the term. It is fair to conclude that these students were resisting taking ownership of their learning and reinforces the concern that technology and support structures must be used judiciously so that students learn to self-organize to ensure their success (Briggs et al., 2012; Jones et al., 2009).

Table 3a

Prompt Value of Reminders

Did Notifications and reminders prompt you to work on course requirements?		
Answer Options	**Response Percent**	**Response Count**
Yes	45.2%	131
No	16.2%	47
Somewhat	38.6%	112

Table 3b

Time Management

Did the chatbot aid your time management?		
Answer Options	**Response Percent**	**Response Count**
Yes	22.7%	70
No	47.7%	147
Somewhat	29.5%	91

Table 3c

Perception of Notifications

If you used the Notifications feature, how did it make you feel when you received it (select all that apply):		
Answer Options	**Response Percent**	**Response Count**
relieved to be reminded	46.7%	129
this is something I must attend to	18.1%	50
they care about me	13.0%	36
they are watching me	6.2%	17
I can plan my own time	15.9%	44

The most interesting insights related to social connection are shown in Tables 4a and 4b. Despite the fact that the chatbot is not human, approximately 65% of students indicated that the chatbot at made the course feel more personal than other courses (Table 4a). In Table 3c we see that 13% of students felt cared for when they received notifications. Students taking the survey often commented on characteristics associated with humans, “Liked the motherly feel it had,” “Liked the sass.” Many students made statements such as “made the professor more relatable.”

Table 4a

Social Perception of Bot

Did use of the chatbot make the course feel more social and/or personal than other courses that did not use a chatbot?		
Answer Options	**Response Percent**	**Response Count**
Yes	38.6%	120
No	34.4%	107
Somewhat	27.0%	84

Table 4b

Willingness to Ask Questions

Did you ask questions to the chatbot that you might not have asked your Professor or TA?		
Answer Options	**Response Percent**	**Response Count**
Yes	28.2%	88
No	71.8%	224

In Table 4b we see that 28.2% of students asked questions of the chatbot that they may not have asked their professor or teaching assistant. Although this may seem like a small number, it is important to note that these students had questions that would have either gone unasked or ran the risk of obtaining incomplete or incorrect information from peers.

In general, the chatbot appears to have been a useful transition tool as shown in Tables 5a and 5b. Just under 50% of students indicated that the chatbot increased their level of motivation in the course in some way, and approximately 69% indicated that it assisted them with the transition and adaptation to university.

Table 5a

Chatbot as a Transition Aid

In comparison to other courses, did you feel that the provision of a chatbot assisted you with the transition and adaptation to University academic expectations in BU 111?		
Answer Options	**Response Percent**	**Response Count**
Yes	28.9%	89
No	30.2%	93
Somewhat	40.9%	126

Table 5b

Motivational Impact

Did use of the chatbot increase your level of motivation in this course more than other courses that did not use a chatbot?		
Answer Options	**Response Percent**	**Response Count**
Yes	19.9%	61
No	51.5%	158
Somewhat	28.7%	88

Conclusions and Future Iterations

Future iterations of the chatbot will incorporate insights gained from this version. In reviewing the comments, some students liked the jokes and individual notifications and wanted more while others did not. As indicated in Table 2c, approximately 16% of students reacted to the notifications with "I can plan my own time." This reinforces the notion of individual information preferences and that "overload" is a very individual thing. Future iterations of the chatbot will allow students to subscribe and unsubscribe to receive notifications as well as jokes and individual review questions so that their individual information and communication preferences are more likely to be satisfied.

In addition, the chatbot will be developed for Facebook Messenger. Students already have Messenger and it is a cross-platform product whereas Kik has fewer subscribers, and it only works on mobile telephones. This created some resistance to its adoption.

We will also be experimenting with making the chatbot "friendlier" by incorporating photos and images. Images are more aesthetically pleasing than text alone, but we believe that visuals of faces and humour increase the "friendliness" of the product and, it is hoped, increases social bonding further.

Finally, we plan to harness more of its potential as an educational tool by pushing weekly or bi-weekly "food for thought" or review questions so that students are at least thinking about the material between lectures. At least one of the instructors also plans to use it to hold virtual office hours. Students often indicate that they are uncomfortable coming to the professor's office and find it intimidating. It is hoped that in allowing students to ask questions during a designated hour (so that the burden to the instructor is not increased), using social media will encourage more students to ask for assistance or at least feel that the instructor is in general more approachable.

Mobile telephones are prolific, and students and their phones are inseparable. Rather than lament their presence, the existing findings related to technology in the classroom suggest that they may represent an opportunity to both make students comfortable in their new environments socially and help them manage its complexity so that they can transition into university more successfully or at least more easily. The use of the chatbot represents an opportunity to assist students by providing information that can be quickly and easily found, as well as make them feel a little more comfortable and connected with the instructor. Importantly, both of these objectives are achieved without increasing the demands on the instructor. Indeed, the instructors of BU111 found that the student e-mails they received asking questions caused by information overload or an inability to find information declined significantly. Chatbots in education represent an opportunity to truly create an improved experience for both students and instructors.

Acknowledgement

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STRATEGIES AND TOOLS FOR MEASUREMENT AND HANDLING STRESS FACTORS OF UNIVERSITY STUDENTS

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Abstract

According to the research carried out in the last five years in terms of frustration tolerance, students on average range throughout the whole school year *within the optimal third zone*. In terms of using strategies when handling stress, *healthy coping strategies* are most frequently used, namely by more than half of respondents. Among university students the psychosomatic symptom of *tiredness and a lack of energy* has the highest proportion, the lowest occurrence was found among sport management students (more than one third). The online application, which enabled subjective questioning and classification into stress factors, was set up and placed on the Web.

Keywords: quality of life, zones of stress potential, frustration tolerance, handling stress, psychosomatic symptoms, coping strategies, online application

Introduction

Psychosomatic medicine, behavioural medicine and psychology of health (Kebza, 2005; Kebza & Šolcová 2000; Křivohlavý, 2001) are based on very similar principles; they use related procedures and try to achieve similar goals. If we think about their differences, then psychosomatic medicine is based on the assumption of psychogenic origin of illnesses and was considerably influenced by psychoanalytic bases and knowledge of theory of stress, and behavioural medicine emphasizes the application of behavioural analysis in the interdisciplinary approach to diagnostics, treatment, prevention and rehabilitation of diseases. Psychology of health remains unlike the above-mentioned branches a psychological branch regardless of its focus and subject. It strives for the application of results of psychological cognition in relation to health (Goleman, 1997; Kebza, 2005). We can say that the studied area that is the subject of our empirical research belongs to the issues of social psychology, mental hygiene, psychosomatic medicine, behavioural medicine and psychology of health.

Statistical Procedure in the Use of Stress Potential Zones

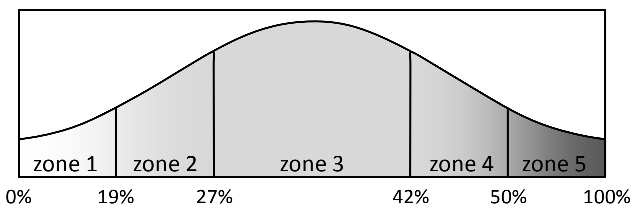


Figure 1. Zones of stress potential converted into percentage values.

Limit values of individual zones of stress potential have been converted into their percentage expression in the scale 0 (0%) to 39 (100%). See Figure 1. Point results of each respondent from individual questionnaires have also been converted into percentages (Strnadová & Voborník, 2015b, 2016).

Statistical Procedure in Evaluating the Questionnaires

For our research, we have chosen the method of a questionnaire survey (questionnaires A–F: A – Frustration tolerance, B – Handling stress, C – Lifestyle, D – Living and social conditions, E – Psychosomatic symptoms, F – Vulnerability, degree of vulnerability to stress). The questionnaires have been modified according to the publication by Micková (2004) – (A–E) – and according to Beech (1987) – (F). From the original set of questions it was possible to obtain a certain number of maximum points (A: 18p., B: 20x3=60p., C: 7x3=21p., D: 6x3=18p., E: 7x3=21p., and F: 12p.). During the evaluation, it was possible to get at least 0 and at most 3 points (questionnaires B – E), alternatively 0 or 1 point (questionnaires A: yes=0, no=1; and F: yes=1, no=0), and the more points received, the more negative the result is (except the answers from category C – coping methods in questionnaire B – *Handling stress* which means the most successful handling stress situation unlike the answers in categories A and B, i.e., malcoping (risky) strategies. The number of points obtained in the questionnaire by each respondent was then divided by the mentioned maximum for a given questionnaire, and thus the *percentage result of each respondent* was gained. Based on this percentage result an individual was consequently put in the particular *stress zone*, either individually or within the average of the group of respondents, which will be compared in the following chapters.

Research on Stress Factors in University Students

Monitored Period and Characteristics of Respondents

The research was going on from September 2011 to January 2016 among 1,513 students who completed 2,237 questionnaires in total. Of these students, 767 were women and 744 were men. Two individuals did not fill in their gender (see Figure 2).

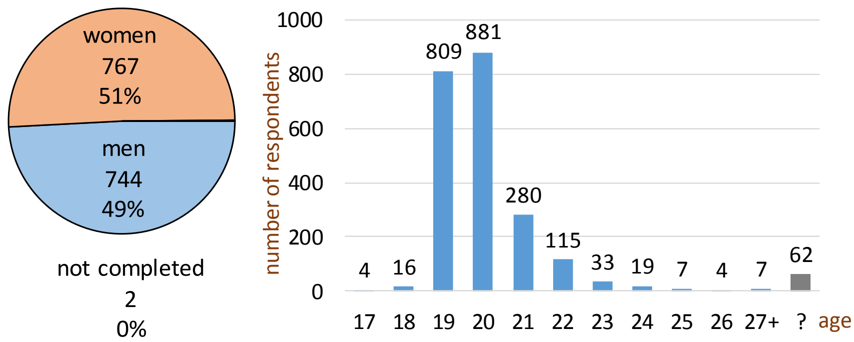
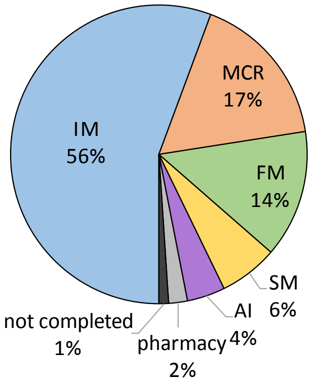


Figure 2. Division of respondents by gender (on left) and by age (on right).

Respondents' average age was 20 years (19.99586); ages ranged from 17 to 41 (62 respondents did not state age). See Figure 2, which includes respondents' age for every single questionnaire (2,237 in total), repeatedly assigned to some of the same students whose age was increasing throughout the study's duration. Respondents were students from the Faculty of Informatics and Management in Hradec Králové, with the branches of study of applied informatics, financial management, information management, management of tourism and sport management as well as students from the Faculty of Pharmacy of Charles University in Prague. (See the chart and the table in Figure 3.)



Abbre-viation	Number	%	Branch and University
IM	846	56%	Information management – UHK
MCR	256	17%	Management of tourism – UHK
FM	210	14%	Financial management – UHK
SM	97	6%	Sport management – UHK
AI	63	4%	Applied informatics – UHK
pharmacy	31	2%	Faculty of Pharmacy – Charles University in Prague
not completed	16	1%	Branch not completed in the questionnaire
Total	**1,519**	**100%**	There are 1,513, i.e., 6 of them changed their branch during the research

Figure 3. Division of students by branch of study.

Students were chosen randomly both from daily form and combined form of studies. The number of repeated processing of the questionnaire by the same students is shown in the graph in Figure 4.

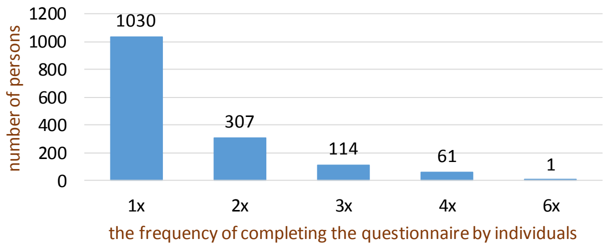


Figure 4. Number of questionnaire completions by individual persons.

Methodology of Research

The questionnaire survey and monitoring zones of stress potential were carried out in the research. Statistical processing by the application IBM SPSS was used in research.

Questionnaire survey. The first method of the research was a questionnaire survey that covered the following items: the degree of frustration tolerance, handling stress, lifestyle, living and social conditions and psychosomatic symptoms. The research into these items was adapted to meet the needs of the student population in compliance with the previous survey among students of FIM UHK according to the manual by Micková (2004). The degree of vulnerability was also examined according to the study by Beech (1987). The selection of both research methods was professionally consulted on with researchers from Institute of Psychology of Masaryk University in Brno. The entries of the form in distributed questionnaires are presented in the following text.

Results of Research
In the next statistical and graphical processing, we analyzed the results of the research into stress factors in university students in the following sections:

- Frustration tolerance (questionnaire A)
- Handling stress – behaviour in a stress situation (questionnaire B)
- Psychosomatic symptoms (questionnaire E)

Frustration tolerance (questionnaire A). On average, students throughout the school year range in terms of frustration tolerance within the optimal third zone (between 28% – 40%). At the beginning of the school year, they start at the upper limit of this zone and gradually they evolve to the fact that at the end of the school year their frustration tolerance grows. Thus, they are moving to the lower limit (up to 28%) of the healthy third zone (see Figure 5).

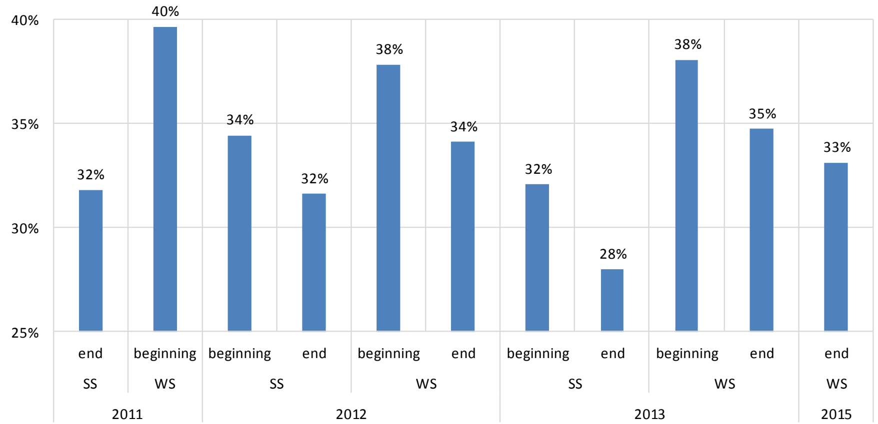


Figure 5. Average percentage results of degree of frustration tolerance (questionnaire A) at the beginning and end of semesters in years 2011/12 – 2015/16.

Total numbers of YES answers to individual items of the frustration tolerance questionnaire (A) range between 2,224 and 2,232, which is a negligible difference in the total number of respondents (see Figure 6). Thus, none of the asked questions was more or less important for the respondents than the others. The more YES answers are given by a respondent, the more the degree of frustration tolerance he/she shows.

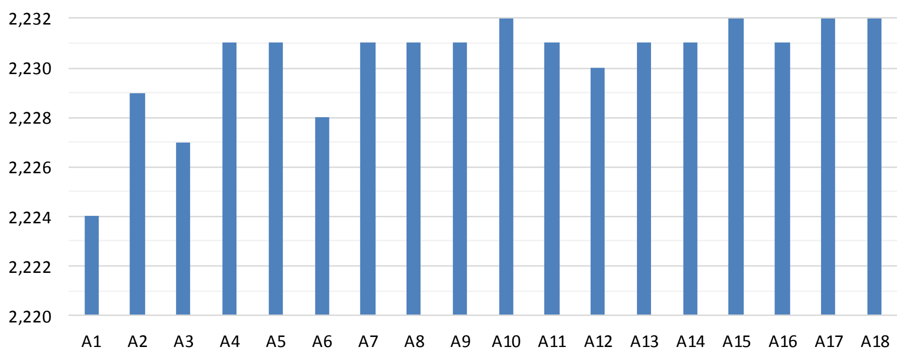


Figure 6. Numbers of YES answers from all A questionnaires (2,237 in total).

According to the graphs in Figure 7, the biggest part of students (941 respondents, i.e., 42%) is included in the third zone as generally expected. However, in the boundary zones (1 and 5) there are a larger proportion of respondents (17% and 19%) than in the zones closer to the center (12% and 10%). It could refer to the fact that university students are engaged in their studies either with maximum effort (zone 5) or they do not take their studies seriously enough (zone 1).

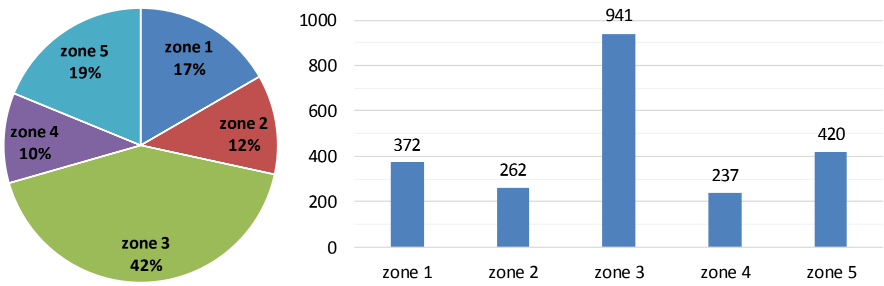


Figure 7. Division of students into zones of stress potential by questionnaire A (frustration tolerance), in percentage (on the left) and nominally (on the right).

Handling stress – behaviour in stress situation (B). The questions in this questionnaire are divided into three categories:

- A – Procedures arousing negative emotions (malcoping)
- B – Damaging (malcoping) ways of behaviour
- C – Coping strategies (healthy handling)

Most used are healthy coping strategies of dealing with stress (category C) – that is in 59%. In the second place, with 34%, there are malcoping procedures arousing negative emotions (category A) that bring a considerable nerve strain. The third position is held by malcoping strategies – damaging ways of behaviour (category B) that are the most dangerous (see the Figure 8 on the left).

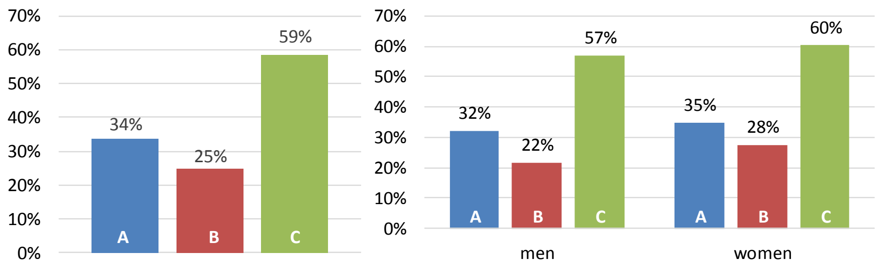


Figure 8. Comparison of handling stress – total values (on the left), of men and women (on the right) in school years 2011/12 – 2015/16.

There are no major differences between men and women (see Figure 8 on the right). Nevertheless, women have slightly higher values (3-6%) in all three categories of dealing with stress, which suggests a greater emotional fluctuation. In the most negative category, B, women have even doubled the difference (6%) compared to the differences in the other two categories (3%). For the subsequent comparison (Figure 9), the calculation of category C, which unlike the other two negative categories (A and B) records a positive effect, is modified so that its resulting value was converted to the complement of the final average (100% – C%), thus marking also its negative component (more % = worse result).

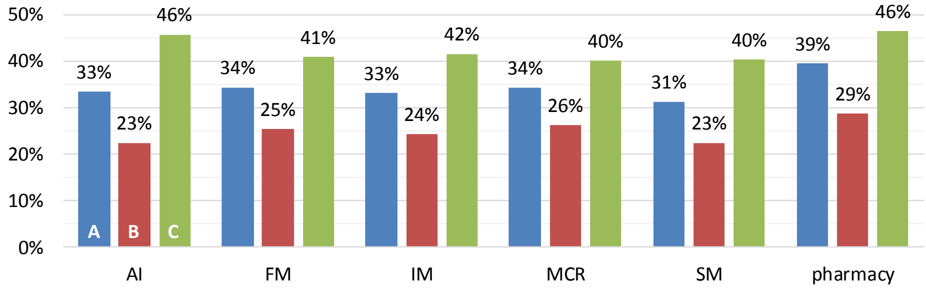


Figure 9. Comparison of handling stress in individual branches of university studies in school years 2011/12 – 2015/16.

In terms of the monitored study branches, the research indicated similar ways of dealing with stress in all three categories A, B, C (see Figure 9).

Psychosomatic symptoms (E).

1. I feel tension in the neck and back muscles
2. I occasionally have a headache
3. I occasionally suffer from a stomach ache
4. I get a fast heartbeat (sometimes associated with heart palpitations)
5. I have memory disorders
6. I feel tired and I feel a lack of energy
7. I suffer from insomnia

In terms of frequency of each of the psychosomatic symptoms, students on average range from the upper limit of the first stress zone (19%) up to the lower limit of the fourth zone (50%), mostly belonging to the optimal third stress zone (27–42%). *Overall, in terms of psychosomatic symptoms students classify in the lower limit of the third optimal stress zone with the result of 29%* (see Figure 10).

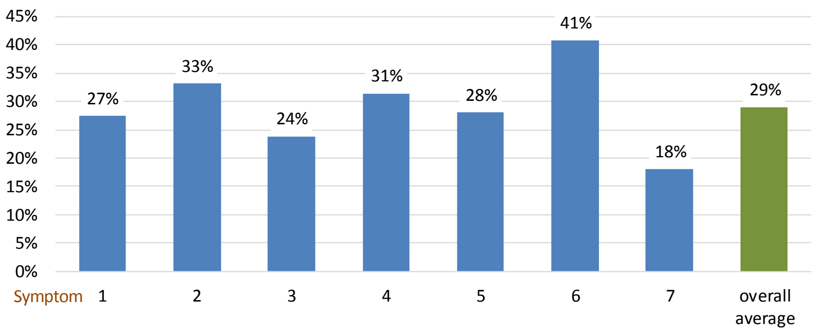


Figure 10. Proportional average frequency of occurrence of each of psychosomatic symptoms (1–7) and their overall average.

Figure 11 shows that *the most represented (41%) psychosomatic symptom in the research is the symptom number 6 – "I feel tired and feel a lack of energy."* . In the second place, there is *a headache* (symptom n. 2) in 33% of cases, and the third position with 31% is occupied by *"disorders of heart activity"* - fast heartbeat, heart palpitation (symptom n. 4).

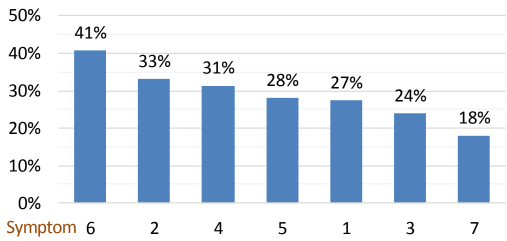


Figure 11. Ordered frequencies of individual psychosomatic symptoms.

The biggest differences in the psychosomatic symptoms between men and women are in the symptom n. 2 (*headache*) where the occurrence is 14% higher in women than men, and the symptom n. 1 (*tension in neck and back muscles*) which women also feel 14% more often. The research shows that in case of the symptom n. 5 (*memory disorders*) the result is identical for both the sexes, i.e., 29% (see Table 1).

Table 1

Division of Frequencies of Psychosomatic Symptoms in Men and Women

	Psychosomatic symptom	Men	Women	All
1	I feel tension in neck and back muscles	20%	34%	27%
2	I occasionally have headaches	26%	40%	33%
3	I occasionally have a stomachache	18%	29%	24%
4	I get fast heartbeat (accompanied with heart palpit.)	30%	33%	32%
5	I have memory disorders	29%	29%	29%
6	I feel tired and feel a lack of energy	38%	43%	41%
7	I suffer from insomnia	17%	19%	18%

The most frequently represented symptom in all study branches is the symptom n. 6 – "Symptom of tiredness and lack of energy". Its highest occurrence is among students of the Faculty of Pharmacy – 50%. The lowest occurrence of this symptom was found out among sport management students – 38%. Symptom n. 3 (*stomach ache*) is the most frequent cause of complaint for students of the Faculty of Pharmacy (43%) unlike students of sport management who complain about this symptom only in 16% of cases. The symptom n. 7 (*insomnia*) has the lowest representation in all the study branches (see Table 2).

Table 2

Division of Frequencies of Psychosomatic Symptoms in Individual Branches of Study

	Psychosomatic symptom	AI	pharmacy	FM	IM	MCR	SM
1	I feel tension in neck and back muscles	17%	38%	29%	26%	33%	25%
2	I occasionally have headaches	25%	36%	37%	32%	38%	23%
3	I occasionally have a stomachache	18%	43%	26%	24%	25%	16%
4	I get fast heartbeat (accompanied with heart palpit.)	29%	37%	33%	31%	32%	31%
5	I have memory disorders	31%	32%	25%	30%	25%	30%
6	I feel tired and feel a lack of energy	40%	50%	39%	41%	43%	38%
7	I suffer from insomnia	19%	18%	16%	18%	19%	16%

According to the graphs in Figure 12 we can conclude that the *majority of students (37%) in terms of psychosomatic symptoms by branches are included in the third optimal stress zone.* In the second place with 31%, there are students belonging to the first least demanding zone. The lowest numbers of respondents, only 7%, are included in the fifth hyper stress zone. The second stress zone (the stress level is low) and the fourth stress zone (the stress level is high) are the closest in representation as far as the number of respondents is concerned, that is 11–14%.

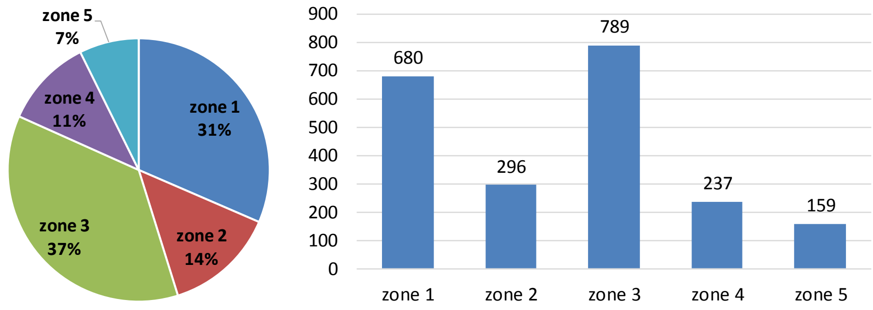


Figure 12. Division of students into zone of stress potential according to the questionnaire E (psychosomatic symptoms), in percentage (on the left) and nominally (on the right).

Summary of the Research

According to the research in the years 2011–2016, in terms of frustration tolerance students on average range throughout the whole school year *within the optimal third zone* (between 28% and 40%). At the beginning of the school year, they start close to the upper limit of this zone (up to 40%). and gradually they evolve to the fact that at the end of the school year their frustration tolerance grows. Thus, they are moving to the lower limit (up to 28%) of the healthy third zone.

In use of coping or malcoping strategies in handling stress *healthy coping strategies* (category C) are used the most – in 59%. Malcoping procedures arousing negative emotions (category A) and bringing a considerable nerve strain are in the second place with 34%. The third position is held by malcoping strategies – damaging ways of behaviour (category B), which are the most dangerous.

There are not major differences between men and women. However *women have slightly higher values* (3–6%) *in all three categories of dealing with stress*, which suggests a greater emotional fluctuation. In the most negative category of malcoping strategies of B type, women have even doubled the difference (6%) compared to the differences in the other two categories (3%). In terms of frequency of individual psychosomatic symptoms, students on average range between the upper limits of the first stress zone (19%) up to the lower limit of the fourth zone (50%). Most of them belong to the optimal third stress zone (27–42%). With a total result of 29%, students in terms of psychosomatic symptoms are included to the *lower limit of the third optimal stress zone*.

The most frequently represented symptom (41%) in the research is symptom n. 6 – "*I feel tired and feel a lack of energy.*" In the second place there are *headaches* (symptom n.2) in 33% of cases, and the third position with 31% is held by psychosomatics of *heart activity disorders*– fast heartbeat, heart palpitation (symptom n. 4).

The biggest differences in psychosomatic symptoms between men and women are in the symptom n. 2 (*headache*), where the occurrence is 14% higher among women than among the men, and the symptom n. 1 (*tension in neck and back muscles*), which occurs among women also14% more often. The research shows that in case of the symptom n. 5 (*memory disorders*) the result is identical in both sexes, i.e., 29%.

The psychosomatic symptom n. 6 – *symptom of tiredness and a lack of energy* has the biggest representation in all the study branches and its highest degree is among students of the Faculty of Pharmacy – 50%. The lowest occurrence of this symptom was detected in students of sport management and that is 38%. Students of pharmacy complain most often (43%) about the symptom n. 3 (s*tomach aches*) unlike students of sport management who show only 16% occurrence of this symptom. The least represented psychosomatic symptom is n. 7 (*insomnia*), which is true about all the branches.

It can be stated (see Figure 12) that in terms of psychosomatic symptoms by individual branches of study, the highest number of students (37%) are included in the *third optimal stress zone*. In the second place, with 31%, there are students included in the first least demanding zone. The lowest number of students (only 7%) belongs to the fifth hyper stress zone. The second zone (the stress level is low) and the fourth zone (the stress level is high) are the closest in representation in terms of number of students, which is 11–14%.

Our research of stress factors has been running since 2011 and even for other groups of respondents. You can also see how university students handle stress (Strnadová & Voborník, 2012) and how employees of selected companies handle stress (Strnadová & Voborník, 2014), and you can find out the various comparisons of groups of athletes and the normal population (Strnadová & Voborník, 2015, 2015b, 2015c, 2016).

Conclusion

The research dealt with stress factors in a selected sample of university students. The method of the research was a questionnaire survey, statistical processing and eventually including respondents in the zones of stress potential in terms of frustration tolerance, stress handling and psychosomatic symptoms.

According to the research, in the years 2011–2016 in terms of frustration tolerance students on average range throughout the whole school year *within the optimal third zone* (between 28% to 40%). In the use of coping or malcoping strategies when managing stress, *healthy coping strategies* are the most used – in 59%. The psychosomatic symptom of *tiredness and a lack of energy* have the highest representation among students of all monitored branches. The highest occurrence of this symptom was detected among students of the Faculty of Pharmacy (50%) while the lowest occurrence show students of sport management (38%).

Access Czech and English versions of the original electronic application at http://qol.alltest.eu/stress, making it is possible to reach a much larger group of respondents. Apart from those directly involved in the project, other "anonymous" volunteers can participate in the research. All the recorded data is available immediately after it is entered, and, thus, it can be automatically continuously evaluated.

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TEACHING EUROPEAN SIGN LANGUAGES AS A FIRST LANGUAGE: CAN THEY BE TAUGHT WITHOUT THE USE OF ICT?

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Abstract

The objective of this paper is to present the importance of the use of information and communication technologies (ICT) for teaching signed languages (SL) as first language (L1). An integrated curriculum and ICT teaching material for the teaching of national sign languages for deaf and hard of hearing students (D/HH) as first languages is introduced. The development of student assessment in learning SL, as well as a teacher and parent training platform, are discussed. Due to deaf students' visual nature, systematic use of ICT for the development of educational materials is required to ensure bilingual education of deaf students and accessibility and quality in educational materials.

Keywords: deaf, hard of hearing students, sign language, first language, ICT

Introduction

In considering the principles of the United Nations Convention on the Rights of Persons with Disabilities (UN General Assembly, 2007) and the Universal Design for Learning (UDL) (Izzo & Bauer, 2015), the Institute for Educational Policy (IEP) proceeded to design and develop a trans-European program called "Teaching European Sign Languages as a first language" (SIGN FIRST). According to the principles of UDL, the development and implementation of educational tools and practices to support all students is crucial. Educational systems must provide each student with the opportunity to evolve using different methodology, tools and materials (Izzo & Bauer, 2015; Mace, Hardie, & Place, 1996; Sfyroera, 2007; Tomlinson, 2001). In the European Union (EU) countries, the ministers of education are bound by the Paris Declaration (European Commission, 2015), declaring that all children and young people: (a) will have access to inclusive education without barriers and/or discrimination, (b) will acquire all the skills, competencies and knowledge needed for success in society by removing geographical, social and educational disparities, and (c) will have integrated and adequate schooling, limiting cases of school dropout and improving their social and professional integration. The principles of universal design are supported directly by information and communication technologies (ICT) as technology contributes to the development of appropriate training materials and learning environments and promotes accessibility and differentiation (Smith & Throne, 2007).

Sign Language (SL) and ICT

International studies argue that the academic progress and normal social and emotional growth of deaf children is directly related to language acquisition and development (Hatzopoulou, 2008; Hoffmeister, 2000; Hoffmeister & Caldwell-Harris, 2014; Hrastinski & Wilbur, 2016; Niederberger, 2008; Ormel, Hermans, Knoors, & Verhoeven, 2012; Woll, 1998). Extensive research on the implementation of bilingual programs in the education for the deaf in Sweden, Denmark and the United States showed spectacular results in the academic course of deaf students and stressed the advantages of acquiring the national sign language from preschool age (Baker, 2001; Fish, Hoffmeister, MacVey, & Clinton, 2006). A recent study by Hrastinski and Wilbur (2016) indicates that children who have competence in SL have higher academic achievement, better understanding of the written texts, proper use of spoken language and good perceptive skills about certain mathematical concepts.

In consideration of the above research, the trans-European program «SIGN FIRST» aims to foster D/HH students' literacy skills/competence by developing bilingual programs and creating effective inclusive school environments. The main aims of the European program are (a) the design and development of innovative educational materials for teaching SL as a first language and (b) the creation of quality teaching tools and methods that will contribute to the professional development of teachers and improve the academic performance of D/HH students.

To achieve this objective, the development and exploitation of ICT is considered essential, as it facilitates the deaf students' access to communication and information. In many cases, ICT is the only solution to minimize deprivation of the incoming information for deaf students. Visual information is a key characteristic of ICT that fits with the D/HH students' learning style since the latter use the visual channel to develop their language and thought (Kourmpetis & Hatzopoulou, 2011). By using ICT we can store, analyse and process data of a language as a signed language, which has no written form. The ICT use also improves the students' participation in the educational activity and leads to the acquisition of new knowledge by strengthening their interest.

SIGN FIRST: Organisation, Key Programme Objectives and Partners

The target group of the SIGN FIRST program is the pupils of the kindergarten and the first two grades of the primary school, aged 4-7 years. However, older pupils of higher grades can also be included in the project's target group as this is a program for teaching SL as a first language, and most D/HH students have never been taught Greek Sign Language (GSL) systematically, at schools. The program is transnational because the challenges for the education of the D/HH students are common throughout the world. In addition, transnationality facilitates the exchange of experience and expertise and the promotion of innovation among the partner countries. Seven different organizations from four countries (Greece, Switzerland, Cyprus and the Netherlands) are the members of this transnational cooperation. The specialization on the education of D/HH students, the knowledge to develop bilingual educational material and the experience in previous European programs were the criteria for the selection of the participants.

The project coordinator is the IEP, which is a leading scientific organisation in Greece with extensive research on the education of D/HH students. IEP has developed specialized accessible multimedia materials for teaching the GSL as a first language (http://www.prosvasimo.gr/el/polimesiko-uliko/ekpaideutiko-logismiko#koita-me-sou-lew) expertise, which is exported through transnational cooperation (see samples in Figure 1).

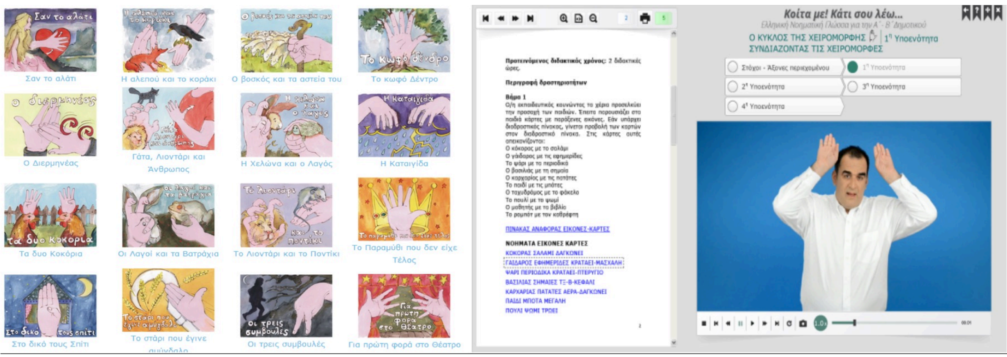

Figure 1. Accessible multimedia materials for teaching GSL as a first language.

The other participant organizations include (a) two universities specializing in teaching and assessing SL (the University of Applied Science in Special Education of Zurich, in Switzerland, and the European University of Cyprus, in Nicosia), (b) two schools for the D/HH students that implement sign-bilingual programs in Greece and teach GSL as a first language, the Special Nursery School for the Deaf and Hard of Hearing Argyroupolis and the Special Kindergarten and Elementary School for the Deaf and Hard of Hearing Likovrisis – Pefkis, (c) the research organization Dutch Sign Centre in the Netherlands, specialized in the research of Dutch Sign Language (DSL) and the development of digital dictionaries, and (d) the Habilis Agency (EPE) organization, with extensive experience in creating accessible digital material for students with disabilities in inclusive education.

SIGN FIRST Outcomes

The outcomes of the SIGN FIRST project are the following:

1. During the first year of the project, existing materials were mapped and best practices used in the EU member countries for teaching and learning SL as a first language, were identified. In the second year, the survey will be extended to countries outside the European region. The aim of the survey is to record:

- The existing curricula for teaching European SL as a first language
- The existing teaching materials, the existing teachers' guides and other resources used for learning SL as a first language
- The good practices that have been used for teaching SL as a first language in the EU countries
- The existing assessment tools and language tests for the knowledge and use of the SL by the D/HH students
- The existing programs for teachers' training for teaching SL as a first language

The research will use a Google Form questionnaire, which is a simple but functional application that allows the development of both open- and closed-type questions. With the use of this application, the given answers can be automatically collected in real time in the questionnaire form offering information and graphs of the responses. Moreover, the data can be exported to excel sheets for parametric analysis.

2. The expansion/development of materials that will enhance the teachers' efforts in implementing bilingual programs-curricula and teachers' guides for teaching SL as a first language will be the main output of the project. Taking into account the existing curricula for the GSL (Pedagogical Institute, 2004) and the existing educational materials for learning the GSL as a first language (Karipi, 2015), the aim of the program is to create a common framework curriculum for teaching European national SL as a first language. Approaching SL as a target language, the systematic recording and presentation of grammatical and syntactical rules is intended, acknowledging that all SLs follow the same linguistic principles and share common linguistic characteristics on grammar and syntax level. The above-mentioned materials will be fully accessible for deaf students and will be presented using a multimedia computer application that will follow specific requirements relating to: (a) the interface and (b) the rendering of the content in SL. The application will be interactive with display screens of the written text and the translation in the national SL, a practice that promotes the full bilingual process of information (Kourbetis, 2013).

3. The development of new multimedia applications and new accessible material for the growth, the improvement and the cultivation of communicative skills of D/HH children and their parents in SL. The project aims to address the restricted knowledge of SL and the lack of resources for parents of D/HH by creating open access on-line material for teaching and learning SL, such as the translation of books and dictionary type of apps.

4. Different assessment tools will be created and adapted for the purposes of the SIGN FIRST project. The tools will evaluate the SL vocabulary knowledge and the narrative comprehension and production skills of the D/HH children, aged between 4-12 years. The students' receptive and expressive SL capacities will be assessed based on the assumption that there exist different degrees of strengths and knowledge.

5. A platform (www.sign1st.eu) has been created to promote the program and disseminate the deliverables and project outcomes. All the material that will be created for the project will be uploaded on the platform, and it will be accessible and free for everyone. The platform will be connected to the Digital Interactive Library based on the pan.do/ra platform (http://pan.do/ra) and the JavaScript OxJS library (https://oxjs.org/#doc) and will be implemented using the PostgreSQL database. It is envisaged to have two main functions: sign language video upload and playback with the potential to create and import interactive video subtitles and the creation and enrichment of an online sign language file-repository. The platform is installed in Ubuntu OS 14.04 LTS 64 bit and is running on nginx web server. The platform's content has been translated into Modern Greek by K. Boukouras, the 4th author, and can be interchangeable with the English language and can be translated to Dutch, German or any other language with ease. The platform can accept various video formats (.mp4, .webm, .mpeg) all of which are converted into .webm format during the upload operation. Video downloading is available through the platform's web graphical interface. The interactive video subtitles are generated automatically using the graphical interface or by uploading subtitle files (.srt files) using the platform's video upload interface (Figure 2).

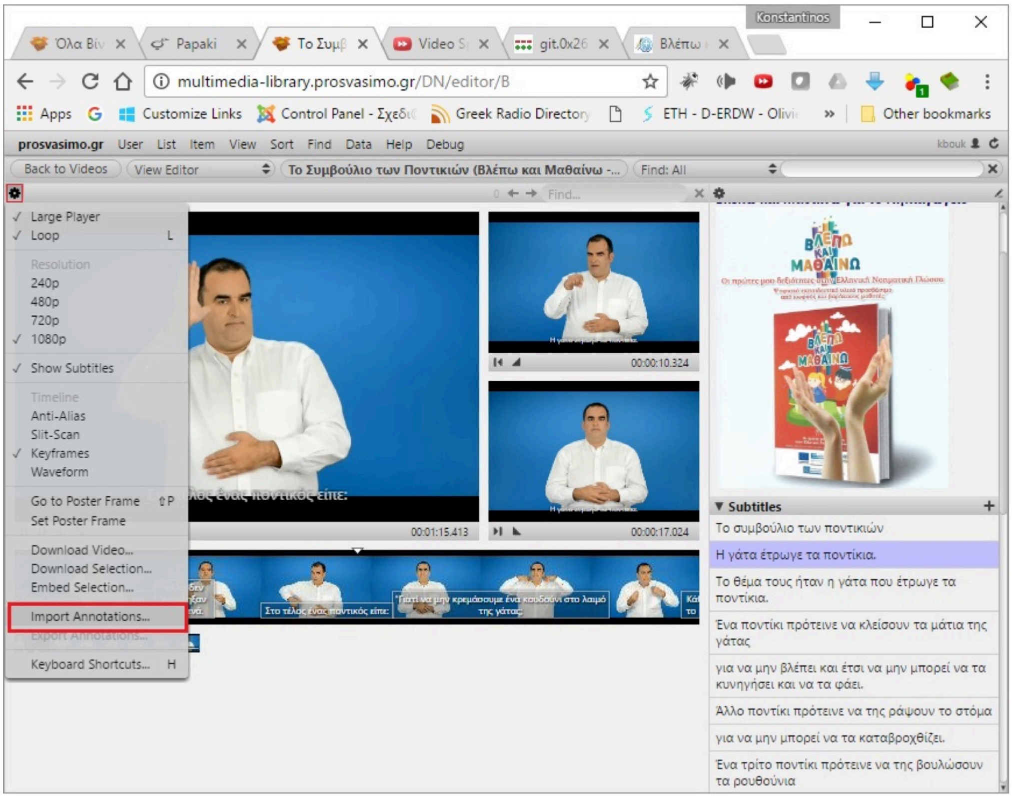

Figure 2. Importing annotations.

During video playback, the subtitles are displayed on the right side (Figure 3A) and they can be interacted with (Figure 3B). When they are selected, the playback of the video begins from the time corresponding to selected subtitle.

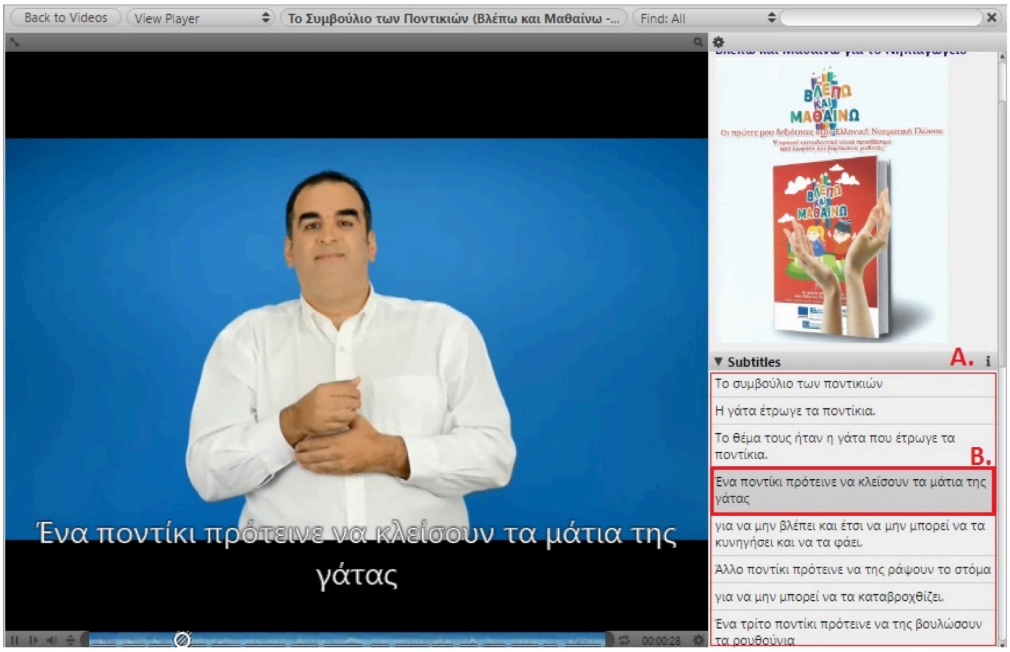

Figure 3. (A) Subtitles panel, (B) Subtitle selection, video resumes playback from selected part.

All the videos uploaded on the platform are available through an advanced search and display form. The default view sorts the video alphabetically (view as a list) and displays the title and the program from which they originated. The next display type is the grid mode that displays the videos with a cover showing a screenshot from the first scene of the video (Figure 3A, 3B).

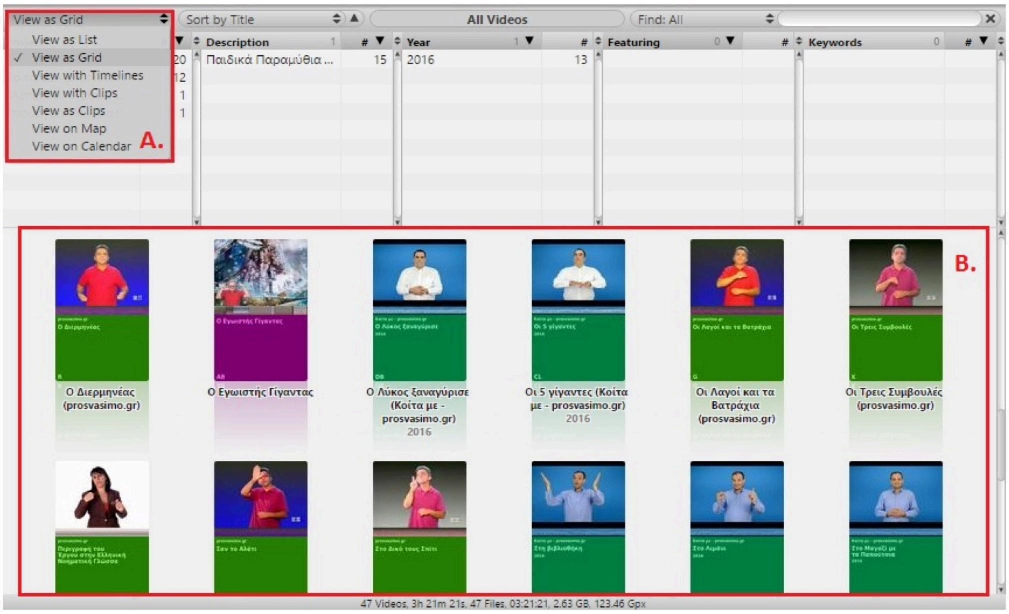

Figure 4. (A) View modes, (B) View area with available videos.

The "view/display as a time series" mode is also available while the "view with clips" displays the video along with the corresponding clips included (Figure 5). The term *clip* describes the video segment that includes a separate subtitle track. Finally, the "view as clips" mode displays all the platform video clips together.

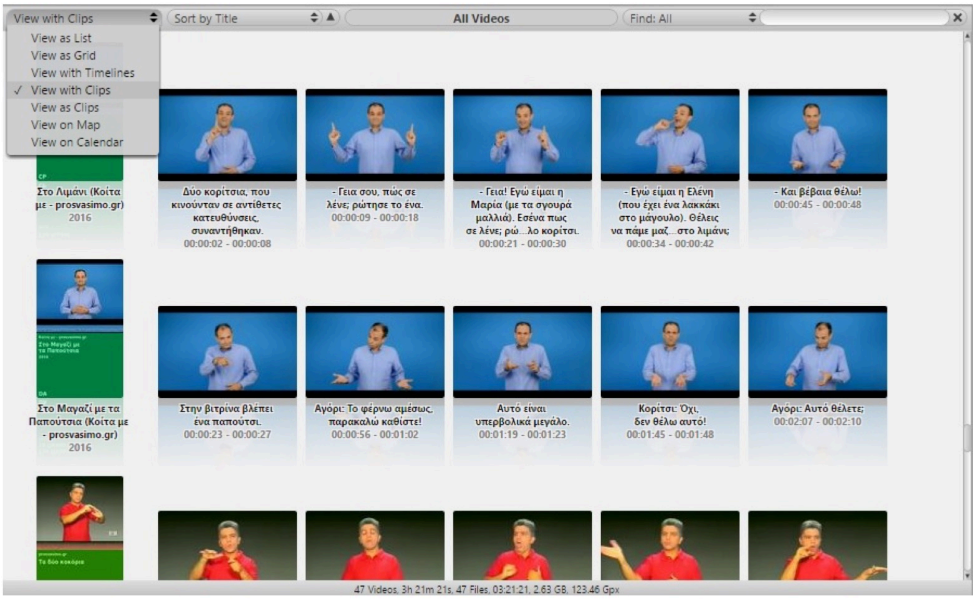

Figure 5. “View with clips” mode. All available clips of each video are shown separately.

All these display modes can show the videos and their clips sorted in many ways such as by title, program name, subtitle number, duration, resolution, video size, etc.

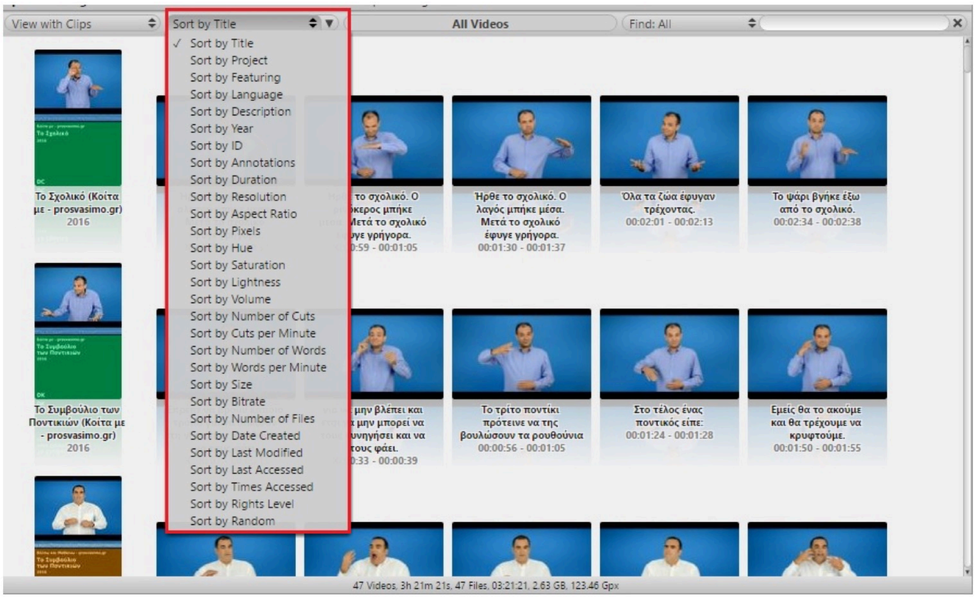

Figure 6. Platform’s sorting options.

Through the digital platform search engine, the user can search the database by various criteria, such as title, keywords or video captions. The search by video subtitles finds words or phrases in the captions of all the platform videos and displays only the clips containing the searched phrase or text. Only the video displayed and the corresponding clips that contain the searched word, appear. The searched word appears highlighted in a yellow background (Figure 7).

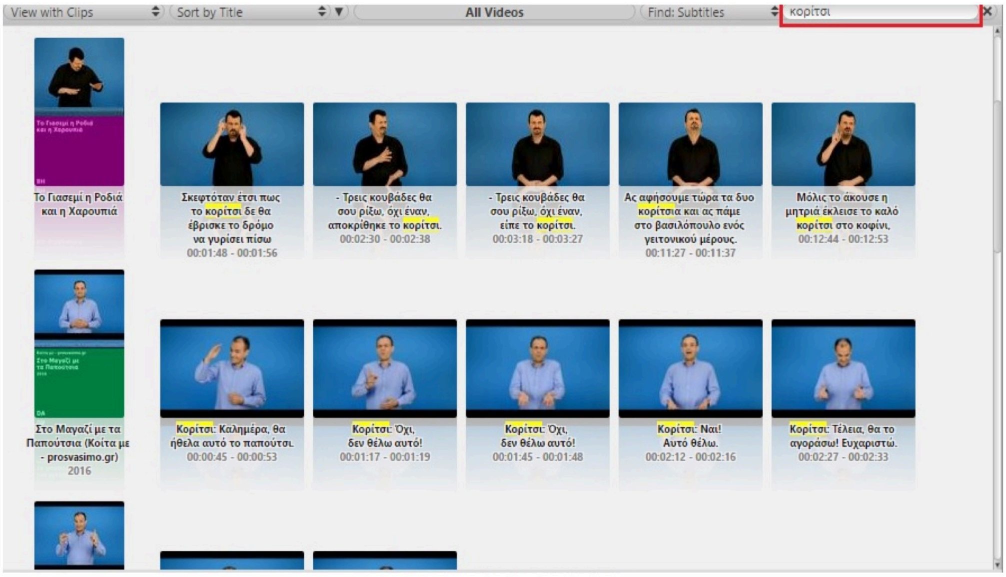

Figure 7. Search through the digital platform for the word "girl." The word "girl" is entered in the search form at the left top corner highlighted in red.

This award-winning search engine allows someone to search for a sign in the digital sign language database and compare the results, something that until recently was impossible to be implemented in the language training of D/HH students (Boukouras, Gelastopoulou & Kourbetis, 2014; Kourbetis, Boukouras & Gelastopoulou, 2016).

6. Two training activities in Greece and Cyprus will be carried out for teachers to develop and improve their didactic skills on teaching SL as a first language. For the continuation and proliferation of these activities the popular OpenEdX asynchronous learning platform will be deployed that allows the organization of Massive Open Online Courses (MOOCs) designed for distance learning and training of teachers and parents. The OpenEdx developed by edX, a non-profit organization founded by MIT and Harvard universities, is the platform behind the popular https://www.edx.org service.

7. Finally, all the outputs, the deliverables and the actions of the program will be presented at a conference that will be held in Greece in 2018.

Conclusion

The answer to the title question "Teaching European Sign Languages as a first language: Can they be taught without the use of ICT?" is clear. Teaching SL as a first language without the use of ICT is like an attempt to teach written language without books. The use of ICT in collecting, storing and using interactive sign texts makes teaching sign language effective and easier than ever. It gives teachers, students and their parents a communicative environment with adequate linguistic input, search capabilities in native sign texts, viewing and reviewing sign and translated texts, storing and sending small or large sign passages for homework. This innovative action for teaching European SL as a first language covers not only the language and communicative needs of D/HH students, but also supports the teachers' efforts at national and European levels as well. Deliverable materials will support a student population that has insufficient service provision from the school and the family, ensuring its equal learning opportunities, participation and access to education and society. Various stakeholder groups (e.g., students, teachers, school counselors, parents) may exploit all outcomes in various ways for educational or training purposes. Through the program, advanced opportunities in the use of ICT by the students are going to be created, contributing to the development of their technological skills and their familiarization with ICT. In conclusion, the project pursues the academic and language development of D/HH students, as well as the respect and acceptance of their diversity, and promotes the differentiated pedagogy and inclusive education. Overall, it improves the quality of education provided in Greece and Europe for D/HH students. The educational material and software will be available in electronic form at www.sign1st.eu and http://www.prosvasimo.gr/el/.

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INNOVATION IN BUSINESS LIBRARIANSHIP'S TRAINING WITH ICT: HOW DO WE WANT TO WORK TOMORROW?

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Abstract

Information communication technologies (ICT) are changing the way knowledge is acquired and/or disseminated as well as the ways of perceiving and thinking about teacher-trainer-learner relationships in the digital age. These technologies are impacting the labor market's expectations and needs for training too. The following paper tries to shed light on these issues by focusing on an ongoing innovative academic project in business librarianship's training carried out in Clermont-Ferrand, France. It takes into account the viewpoints of a group of stakeholders such as academics, students, practitioners, employees and job seekers and tries to see what they think about these issues and whether they want to work together or not. It examines the drivers of change that encourage or constrain innovative pedagogic practices using ICT, relying on the findings of two online surveys that ascertain the changing perceptions and determine what approach should be adopted for future academic training. It also shows that training should be done collaboratively for greater efficiency.

Introduction

Innovation in French higher education seems indispensable because students are changing, and teachers have to acquire new skills to capture their attention and deliver added value training. Obviously, students become more self-sufficient as they commonly use the Internet and search engines to find information and quick answers (Weiler, 2005), but the amount of information available on the Internet is greater than what any student could keep up with. They need support to retrieve the relevant information and understand societal and economic challenges (Sider, 2009). Thus teachers have to use dynamic and flexible teaching styles to guide students mastering the knowledge that exponentially grows in a changing world in order to train them to have a spirit of analysis and synthesis and take a step back (Assude, Bessiers, & Combrouze, 2010). They also need to know how to renew their practices to adapt to change and educate students to learn how to learn.

Besides, the multiplicity of information sources and the explosion of storage and transmission media have significantly altered the information specialists' practices. Their role is to deliver useful and accurate services and resources in business. They are trained to understand the challenges and provide relevant information to the right person in the right place and at the right time (Ertzscheid, 2013; Lamouroux & Ferchaud, 2006). Except that now, the information is both fragmentary and highly fragmented (Ackoff, as cited by Detrick, 2002). That is why information governance known under the term *IT* *governance* (Peterson, 2004; Willson & Pollard, 2009) represents a key challenge for companies today that enables them to gain in terms of reliability, efficiency and rigor (traceability, compliance with laws, standards and regulations). How could information specialists continue to play a key role in this area while information has been steadily increasing? And how could they be trained to meet companies' expectations and needs? The issue of whether learned skills in teacher training in business librarianship are adaptable to the observed changes needs also to be addressed.

Based on this theoretical framework and the resulting questioning, it is assumed that the knowledge of each one's perception to change as well as the sharing of expertise and constraints are the key factors of success in the implementation of an innovative training in business librarianship.
This paper deals with these hypotheses. First, it gives a general overview about innovation in education in France. Second, it examines its viability through the findings of two online surveys started in 2017 that concern a group of Francophone stakeholders (academics, students, practitioners, employees and job seekers) who are involved and/or affected by training in business librarianship.

Literature Review

The observation is clear and without call: ICT are ubiquitous (Watson, 2006), and digital is present in all teaching situations (Scallon, 2015). In France, teachers have been encouraged to deploy them in primary, secondary and higher education in order to promote the acquisition of digital skills for all and to combat inequalities. ICT are seen as a central vector for collaborative learning. The process of its integration in higher education was rapid.
At the beginning, ICT were used to solve some practical problems of mass education and reduce the digital divide (Sidir, 2009). Quickly, students were encouraged to use digital resources to search information and write texts. Then social media have been gradually introduced in class to encourage students' collaboration and help reduce the digital divide of the most disadvantaged social groups.

The objective of this policy was to foster the exchange of one with the other in learning and creativity and to allow the acquisition of technological skills (Pinte, 2011). Therefore, many useful networks for the sector of business librarianship are available such as Netvibes, YouTube, Flickr, Pinterest, Instagram, etc. (Ertzscheid, 2009). These networks, which support business intelligence, are now taught in universities. Besides, it has also increased the number of distance education programs and assistance given to teachers to integrate ICT into their teaching and introduce them into the classroom.

In fact, the online course offerings increase and permit access to training anytime and anywhere. For example, social language learning networks such as Babbel or fr.bab.la dominate the market. In addition, there is a rapid generalization of digital reading tools, including multimedia tablets, smartphones and dedicated readers that encourage teachers to innovate in order to continue supporting learners in their learning (Biancarosa & Griffiths, 2012).

But, the most known solution developed all over the world is the MOOC, Massive Open Online Course that gathers people from different horizons willing to collaborate. It offers a new pedagogical format in learning, teaching and training. In France, MOOCs began between 2013 and 2014 (Landry, 2014). Today, there are more than 1.4 million registered and more than 150 online courses.

Accordingly, ICT are transforming how we learn and how we come to interpret learning (Säljö, 2010) and have challenged teachers to work differently to continue practicing their trade. Many studies show that teachers' professional practices are changing because of the use of digital media, as young people in favor of digital technology increasingly abandon paper. But a review of the literature demonstrates that it is mainly the policies that strengthen ICT development to propose dynamic approach of teaching (Walder, 2014).

This literature reviews different attitudes toward these changes in France: progressions, regressions and stagnation in terms of techno-pedagogical innovation (Develotte, 2011). For some, ICT represent an insurmountable challenge for teaching because they are difficult to integrate into the professional practices of teachers and are not exploited as they should be (Poyet, 2015). Researchers observe that teachers' preparation, design and educational engineering activities are considerably expanded upstream but still lag behind the changing expectations in innovation. For others, it was noted that on the Internet, there is the best and the worst, raising the question of the teachers' teaching methods.

It stems from the above that the reforms conducted in France are moving faster than the adoption and adaptation of new technologies by teachers. So, what evolution in innovation arouses the most interest at present? And what do stakeholders think about this? The following section examines the drivers of change that encourage or constrain innovative pedagogic practices using ICT relying on the findings of two online surveys started in 2017 that ascertain the changing perceptions and determine what approach to adopt for future academic training that should be done collaboratively in business librarianship training.

Ideas for the Development of an Innovative Training Offer: A Case Study

In this section, we will describe how the actors directly involved and/or affected by changes in higher education interact with the technical-pedagogical devices. We focus on business librarian' training and we study the francophone context. The objective of the study is twofold: (a) to explore how actors take ownership of the training offer as a new reality, and (b) to describe how they are doing it to give a clean intelligibility to this reality.

Thus, we proceeded step by step. First, answers were given to the following questions: What are the goals of the survey? How long will it take to achieve the survey purpose? And whom do we want to address? Second, we determined some specific criteria. These included:

1. The socio-professional category (students in initial training, students in continuing education, teachers and professionals).
2. A selection of heterogeneous cases (those who are involved in a training program, those who are interested in training).
3. The last criterion is logistical: we wanted to reach the highest number of people. Thus, the study was based on two online surveys.

The objective of the first survey was to study the feasibility of implementing a new university degree in business library and to identify the needs in terms of contents and type of training. It was a web-based survey conducted through the SurveyMonkey application from January 5 to March 5, 2017. The sample was previously identified: employees in a company, community, association or research laboratory, jobseekers, retraining professionals and students. The survey was conducted via an online questionnaire to which150 people replied. The survey consisted mainly of fourteen closed questions amenable to quantitative analysis. It included also an open ended question and a comments section.

For the second survey, which started in February 2017 and was broadcast on the networks, 221 people responded. We used the same application, and we kept mostly the same respondents' profiles -- students, employers and people in retraining. But, we added in the sample, both teachers who transmit their knowledge, concepts and theories in their classes to students and independent consultant trainers who shared their knowledge, practical experiences and competencies in the fields of documents with trainees who paid for the training. The objective of this second survey was to see whether all stakeholders were ready to work together despite the difference in interests and objectives, how exactly they consider collaborative working in innovation with ICT and if they proposed alternative means. This survey consisted of 35 questions: 23 closed questions, 10 semi-closed questions and 2 open questions.

A quick summary of the findings showed that for both surveys, almost three-quarters of respondents were women between forty and fifty-years old. They were mostly professionals of the book chain and multi-media. Based on the survey, those libraries trades are the most representative. Of respondents, 70% came from France in both surveys. Tunisia, Belgium and Canada were also represented but very weakly in the second survey (see Figure 1).

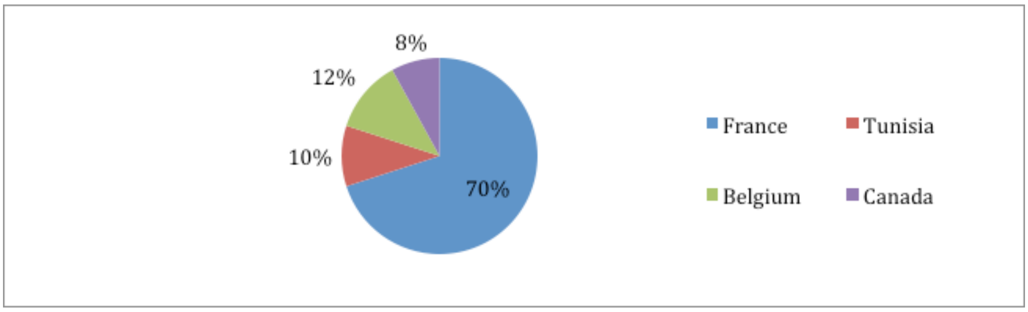

Figure 1. Respondents' country of origin.

Main Findings

About Innovation and ICTs in Training

Although many respondents talk about innovation and are motivated for its implementation (see Figure 2), only (10%) know how to make it happen (see Figure 3). They consider that clear ideas about creating materials and skills must be developed and tested before implementing innovative training.

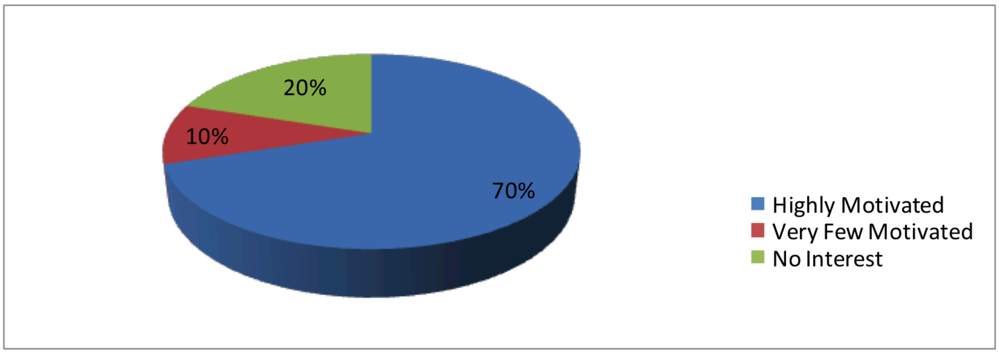

Figure 2. Are you motivated to innovate your training practice?

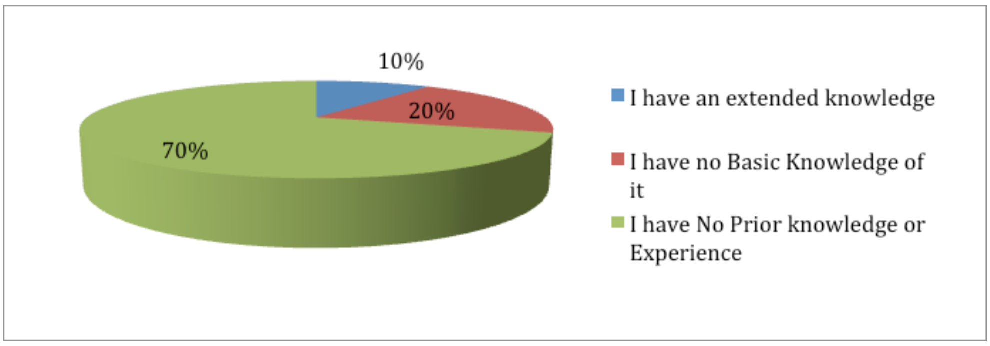

Figure 3. Knowledge about innovation.

To the question why use technology in training? There is a general agreement that "technology is useful and must be applied to facilitate classroom activities; and to assess learning inside the classroom or online." All respondents agreed about the fact that technology supports them in finding, creating, and sharing content between them. However, the findings reveal some differences. In fact, respondents classify their priorities differently. For example, 35% of them consider that using technology enables them to enhance their activities, lectures and presentations while 44% believe that technology makes it easier than ever to share contents in different formats. For the remaining 21%, technology represents essentially a facilitator in class activities.

Besides, the survey reveals that teachers took into account other key areas: 38% of the respondents think that ICT get students more involved in course creation and 62% believe that it supports their current practice. However, all of the responding teachers consider that ICT must support what they do every day. So, before carrying it, it is fundamental to identify teaching and learning needs. One of the respondents said, "We can't put the cart before the horse! It is unrealistic and improper!"

Meeting Stakeholders' Needs and Expectations

Most respondents are interested in the new offer for three main reasons, which have been prioritized as: (a) to deepen the knowledge and skills already acquired elsewhere (47.73%), (b) to obtain professional recognition by validating a university degree (27.7%) and (c) to acquire new knowledge and skills (22.73%). The remaining 2.27% intend to follow this training to get promoted or to search for a business position.

To the question "what is the ideal offer for you?" the majority of the respondents plead for a training program resulting from the work of a collaborative community that exchanges and shares around pedagogical activities and crossed knowledge. Meanwhile, they classify their priorities for access to training differently: 65% of respondents require access to training in a mobility situation. Another 25% favor a flexible combination of security and access management activities. For them, the major challenge is to define the rules and processes in terms of access to services and pedagogical activities that will be available for users. For the remaining 10%, the security and the simplification of the modes of access are the leitmotiv that will determine their choice.

Regarding who can undertake and participate in the establishment of the new training offer, all respondents prefer that the courses be taught by professionals (52%) and teachers (38%). They consider that only students who are at the end of the training year could participate (20%) in the new innovative training program (see Figure 4).

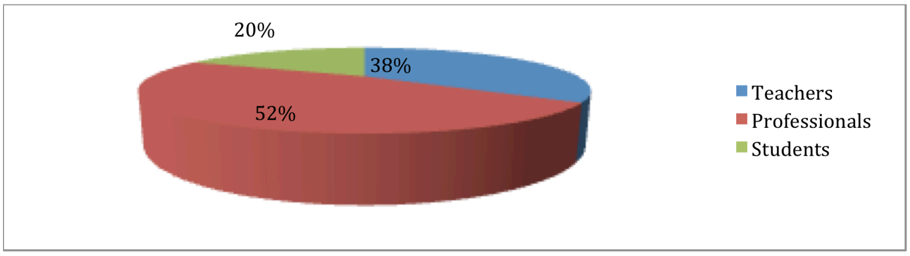

Figure 4. Who can participate in the innovative training offer?

Furthermore, 64% opt for face-to-face interviews between the trainer and the learner, compared to 46% who prefer group discussions to promote collaborative work and knowledge sharing (see Figure 5).

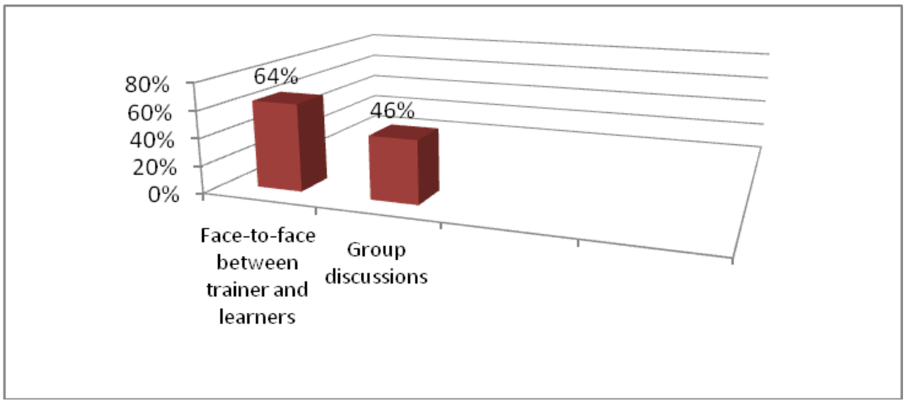

Figure 5. What do you prefer in the innovative training offer?

In addition, the idea of offering training that is accessible to all, whether they are students, professionals or simply curious participants, seduces most of the respondents. It seems always awesome! – 55% of respondents would like to have training that follows the needs of learners and gives them the opportunity to have access to information and training about traditional occupations, as well as other professional areas related to digital. However, 45% of the respondents seek more freedom in learning. They want the new training programs to enable everyone to modify courses and add items such as images and text boxes in order to enhance lectures and presentation with technology.

Opinions About the New Training Framework in Business Librarianship. Concerning the offer's content, the existence of a shared interest may simply be observed (see Figure 6). The findings reveal that most respondents interested in this training are librarians, or information officers or else students in information and communication sciences. Booksellers (5%) and publishers (10%) are interested in this training, too.

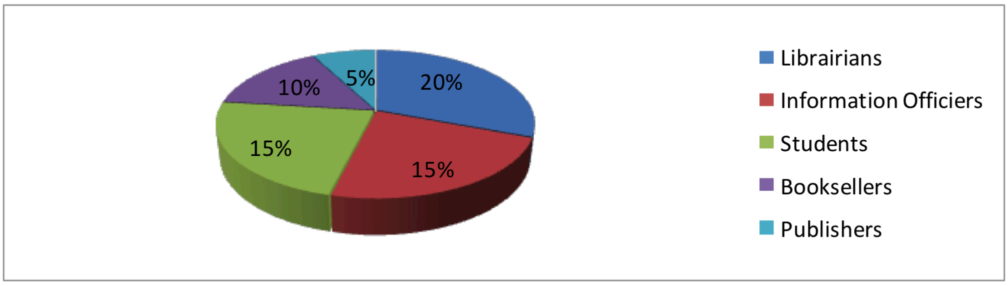

*Figure 6.*Who is interested in this offer?

Concerning teaching modules, the results of the two surveys show that the most popular courses, concern the mastery of collaborative tools, strategic intelligence, IT governance, KM and collective intelligence exercise. However, respondents have shown their interest in other content such as:

- The learning of languages other than French
- Pedagogical innovation
- Writing on the Web
- The management of time in the digital age
- Communication and information on social networks

Furthermore, all the respondents want rich and scalable content following news from the business world that could analyze the issues of information literacy in organizations and could provide information on the specifics of each country including legal and administrative plans. According to all the respondents, the ideal for them is to have a theoretical knowledge part and another part dedicated to specific cases with techniques. However, some respondents stress the idea of have training adapted to the needs of students who are different from that offered to professionals with distinct approaches and contents.

Concerning teaching methods, all the respondents believe that face-to-face and online courses are complementary. But they do not agree on the importance accorded to each. Indeed, 72% of respondents consider that the hourly volume devoted to face-to-face training must be more important than that of online courses. Training must focus on the practical case study that requires face-to-face training with trainers and immediate and concrete answers. They add that everyone should be given the opportunity to move at his/her own pace; thus, it could be useful to utilize online courses.

Regarding innovative tools in training, there is a general agreement about the MOOC: the MOOC is a very attractive solution because it is accessible and digital for 77% of the respondents. The other 23% of them think that it is the multiplicity of the conditions of its use (use alone or in group) that makes it attractive. Most respondents assume that the MOOC should have two components, a paid component that offers training only to subscribers, and an open space that provides free access to general information and offers short videos dealing with the profession of business librarians, their activities and the reality of this profession. Meanwhile, 92% of respondents believe that MOOCs meet a specific and urgent need such as taking a new position or participating in a competition or even looking for a job. It must therefore be specific and not general. Besides, 71% of respondents believe that MOOCs should be open access and should complement face-to-face classes. For the remaining 29%, courses must be paid for. They find that users will pay more than 50 Euros for access while others think that such access must be between 20 and 50 Euros.

Finally, it should also be noted that the respondents have put forward several obstacles to the implementation of real collaborative work: 67% highlight the complexity of this project, which underlies the fact that they do not know how to go about it. They consider that further collaborative work dealing with different aspects (such as technology, changes in human behavior, legal evolutions, and new practices in work processes...) should be studied before the conception of the framework.

Conclusion

The findings confirm the research hypotheses that have been presented in the paper. It is clear that innovation has a positive impact on almost all stakeholders, regardless of their socio-professional groups. They do not want ICT to radically change teaching methods. They did wish that training should be carried out by instructors who have a strong foundation in the form of knowledge and valuable experience in business librarianship.

The findings show that almost all the respondents are willing to change their habits but they don’t know how to choose the right application or tool, that’s why they remain cautious. They require further information about its applications and benefits.

In addition, the findings underline a problem of disparity between the expected objectives and the real needs. There is a certain consensus regarding innovation by ICT in training that gives us a little more information about the aspects that should be analyzed before setting down our innovative academic project in business librarianship's training. So, continuous sharing of knowledge and best practices will facilitate the intelligent and appropriate use of ICT in the new offer of training.

The study confirms the substantive gap between the requirements and expectations as well as the reality on the ground. The observed distrust affirms the need to continue to communicate more between different actors to establish a successful collaborative project. Otherwise, the project would risk losing focus through the development of a framework that would be too large and disparate. In doing so, there would be no need to follow the procedure if the difference of perceptions is important.

The paper shows that despite the motivation for innovation by ICT, we should be more careful as it demands further time and willingness to deal with it. We have to undertake more ambitious research that deal with three main aspects:

- Describe and apprehend digital practices of all stakeholders in order to accommodate individual needs and differences.
- Gather these actors around the project to define what is meant by "innovation by ICT."
- Getting them involved in the development of the pedagogic device and framework design.

In conclusion, the results that have been obtained from the quantitative research are very significant as they provide a general view of the situation and permit us to determine those who want to participate in the project. The quality of the data is lacking and we must deepen our research knowledge. Until now, it remains a work in progress but we are only just at the beginning of this process. A qualitative survey will give depth and better understanding about the academic digital pedagogy in Business Librarianship. This survey where data will be gathered by means of interviews will lead to extracting concrete ideas and suggestions for the project.

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THE ONLINE LEARNING HIVE: TRANSFER TO PRACTICE WITHIN A MOOC COMMUNITY OF EDUCATORS

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Abstract

We describe the analysis of online engagement by participants in a MOOC on teaching with tablets and mobile devices. The MOOC was aimed at educators, prompting them to use tablets in novel and innovative ways in their own educational practice. The MOOC included instructor-led and student-led activities and had a substantial social and constructivist component. We analysed the online discussions (across several platforms) and identified clear and frequent examples of participants providing evidence of their own practice, and many examples of peer-to-peer learning. While the MOOC was designed to facilitate the transfer of novel teaching approaches to the participants' practice, there were fewer examples of this happening. A surprising finding was the degree to which peer support encouraged participants to engage more fully in the MOOC.

Introduction

How can we encourage educators to take what they learn online and embed it meaningfully into their classroom practice? This paper examines the nature of the interactions within a community of practice associated with an online hybrid MOOC, "Teaching with Tablets," to see whether the learning environment facilitates a more effective transfer of skills to practice.

Our key questions were:

- Does participation in a hybrid MOOC prepare educators for using tablets more effectively in their classrooms?
- Is the hybrid MOOC format effective in influencing the teaching practices and pedagogical beliefs of those involved?

MOOCs (Massive Online Open Courses) can be characterised in many ways (Smith, Caldwell, & Richards, 2016), including the degree to which a MOOC is didactic (xMOOC) with learners traversing a pre-defined learning path, or connectivist (cMOOC) with learners co-constructing their own content around themes (Pomerol, Epelboin, &Thoury, 2015). Hybrid MOOCs, such as Teaching with Tablets, combine features of both (Chauhan, 2014).

Teaching with Tablets MOOC

The aim of the Teaching with Tablets (TwT) MOOC was to prepare educators across sectors to use mobile devices effectively in their own institutions. We adopted a hybrid approach in this MOOC. It incorporated xMOOC elements, such as a structured programme of browsing and e-tivities (Salmon, 2013) presented in a Blackboard virtual learning environment. Some material was hosted in Blackboard while other resources were included as hyperlinks. The e-tivities prompted and required discussion in a variety of social media platforms, such as Google+ and Twitter (Table 1). The heterogeneous presentation of interactions and material posed a challenge in how their impact on practice could be analysed.

Content in the MOOC was drawn from the book *Teaching with Tablets* (Caldwell & Bird, 2015) and e-tivities were based on six themes; Exploring Apps, Manipulating Media, Visible Learning, Technology Outdoors, Digital Storytelling, and Talk and Collaboration. A choice of e-tivities was offered for each theme in order to appeal to a range of sectors. The benefits of e-tivities in scaffolding online learning and promoting learner engagement are well documented by Salmon (2013). The TwT e-tivities were designed to promote exploration of ideas in practice within educators' various settings and encouraged participants to discuss their experiences in a learning community, where the MOOC moderated, participating as equal members. The combination of active, constructive learning through e-tivities and participation in the discussion has been shown to be key to successful course outcomes (Palloff & Pratt 2007; Salmon 2013).

In addition, the hybrid MOOC included synchronous interaction via Google hangouts and Twitter chats (Figure 1). From Lave and Wenger (1991) onwards, socialisation among members has been emphasised as an important and defining factor in the procedure of building a Community of Practice (CoP).

Numerous commentators have stressed the importance of face-to-face communication in a virtual CoP, even in the modern distributed environment with a wide range of communications media (Hildreth, Kimble, & Wright, 2000; Johnson, 2001; Kimble, Hildreth, & Wright, 2001).

We hypothesised that these interaction methods would facilitate transfer of ideas to educational practice.

Table 1.

Features of the Hybrid MOOC Design

	Platforms			
	Blackboard Open Education	**Google + community**	**Twitter**	**Google Hangouts**
Affordances	Access to course content	Posting text, video and image-based content	Synchronous timed twitter chats	Synchronous face-to-face chats
	e-tivities	Asynchronous commenting on posts	Asynchronous commenting	
	Announcements			

Methods

The TwT MOOC had 570 students registered, of which 294 accessed the course website and 171 accessed some learning material. The Google+ Community had 273 members. The engagement by week shows a reasonably typical drop-off in participation, though 29% of active learners engaged in the fifth week of content (Smith et al., 2016). The Google+ community was international: the Zeemap of Google+ participants had 103 pins from 28 different countries. We had 85 responses to a poll that indicated a spread across Primary (38%), Secondary (25%) and Higher Education (22%).

Early engagement in the MOOC was prompted by two general e-tivities, which were not part of the main themes and e-tivities. Participants were asked to introduce themselves and then use the Exploring Apps page on the Google+ community to suggest Apps that they currently used. Palloff and Pratt (2007) suggest using these icebreaker methods is a good way to develop and sustain a sense of community. This demonstrated the emergence of the community as initially the moderators strongly welcomed everybody, setting the friendly and welcoming tone that was maintained throughout the MOOC.

Evaluating Interaction in the MOOC

Samples of the Google+ posts were taken for analysis; every third post made by participants was taken from all categories. The Storify of each Twitter chat for each week and other data from video, multi-modal reflections (such as Thinglink) and Google Hangouts was also analysed.

We started analysis with selective coding (Strauss & Corbin. 1998) to identify interaction related to the research questions, augmented by open and axial coding to identify and record other types of interaction. Interactions via any media were tagged with the same set of codes. For example, the code ‘Participant Reflection’ could be applied to posts or comments on the Google+ community, tweets within the Twitter chat, questionnaire responses or in final evaluations.

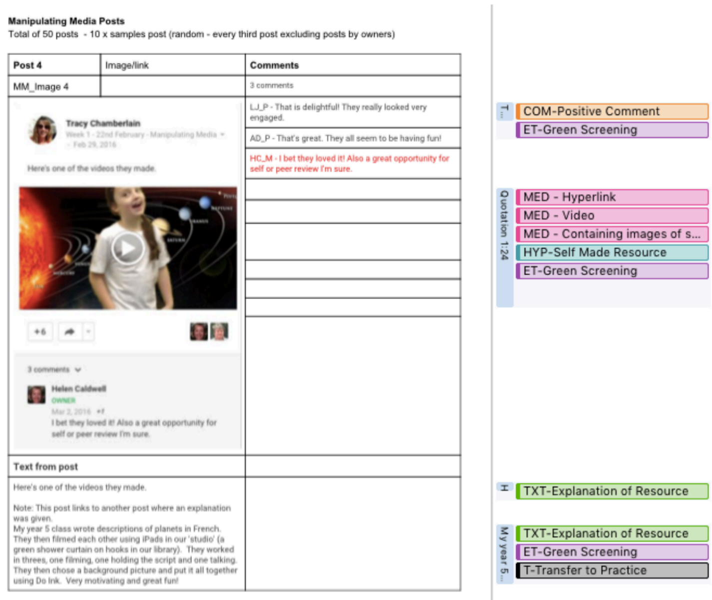

Figure 1. Example of coded data.

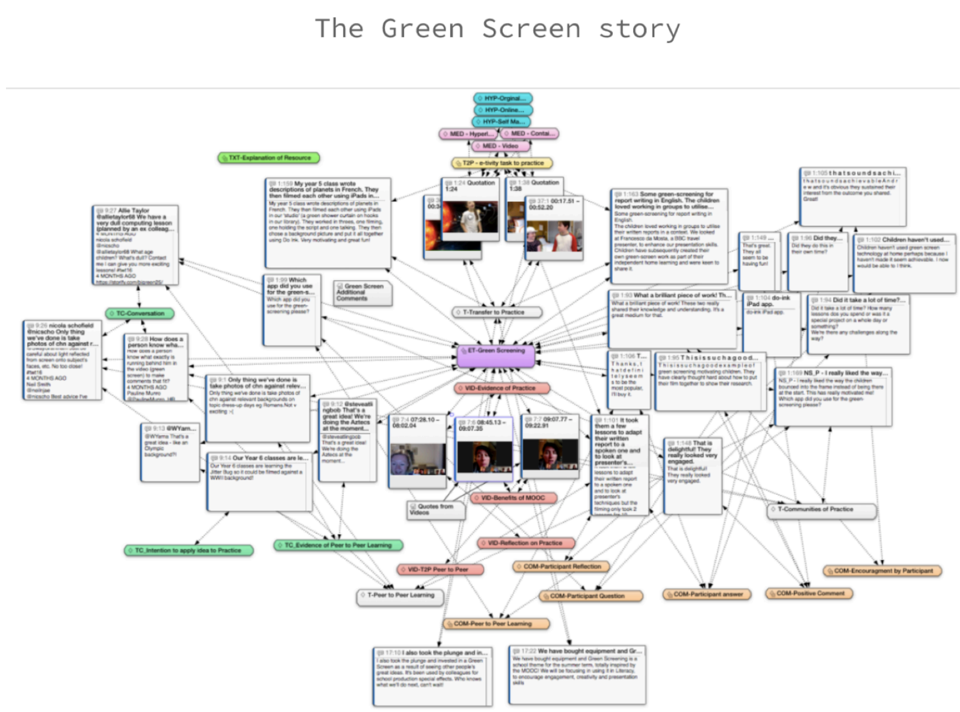

Figure 2. A visual network around the theme of green screening.

The connections between postings and identified codes allowed us to understand the types of interaction that surrounded each e-tivitiy. For instance, Figure 2 shows some of the learner activity around the “green screen” e-tivity

Findings

We found that the hybrid MOOC demonstrated clear elements of an active and supportive community of practice as identified by Lave and Wenger (1991) and Rogers (2000). The community was originally driven by the moderators but shifted in balance and tone throughout the progression of the MOOC. Online exchanges started within the comments section of the Google Plus community pages with participants starting to ask questions and receive responses from other participants as well as moderators.

This continued to develop as the MOOC progressed and evidence from across a range of media demonstrated that these interactions started to create tangible online relationships between participants. The common goals of the e-tivities as well as the diversity of outcomes from the same task brought a sense of mutual engagement to the community.

Many of the participants who completed the MOOC developed new levels of IT skills as a result of their engagement with the community. This is evidenced by the shared repertoire of artefacts such as photographs, screenshots, videos and hyperlinks they shared and their accompanying explanations of classroom practice.

Examples of shared discourse as well as humour can be found within the comments on the Google+ community. Questioning and reflection, both by participants and moderators and this often led to statements of intention to transfer to practice (Figure 3), or evidence of actual transfer to practice. This generated a real learning community and enabled additional peer-peer and instructor-participant learning. Evidence gathered indicated evidence of practice, often from before the MOOC, peer-to-peer learning, and some evidence of transfer to practice.

Evidence of Practice

The main source of evidence of practice came from the participants directly posting the evidence, either as a text description of an instance of practice, or the posting of an artefact (picture, photo, or video) that resulted from the practice. This evidence of practice was a simple and direct transfer of knowledge from the participant to the community.

Examples

TC: My Year 5 class wrote descriptions of planets in French. They then filmed each other using iPads in our studio (a green shower curtain on hooks in the library). They then chose a background picture and put it all together using Do Ink. Very motivating and great fun!

AM: Some greenscreening for report writing in English. The children loved working in groups to utilise their written reports in a context…children have subsequently created their own greenscreen work as part of their independent home learning.

Manipulating Media Posts
Total of 50 posts - 10 x samples post (random - every third post excluding posts by owners)

Post 6	Image/link	**Comments**
MM_Image 6		8 comments
Dana Moraru Week 1 - 22nd February - Manipulating Media - Feb 28, 2016 Hoping to not be too late with my homework for week 1. Here it is just a simple idea to have a revision after studying Physics of Atoms with my students from last year of high-school.  W. Pauli by Daniela Moraru thinglink.com TOUCH this image to discover its story. Image tagging powered by ThingLink +2		**LJ_P -** That's an amazing image. How did you /will you share it with learners?
		MJ_P - The great thinkers on who's shoulders we all stand
		DM_P - To Liz Jones - I could use it at starter for an open lesson. Each student can bring his/her own contribution to appreciate the importance of each scientist in science evolution till these days. To Merlin Jones - Yes, this is my opinion too.
		LJ_P - **+Dana Moraru** sounds really interesting. I bet they could share further knowledge on the people and maybe give you links to add to the Thinglink.
		DM_P - I trust them that they'll do like this. They are clever and creative students.
		LJ_P - **+Dana Moraru** sounds even better then. Sounds exciting.
		HC_M - I like the idea that you could give students a line up and they could research and add links during the lesson starter. Or do this in advance. Has anyone tried this with a group login to Thinglink?
		DM_P - Thank you, Helen. I discovered the group on Thinglink recently and after the discussions above this idea came to me also. And I like it. For this lesson I have to wait till next year, but is no time to wait for another lesson.
Text from post		
Hoping to not be too late with my homework for week 1. Here it is just a simple idea to have a revision after studying Physics of Atoms with my students from last year of high-school.		

Figure 3: A ThingLink image prompting reflective questioning and intent to transfer to practice.

Learning from each other (peer to peer learning) comes across strongly throughout the data collected. This is demonstrated within the comments of posts on the Google+ community and within the micro-conversations within the Twitter chats. Examples of ‘conversations’ in the twitter chats are given where someone asks for some ideas on how to use Green Screening with Early Years and another conversation about how to use help those being filmed interact with the video being ‘placed’ behind them. These sit outside the direct questions which framed the format of the chat but demonstrate participants using the expertise of others on the course to further their own knowledge.

Many elements seen in the comments in the Google+ posts added to these examples of evidence for example there were questions, answers, reflections, encouragement by both participants and moderators. The community appeared to grow through these interactions. Where there were clear roles at the beginning (participants and moderators) these appeared to blur as the course continued. Moderators learned from participants and vice versa. Participants took on the role as the expert, sharing, answering questions of other participants.

Example

> It has been brilliant to connect with people who are in the same interest of doing something with apps at the same time because of the hardest things when you are isolated in your organisation and in your own job trying to find other people doing the same thing at the same time who have time to do it then. I have lots of enthusiastic colleagues but if you say 'Can we chat about this?' or 'Would you like to share that?' it is often governed by whether they are available...we have all made ourselves available and there has been so much collaboration because of that and I've found it really powerful.

Transfer to Practice

In the MOOC communities, there were few clearly identified instances of transfer from the MOOC to novel practice in the participants' own educational contexts. (There were many examples of participants stating they were intending to transfer ideas from the MOOC to their practice. We surmise this is due to the time frame between new e-tivities and themes and teachers’ already busy lives.) There were more examples of concrete transfer in the retrospective videoconference we carried at the end of the MOOC.

In all cases, the journey into practice was not as straightforward as we expected. Participants did not take the suggested sample activities presented in the e-tivities and other MOOC material and directly transfer it. Instead, they seemed to reflect on the provided material and discuss it in the various communities, where they engaged in peer-to-peer learning about the uses and possible impact of the new practices. When participants did successfully transfer content from the MOOC to their practice, they did so after this interaction and a subsequent period of self-reflection. Only then did they apply the new practice to their context, following it up with a reflective post on the activity in the MOOC community.

Evidence of learning and some classroom practice was therefore found through comments made on others’ posts, peer to peer learning in the form of comments over time in the Google+ Community or mini-dialogues between smaller groups of individuals in the Twitter chats (figure 4).

A - I like the idea of the shower curtain. Are there any images? Thanks for sharing.
B - Yes! I think I even have an idea green shower curtain in the loft! Great idea. It's a bit shiny though - is yours and if so does the light reflect too much? Thank you for reminding me :-)
C - I got mine from Argos. It's slightly shiny, a bit like dull satin. One of my groups I had problems with the chroma effect, that may have been why. Now that I've tested the process, I'm going to investigate some other fabric to use, I'd like a slightly darker shade and not shiny. If you've got one already, it's certainly worth a try.
D [owner]- Perhaps using clothes pegs on the sides of the curtain might help keep it smooth. That might help reduce the number of reflections.
B - +C Thanks, I'm thrilled as I just got permission to buy a proper green screen thing & my HT thinks she has a spare tripod for the iPad at home. Just need to work out the sound and we're off! Thank you everyone for motivation x
A - +B I got some great iPad tripods from a UK company called Hills. They were really reasonably priced and extremely worth having.
B - Thanks for the tip!
E [OWNER] - Love the idea of the shower curtain! We've used material, a painted wall, a PowerPoint slide and a pop up screen. All have been equally magical, as is yours!

Figure 4. Example discussion from Google+ on green screen e-tivity.

Example

> We bought a green screen (as a result of being on the MOOC) before I was totally confused as to what it would might be useful for. It seemed obvious about filming but it didn't really seem obvious about the lovely activities that other people did. There was that one where there was a film in the background, and they were using scripts from things. And it was so inspiring.

Peer Support and Encouragement

An unexpected result of the MOOC interactions was the degree to which peer support and encouragement was valued by participants, and how this prompted further engagement with the MOOC and the community. While this was evident throughout the MOOC, it was most clearly articulated in a videoconference held with MOOC participants at the end of the course. This feature of the MOOC seems to have had a large impact on the degree of participation in the MOOC and the quality of learning that came from the MOOC.

Examples

> It 's so inspiring. That's why the course has been so interesting. Because you might not have an idea. And then you might not know what to do with something so seeing someone else use it effectively just makes you go 'OK, I'm going to try that.'

> I really liked the opportunity to settle in because sometimes you are not really clear what a course is going to involve. Having a couple of

> weeks to think and say and say this is what I am doing and this is what I like was quite reassuring because you need to get to know people when you are going to work alongside them. And being able to see other people sharing things that you recognise is good. And then them doing something different with something you think you know. Or they visited something that you abandoned. It just kind of pulled you in nicely through familiarity mixed nicely with new stuff. I really enjoyed that. (in response to question about starting the MOOC and Exploring Apps phase)
>
> The course has been a veritable Teacher's Centre for me. Something I've missed since moving to an international context. I'm very impressed with the range of benefits and the way that the collaboration has worked. Meanwhile I've found new enthusiasms as a result of joining. Learning on your own has never been very successful for me before. I can sit down and do an assignment but it's always hard to get stuck in. With Teaching with tablets the fluid and flexible nature of this course has been a real transformation. Of course, this means that I've learned more about learning too. I'll be exploring how to take that to my colleagues and students. It's been really interesting to find a medium that feels truly 21st Century and about as far removed from the Victorian classroom setting as I can get.

Gains by Non-Social Learners

What we were unable to identify through this research project was the impact that the MOOC had on those that chose to "lurk" by engaging in the e-tivities by not participating in the community interactions. No lurker applied for a certificate at the end there was nothing to suggest that "lurking" actually prompted any action and participants transferring ideas into their own practice. We can deduce that it was the engagement with the community that made the experience more successful for those who were involved.

Conclusions and Further Work

We posed two research questions for this paper:

- Does participation in a hybrid MOOC prepare educators for using tablets more effectively in their classrooms?
- Is the hybrid MOOC format effective in influencing the teaching practices and pedagogical beliefs of those involved?

The first question was answered by analysis of the participants' responses. There was clear evidence of knowledge transfer, both from instructors to participants and peer-to-peer between participants. For example, the dialogue in figure 4 is a clear example of participants preparing to use tablets.

The participants in the TwT MOOC were having virtual discussions about real practice. The knowledge transfer was not so much in what they posted as in the discussions around the posts. It is not as simple as implementing the e-tivities, but much more complex as people learn from each other and knowledge transfer becomes closely linked to participants' roles within the developing community of practice.

The effect of the MOOC on teaching practices and pedagogical beliefs is harder to unambiguously identify. Answering the first research question simply requires looking at the artefacts created or referenced by participants during the MOOC. However, Kimble et al. (2001) suggest it is not the artefact per se which is important but the process involved in its creation. In the MOOC creating the artefacts appear to be catalyst for individual understanding and reflection, however the sharing of the artefacts appear to be the springboard for more learning. This was clear in some of the examples of conversations we found.

There are many other aspects of the MOOC interactions to explore, including more investigation into the transfer of learning into practice and reflections on that transfer. We will also investigate the development of a community of practice in the MOOC over the duration of the MOOC and beyond. One element we intend to explore is the notion of technology stewardship (Wenger, White, Smith, & Rowe, 2005), where the cultivation of an online community of practice is taken on by an individual or small group actively playing a facilitating role within the community. Some features of the interactions in TwT indicate that this role moved from instructors to learners over the course of the MOOC.

Another area to explore is the degree of participation in the social aspect of the course and the retention of students in the course. The MOOC had a small retention rate, with only 17% of people engaging with the MOOC in some way engaging with all the e-tivities and online community. We have not yet tracked individuals through their participation in the MOOC and compared it to their engagement online. Such an investigation could lead insights into what contributes to participants fully engaging (or not) in MOOCs.

We also intend to investigate the progression of learning in participants as they participated in the MOOC community. Wenger et al.'s framework (2005) suggests that participants work successively through a series of steps to achieve their goal. However, analysis of the interactions in the MOOC suggests that something more aligned with rhizomatic learning (Cormier, 2011) is taking place.

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MINDING THE GAP: A COMPREHENSIVE RUBRIC FOR INSTRUCTIONAL DESIGN IN E-LEARNING

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Abstract

The recognition of practice in online instruction is still subject to interpretation and different approaches as a result of the rapid changes in technology and its effect on society. This paper reviews different examples of rubrics and instruments in higher education to propose a more comprehensive rubric that constitute a synthesis of how some institutions in HE approach best practice in this field. As such, the proposed comprehensive rubric is intended to support the development, remixing, sharing, and integration of online modules and courses by providing a single reference point with as wide a range as possible of potential pedagogical tools, facilities and approaches to e-learning.

Keywords: instructional design, e-learning, digital pedagogy, OER, higher education

Literature Review: Slightly Different Paths for e-Learning

By the year 2002 the fusion between in-class instruction and online instruction was already being recognised as a major new trend; old practices were being transferred online, and different institutions had rather different understandings of the concept of e-learning (Frydenberg, 2002; Graham, Woodfield, & Harrison, 2013; Young, 2002). As late as 2011, Guri-Rosenblit and Gros (2011) concluded there were “noticeable gaps” in e-learning research and definition of terminology. One of the reasons for this lack of coherence is:

> The technological environment within which modern education operates is becoming increasingly complex, offering new possibilities but also giving rise to challenges. We have seen a continual evolution of technologies and how they are used since the introduction of the Internet. (Conole & Alevizou, 2010, p. 9)

De Freitas and Conole (2010) observed the trend of more global, more networked and more mobile technology infrastructure, and these are emerging in online pedagogy. Indeed, McLoughlin and Lee (2010) argued that this new landscape:

> Calls for the active involvement of students in defining their learning goals and choosing both ICT tools and strategies for learning; it also requires recognition that user and learner generated content has a central place in a curriculum that fosters self-regulated learning. (p. 38)

Learning in the digital age thus requires a re-thinking of teaching and learning and not just replicating existing practices with new technology (Beetham & Sharpe, 2013).

While in the early years of public Internet the emphasis was on the technical foundations of e-learning, the pedagogical implications started shifting direction from managing the logistics of e-learning to managing the content (Govindasamy, 2002). An "interactive and constructive potential of e-learning" was being recognised, one which contrasts with the traditional *sage on the stage* approach of information transfer. However, it had to prove it was more than just a more convenient way to access content (Garrison & Anderson, 2011, p. 54).

The focus of course design and pedagogy has shifted from teaching to learning, with teachers also becoming learners in the process of professional development and engagement with their students. Rather than transferring the passive teacher-centred form of learning to the online domain, a constructivist approach would make the experience learner-centred, where active learning and engagement takes place (Rovai, 2004). The emphasis in higher education has shifted from the delivery of instruction to the production of learning (Barr & Tagg, 1995).

Far from simply providing a more comfortable channel to access instructional content, Nagel and Kotzé (2010) found, "When students engage in online activities and take responsibility for the quality of interaction, they can have a superior learning experience" (p. 218). ICT can indeed be successfully applied to enhance the educational process, especially in making learners active participants (Tomte & Sutherland Olsen, 2014,). On the other hand, the digital literacy of academic staff remains a challenge (Johnson, Adams Becker, Estrada, & Freeman, 2015), with many feeling the pressure of 24/7 online connectivity in the age of social media (Grove, 2017).

E-learning faces issues of suspicion (Casey, 2008) and quality (Jung & Latchem, 2012) when compared to traditional instruction. However, a meta-analysis by Means, Murphy, and Bakia (2013) on behalf of the U.S. Department of Education, reveals a significant increase in performance for blended learning but not for pure online learning. This confirmed earlier conclusions by Roberts and Savio (2012).

In their literature review on the use of Web 2.0 technologies in HE, Conole and Alevizou (2010) observed a number of key challenges proposed when technology meets education, including the tensions around the nature of openness, and changes in the role of educators and students. HE in Europe seems to be responding positively to these rapid developments in e-learning, though the adoption of e-learning and MOOCs is gradual (Gaebel, 2015).

Empirical evidence is increasing in respect to online learning and new developments such as Open Educational Resources (OER), mobile learning, software agents for online evaluation (Daradoumis, Bassi, Xhafa, & Caballe, 2013), bring your own device (BYOD), the flipped classroom, wearable technologies, adaptive learning technologies and the Internet of Things (Johnson et al., 2015). These have attracted the attention of researchers to an ever-higher degree in recent years. However, more research on OER and MOOCs is required (Bozkurt et al., 2015).

The *NMC Horizon Report 2017* (HE Edition) refers to a medium-term trend of using digital tools to measure knowledge and skills acquisition in online learning environments, including collaboration and creativity (Adams Becker et al., 2017).

According to the *Times Higher Education Teaching Survey 2017*, half of academics and 68% of administrators agree that students benefit from digitised content, but they evidence less enthusiasm for recording lectures and putting them online. The use of social media for instructor-student contact is still not widespread as many academics feel the pressure of constantly being in demand by students (Grove, 2017).

Crossbreeding between social network sites and e-learning is increasingly observable. Though Facebook is not a replacement for VLEs in education, the latter “could certainly learn something from Facebook and the nature of its user created groups and networks, instant communications, alerts and like/sharing features” (Hogg, 2013, p. 35). These VLEs, such as MOODLE and Blackboard, had to introduce features similar to the increasingly popular social network sites (Ronan, 2015) while some social network sites such as LinkedIn are assuming educational roles (Hoffman, 2015). This development and the proliferation of MOOCs are some of the most interesting but controversial trends in higher education right now (Johnson, Adams Becker, Estrada, & Freeman, 2014). Early research shows MOOCs are indeed contributing to online learning, though more empirical research is needed (Gamage, Fernando, & Perera, 2015; Glance, Forsey, & Riley, 2013).

An Overview of Four Different Rubrics

Measurement Through Rubrics

The measure of the success or failure of whether technology-driven education delivers the promised success can be determined through rubrics based on traditional principles, updated to cover the introduction of new technologies. In this manner, different instructional strategies can be devised to serve the different learning domains, including intellectual and cognitive strategies, attitudes, etc. (Fenrich, 2008, p. 310).

Graham, Cagiltay, Byung-Ro, Craner, & Duffy (2001) refer to the *Seven Principles for Good Practice in Undergraduate Education* published in 1987 as a popular framework for the evaluation of traditional classroom-based education, based on 50 years of research. These principles have been adapted for online education:

Principle 1: Good Practice Encourages Student-Faculty Contact
Principle 2: Good Practice Encourages Cooperation Among Students
Principle 3: Good Practice Encourages Active Learning

Principle 4: Good Practice Gives Prompt Feedback
Principle 5: Good Practice Emphasizes Time on Task
Principle 6: Good Practice Communicates High Expectations
Principle 7: Good Practice Respects Diverse Talents and Ways of Learning

Established frameworks began to be adopted and adapted to e-learning. For example, the rubric provided by the *Quality Online Course Initiative* of the University of Illinois (http://www.ion.uillinois.edu/initiatives/qoci/index.asp) is based on six sections, each with specific criteria, that mirror the above-mentioned Seven Principles:

1. Instructional Design - Criteria: 1.1 Structure, 1.2 Learning Goals/Objectives/Outcomes, 1.3 Course Information, 1.4 Instructional Strategies, 1.5 Academic Integrity, 1.6 Use of Multimedia.
2. Communication Interaction and Collaboration - Criteria: 2.1 Activities and Opportunities, 2.2 Organisation and Management, 2.3 Group Work.
3. Student Evaluation and Assessment - Criteria: 3.1 Goals and Objectives, 3.2 Strategies, 3.3 Grades, 3.4 Feedback, 3.5 Management.
4. Learner Support and Resources- Criteria: 4.1 Institutional/Programme Support and Resources, 4.2 Academic Support and Resources.
5. Web Design - Criteria: 5.1 Layout Design 5.2 Use of Multimedia, 5.3 Use of Images, 5.4 Links/Navigation, 5.5 Accessibility
6. Course Evaluation - Criteria: 6.1 Layout/Design

California State University provides a *Quality Online Learning and Teaching (QOLT)* instrument to measure the effectiveness and quality of online courses (Christie, 2014). The instrument can be used for both self-evaluation and peer evaluation. It consists of 58 objectives in 10 sections:

Section 1. Course Overview and Introduction (8 objectives)
Section 2. Assessment of Student Learning (6 objectives)
Section 3. Instructional Materials and Resources (6 objectives)
Section 4. Students Interaction and Community (Course Design) (7 objectives)
Section 5. Facilitation and Instruction (Course Delivery) (8 objectives)
Section 6. Technology for Teaching and Learning (5 objectives)
Section 7. Learner Support and Resources (4 objectives)
Section 8. Accessibility and Universal Design (7 objectives)
Section 9. Course Summary and Wrap-up (3 objectives)
Section 10. Mobile Design Readiness (optional) (4 objectives)

The University of Malta (UoM) provides *Minimum Standards for Study Units in the VLE* (2015) with a shortlist of suggested elements that must be provided in face-to-face courses complemented by online study units (blended mode) to meet minimum standards. This 'advisory' is provided by the IT Services at the University of Malta rather than a unit responsible for academic quality assurance or pedagogy. Indeed, quite significantly, these guidelines do not make any reference to pedagogy for e-learning.

The following are the elements listed in the advisory by the University of Malta (http://www.um.edu.mt/vle/staff/minimumstandards): (a) Study Unit Description, (b) Tutor Profile on VLE, (c) Class Announcements (provided by default in the VLE), (d) General Q&A Forum, (e) Communication Statement (tutor-student communication protocol), (f) Course Readings, (g) Other Learning Resources, and (h) Assessment Outline, (exemplars and use of anti-plagiarism software).

QualityMatters™ is a commercial product that provides course design rubrics for different levels in the education domain. One of them is specific to higher education and provides eight general standards that "work together to ensure students achieve desired learning outcomes" in online and blended learning (QualityMatters™, 2014, para 5). A score of 85% qualifies a course to receive a QM certification for quality in course design.

The standards QualityMatters™ (2014) are: (a) Course overview and introduction, (b) Learning Objectives (competencies), (c) Assessment and measurement, (d) Instructional material, (e) Learner activities and learner interaction, (f) Course technology, (g) Learner support, (h) Accessibility and usability.

A Synthesis of the Rubrics to Formulate the New Comprehensive Rubric

Synthesising a Comprehensive Rubric

The rubrics referenced in this document all have common criteria that cover the most basic elements that an online course should satisfy if it aspires to provide effective teaching and learning. These common standards are (in no particular order): instructional design, web design and technical access, communication between tutor/s and students, interactivity and community building, instructional resources with possible multimedia use, instructional support, assessment, and evaluation of the instruction with learner feedback (see Table 1).

The four institutions under analysis all cover most – if not all – the criteria derived from the synthesis of their rubrics.

Table 1

The Criteria in the Rubrics by the Three Educational Institutions and One Commercial Organisation Under Study.

Legend:

(red)	Assessment
(yellow)	Instructional resources
(orange)	Instructional design
(green)	Learner support
(light blue)	Communication
(purple)	Web/tech design
(dark blue)	Intro/wrap-up/evaluation

Univ. of Illinois	California State Univ.	Univ. of Malta	QualityMatters™ (2014)
Instructional Design	Course Overview & Intro	Study Unit Description	Course Overview and Introduction
Communication	Assessment of Student Learning	Tutor/s Profile/s	Learning Objectives (Competencies)
Student Evaluation and Assessment	Instructional Resources	Class Announcements	Assessment and Measurement
Learner Support	Student Interaction & Community	General/QA Forum	Instructional Materials
Web Design	Facilitation and Instruction	Tutor-Student Communication	Course Activities and Learner Interaction
Course Evaluation	Tech for Teaching and Learning	List of Readings	Course Technology
	Learner Support	Digital Resources	Learner Support
	Accessibility and Universal Design	Assessment	Accessibility and Usability
	Course Summary and Wrap-up		
	Mobile Design Readiness		

In terms of ratings, the California State University (2013) and QualityMatters™ (2014) provide their own rating scales. The former allows the adopter of the rubric to assign the same weighting range to all criteria (one to three points) according to the extent to which it is met or not, while the latter sets specific number of points (one, two or three) to be awarded to any individual standard when it is met (no points for partial or non-fulfilment). The QualityMatters™ rubric assigns the most points (three out of a maximum of three) to the statement of the learning objectives/competencies, assessment, the quality of instructional resources, tutor-learner interaction, learner support, and the ease of use of the technical platform where the virtual learning environment resides.

The Comprehensive Rubric

The synthesis of the four rubrics just referenced has produced the following *comprehensive rubric* that covers all the aspects mentioned by the four institutions. This comprehensive rubric is not a collation of the four rubrics but a synthesis of the separate approaches that – in the author's view - reflects the context of e-learning as explained at the beginning of this paper. This rubric has not been tested in lab setting or a real-life scenario.

There are 10 main standards, each containing specific standards.

10 Main Standards and Specific Standards

1. **Instructional Design – An analysis of the learning needs and the use of appropriate strategies and methods to meet them**
   1.1. Structure of Learning.
   1.2. Learning Aims & Objectives - What the instructor needs to achieve with the learning process.
   1.3. Learning Outcomes - What learners need to achieve to have successfully completed the learning process).
   1.4. Instructional Strategies and Methods.

2. **Course Opening – Welcoming learners**
   2.1. Accessibility – The instructor gives clear instructions on how to access all elements of the online learning environment.
   2.2. Role – The instructor gives clear information about his professional role in the learning environment.
   2.3. Description - A course description with pre-requisites (if any), clear learning outcomes and what is expected of the learners is provided.
   2.4. Behaviour - The learners are made aware of regulations, policies and ethics than govern the course.
   2.5. Integrity - The instructor is aware of the academic integrity needed to facilitate learning.
   2.6. Technical Competences - The learners are made aware of the technical competences needed to successfully reach the learning outcomes.
   2.7. Ownership – The instructor gives learners the opportunity to share their own learning goals.

3. **Assessment of Learning – Determining what the learner has learnt and subsequent accreditation**
   3.1. Goals and Objectives – The learners are aware of what is expected of them when they are assessed.
   3.2. Strategies – Clear, well-defined and measurable assessment of learning outcomes suited to the level of the learners.
   3.3. Grading – Grades are given in a fair and transparent manner through appropriate assessment instruments sanctioned by the institution.
   3.4. Feedback – Both instructor and learners are given the opportunity to provide feedback related to grading.
   3.5. Management – Learners have access to their grades and feedback at all times so that they can track their learning progress.

4. **Interaction and Community – The exchanges between instructor and learners that build a community that supports teaching and learning**

4.1. Fostering – The instructor welcomes learners and gives them the opportunity to communicate and create an online environment that fosters peer learning and engagement.
4.2. Management – Community-building is supported by clear instructions, rules and regulations. While the instructor facilitates engagement, learners are invested with the ownership of community-building.
4.3. Peer learning – Group work and other activities that foster peer learning are encouraged and structured not only to fulfil the learning outcomes, but also to present learners with an opportunity to learn skills and competences that go beyond such outcomes, e.g., digital literacy.

5. Instructional Resources for Teaching and Learning

5.1. Provision – Learning materials are either provided by the instructor or the learners are given enough time to procure such resources. The difference between compulsory and optional resources is to be made clear.
5.2. Application – The instructor clearly explains how the resources are going to be applied and utilised.
5.3. Entitlement – The instructor makes sure that the resources indicated to fulfil the learning outcomes are open and accessible by all the learners without unwarranted technical, financial or administrative barriers. The use of Open Educational Resources (OER) should be encouraged.
5.4. Variety – Learning resources are varied in terms of the multimedia content and multi-modal delivery channels to cater for the different learning preferences of learners.
5.5. Openness – The instructor should give learners the opportunity to suggest their own resources for adoption in the course.
5.6. Academic Integrity – The instructor promotes best practice in the use of third party resources, including anti-plagiarism practices and sound academic research/writing practices. The use and/or adherence to the Creative Commons licensing framework is encouraged.

6. Learner Support – Learners enabled to achieve their maximum potential

6.1. Instructional Support – The instructor explains his/her role in the process.
6.2. Academic Support – Learners know how to obtain such services as mentoring, advice and other skills that support them in achieving the learning outcomes.
6.3. Technical Support – Learners know how to obtain technical support to overcome potential issues in accessing the learning area and achieving the learning outcomes.
6.4. Administrative Support – Learners know how to obtain administrative support to overcome potential issues in accessing the learning area and achieving the learning outcomes.

7. **Technology design – Technology is at the service of teaching and learning**
   7.1. Support – All the utilised technologies and resources support the achievement of the aims and objectives of the instructor and the learning outcomes for learners.
   7.2. Centricity – All technologies and resources used support a learner-centric rather than an instructor-centric educational approach. The learners must be in control and technology must assist them in achieving the learning outcomes.
   7.3. Openness – The technical infrastructure used to deliver the teaching and learning is procured and implemented according to open standards and formats that maximise the value for money and the range of options to fulfil the learning outcomes and the academic needs of faculty and learners.
   7.4. Authentication – Authentication at different levels (device, software, virtual learning environment, specific course/learning area) should provide access to a safe and secure teaching and learning environment with the minimum number of steps possible to access the learning areas.
   7.5. Access – The virtual learning environment/learning area is device/platform agnostic as much as possible, thus accessible over different software platforms, browsers and computing devices. The instructor provides alternative resources if any of these are not easily accessible for technical reasons related to special needs of learners.
   7.6. Interface – The user interface and navigation in the learning area is simple enough to be conducive to teaching and learning without the need to possess advanced ICT skills and competences.
   7.7. Investment – The technical requirements of the instructional resources and the virtual learning environment/learning space do not require learners to make any significant new investment in hardware, software and online services to be able to access and use these resources to fulfil the learning outcomes.
   7.8. Management – Learners are aware of the rules, regulations and policies at institutional and at learning community level that govern the use of the technological infrastructure supporting e-learning.

8. **Course evaluation – Feedback to improve teaching and learning**
   8.1. Entitlement – Instructors should give learners the opportunity to provide feedback on the whole learning experience. On the other hand, instructors should also be able to provide their feedback within their organisation.

9. **Course Closing**
   9.1. Assessment – Learners should have access to their grades and the course material after the closure of the course (depending on the institution's access policies). The final grades should be provided within a reasonable timeframe after the closure of the course.

9.2. Resolution - All pending issues between the instructor and the learners are resolved.
9.3. Archiving – The instructor makes sure the course/learning area resources, texts, communication, etc., are backed-up or archived (in line with the institution's access policies) in a safe and secure way.

10 Instructional Design Cycle

10.1 Academic Review – The instructor and the organisation review the course description, the experience gathered, and the evaluation given.
10.2 Technical Review – The instructor, with the relevant technical unit in the organisation, reviews the performance of the technical infrastructure used to deliver teaching and learning.
10.3 Administrative Review – The instructor, with the relevant administrative unit/s in the organisation, reviews the administrative processes supporting the delivery of teaching and learning.

Recommended Actions in Support of Instructional Design for e-Learning in Higher Education

The following recommendations are compiled from the literature review and the development of the comprehensive rubric:

1. Teaching and learning should dictate the technological implementation of supporting tools and facilities, not the other way round.
2. An educational institution wishing to provide e-learning opportunities needs a clear vision and a strategy sustaining e-learning from an academic, technological and administrative point of view.
3. The use of e-learning pedagogies should be promoted as an official part of the professional work of academics, with tangible incentives and rewards that can take different forms, including professional recognition, financial and material rewards.
4. An educational institution wishing to implement e-learning needs to invest in academic training and support, in technical support and a sound technical infrastructure, and in administrative support.
5. An educational institution should take time in getting to know the views and needs of its faculty and students.
6. A VLE should not be utilised as a simple online repository of content or for document management.
7. E-learning should attempt to benefit from the affordances provided by technology as guided by the digital pedagogies and experience with e-learning, especially providing students with an element of control over the pace, time and path of study. Otherwise it simply serves as an extension of traditional teaching practices.
8. Student-instructor and student-student interaction, collaboration and work through the VLE. Community building.

9. A VLE alone does not provide a complete range of tools to facilitate online learning, therefore complementary tools such as social media should be sought.
10. E-learning, with MOOCs for example, is an opportunity to explore micro-credentialing and accreditation of online learning.

Discussion

The analysis of the rubrics has confirmed the myriad of possibilities provided by technology when applied to teaching and learning. Indeed, the resulting comprehensive rubric is rather long, and its components may indeed contribute to the welcome conclusion of the long-standing debate on whether e-learning is as rigorous and effective as traditional face-to-face environments (Casey, 2008; Jung & Latchem, 2012). Such a rubric will surely support faculty in the ever-increasing implementation of e-learning (Gaebel, 2015).

The active involvement of students in the learning process, rendered possible by technology, is well catered for in the comprehensive rubric. The early emphasis of technology in e-learning has given way to more credence in the pedagogical benefits (Garrison & Anderson, 2011; McLoughlin & Lee, 2010; Rovai, 2004).

The lack of common definitions of e-learning and its constituents is notable in the chosen rubrics, but there is nevertheless a common approach: empowering the educator to empower the student in an online environment that promotes learning.

Digital literacy of faculty and time pressures remains a challenge and even though technology is available, the application of the elements listed in the comprehensive rubric requires a level of digital competence from instructors (Conole & Alevizou, 2010; Grove, 2017; Johnson et al., 2015).

MOOCS, OER, BOYD, social elements, artificial intelligence, augmented and virtual reality are acquiring more space and attention in education, and the comprehensive rubric must take into consideration these new instructional approaches and updated digital pedagogies (De Freitas & Conole, 2010).

The tensions created by the implementation of technology in HE, especially the changing role of educators and students brought by more social, more ubiquitous and more open learning spaces, will surely bring to light any gaps between the planned and the actual implementation of e-learning. It is up to the educator, as a professional, to mind these gaps and bridge them.

Limits of Scope

It is not within the scope of this paper to review quality assurance processes and administrative components, but to propose a rubric for course design and self-review of faculty and HE institutions for a better alignment with what is regarded as current standard best practice.

Suggestions for Further Research

The proposed comprehensive rubric does not provide a scale for assigning points when applied, thus giving a weighting to the elements of the rubric perceived as more important than others. There are other rubrics on e-learning by reputable HE institutions that could be included in the analysis. The litmus test for the rubric is its application in real life situations. This is an excellent opportunity for follow-up research analysing the outcomes of the its application.

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Notes

REDEFINING THE FRAMEWORK FOR TEACHING PROGRAMMING TO PRIMARY SCHOOL STUDENTS: RESULTS FROM THREE PILOT PROJECTS

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Abstract

The study summarizes the findings of three pilot projects in which 2nd, 5th, and 6th-grade primary school students were taught basic programming concepts using game-like applications. In all projects, two more groups of students were formed that were taught the same subjects using conventional methods. Results' analyses revealed that students who used the game-like applications had better learning outcomes compared to the ones that were taught conventionally. The results can be attributed to increased students' motivation and to the applications' game-like characteristics. Based on the results, suggestions for redefining the framework for teaching programming are presented.

Introduction

Technology has changed many aspects of our lives. As far as education is concerned, technology has imposed a significant shift in focus: from knowledge acquisition to the acquisition of a set of skills that will render students creative and capable of responding to the needs of modern society. Students must stop being passive users of devices and applications and become content designers and creators through them (OECD, 2015). Even if Prensky (2001) describes young students as *digital natives* because of their familiarity with technology, their skills are still associated with the simple use of devices and applications. The prevailing educational model continues to be that of facilitating learning through the use of technology, that is also related to the simple use of ICT tools during teaching.

The question emerges: How can we turn students from adept users to skillful content designers and creators through technology? There are many who believe that this can be achieved if students acquire programming knowledge and skills (Resnick et al., 2009). There are multiple benefits for students when they learn how to program: development of analytical thinking, development of skills related to the design of algorithms, and a positive impact on their creativity and imagination (Fessakis, Gouli, & Mavroudi, 2013; Liu, Cheng, & Huang, 2011). Researchers suggested that when the teaching of programming becomes an enjoyable experience the results are noteworthy (e.g., Margulieux, Guzdial, & Catrambone, 2012).

The teaching of programming concepts in Greek primary schools is included in the last two grades, not as an independent course, but within the IT course (Hellenic Ministry of Education, 2003). However, the content is poor, outdated, not well organized, and students face difficulties (Papadakis, Orfanakis, Kalogiannakis, & Zaranis, 2014). Therefore, a two-fold intervention is needed to rectify the problem. The first is to redefine the objectives and the content of programming as a teaching subject. The second is to find easy and fun to use tools, so students are motivated to learn how to program and to develop positive attitudes towards this subject. Three pilot projects were designed and implemented over a school year. Though the target groups were students of different ages, they shared some common features: (a) the tools that were used exploited the elements of fun and play, (b) the programming concepts that were taught were basic but went beyond those included in the official curriculum, and (c) the duration and sample sizes were sufficient so that reliable conclusions can be drawn. The main research questions were: (a) to what extent primary school students can understand basic programming concepts, (b) what is the appropriate teaching method, (c) how important are the elements of fun and play, and (d) what is the role of students' autonomy during the learning process. The coming sections summarize the rationale, methodology, and findings of these projects. On the basis of the experience gained, specific suggestions on how to improve the current situation are also presented.

Programming as a Teaching Subject

Programming, as a teaching subject, is included in the Greek primary school's curriculum, as part of the Informatics' course, which is taught just for an hour each week, and only in the last two grades. Its objectives are that through the use of a simple programming language (Logo-like) students learn how to use simple commands in order to create shapes or solve simple problems, understand algorithmic structures, and develop their problem-solving skills (Hellenic Ministry of Education, 2003). Apart from the fact that Logo is outdated, compared to other modern programming languages for children, the curriculum is poor both in terms of its duration and content (Grigoriadou, Gogoulou, & Gouli, 2002). In general, students face some major problems when they learn how to program. They have a poor understanding of how programs are executed (Pea, 1986), and of the rules, logic, and syntax of the programming languages (Kristi, 2003). Variables, as well as other concepts, are not easy to grasp (Pane & Myers, 1996). The reasons given for the above issues are young students' lack of logical reasoning and their undeveloped algorithmic and critical thinking (Robins, Rountree, & Rountree, 2003).

The teaching/learning of programming fosters a series of mental and cognitive skills. Besides learning fundamental programming concepts (Zhang, Liu, Ordóñez de Pablos, & She, 2014), students can develop a positive attitude toward learning computing in general (Fessakis et al., 2013). A better understanding of mathematical concepts and improvement of their social skills (Fessakis et al., 2013), problem-solving skills (Akcaoglu & Koehler, 2014), computational thinking (Grover & Pea, 2013), higher order thinking skills (Kafai, Burke, & Resnick, 2014), as well as an impact on their creativity and imagination (Liu et al., 2011), were noted. There is extensive literature on the ways that programming can be taught to primary school students. For example, Scratch and its versions attracted the attention of the scientific community (e.g., Su, Huang, Yang, Ding, & Hsieh, 2015). Many have pointed out that its effectiveness is the result of its game-like characteristics (e.g., Su et al., 2015). Furthermore, very positive results yield programming environments where their purpose is the development of games. Besides having the positive effects that were previously mentioned, research has shown that such programming environments render students more creative and more motivated for learning how to program computers (Preston & Morrison, 2009).

The Pilot Projects

Assuming that game-like programming environments are particularly effective, the interest turned to them, and it was decided to examine their effectiveness. Therefore, in 2016, three pilot projects were designed and implemented. In the sections that follow, brief summaries of their rationale and methodology, as well as their main conclusions, are presented.

Pilot Project 1

In this project, the target group was sixth-grade students (ages 11-12). The tool chosen for teaching programming was Microsoft's Kodu (http://www.kodugamelab.com/), which allows the rapid development of 3D games. The programming language has very simple rules and it is based on physical terms and concepts such as see, hear, and bump, for the control of the games' characters and objects. Even 10-year-olds developed their own games. The programming concepts that were taught were variables, sequences, and subroutines. Two two-hour sessions were allocated for the teaching of each programming concept. Students worked in pairs. The teacher introduced each programming concept and students were then asked to develop mini-games using the programming concept that had been introduced to them. To enable comparison of the results, two more groups of students were formed. To the first, only evaluation sheets, presented in the coming paragraph, were administered. Thus, it was examined what students can intuitively perceive regarding the above programming concepts. The second group was taught conventionally. The teacher taught using notes, presentations, brochures, and the whiteboard. Instead of the students developing mini-games, the teacher posed problems, derived from students' everyday life, associated with each programming concept, and students (working in pairs) solved them, on paper, in the form of pseudocode. For example, in sequences, they were asked to write down the recipe for a pizza in a form of a sequence of events.

The assessment of students' performance was done using: (a) evaluation sheets that were given immediately after the end of each session and (b) delayed post-tests, that were given about two weeks after the end of the project, to test the sustainability of knowledge. Each of the above tests consisted of two distinct sections. The first had multiple choice, fill-in-the-blanks, and right-wrong questions (at least 10 of them). In the second part, students were instructed to transcribe, using programming terms and concepts, everyday life activities (at least 5 such problems). Also, at the end of the project, a short questionnaire was administered in order to investigate the attitudes and opinions of students for Kodu (15 Likert-type questions). A total of 66 students participated in this project coming from three neighboring schools in Athens, Greece. The analysis of the results (available at http://opensimserver.aegean.gr/pilotproject1.htm) revealed that the group of students that was taught using Kodu achieved statistically significantly better learning outcomes compared to the other groups, in all cases. The vast majority of students reported that they liked working with Kodu a lot. At the same time, they stated that the whole process was pleasant, fun, and like a game. No problems whatsoever were reported.

Pilot Project 2

In the second project, the target group was fifth-grade students (ages 10-11). The research methodology was different than the previous one. Since conventional teaching did not produce good results, it was decided to examine different types of teaching methods, but, in all, collaboration between students played a major role. Again, three groups of students were formed. All used Kodu, and students worked in groups. In the first, the teacher had an active role, systematically teaching the programming concepts, by giving examples in Kodu, and by providing constant support to students. In the second, the teacher had only a supporting role (e.g., answering technical questions), and students studied the programming concepts using detailed notes. In the third group, the role of the teacher was again limited, and the notes were not available to students; they had to seek by themselves solutions to the problems they faced. The main goal was for students to develop a complex game by the end of the project. This was implemented in three stages. First, students were asked to develop simple games, without any programming, in order to explore the objects included in Kodu. The second stage involved the development of a simple game, by adding interactions and by implementing a simple game scenario that was given to them. Students encountered important programming concepts such as variables, sequences, logical expressions (AND, OR), conditions (When-Do), and subroutines. In the final stage, a detailed game scenario was given to students, and they were asked to implement it in the best way they could. This stage was significantly longer, compared to the previous stages. The project lasted for about three months (70 hours for each group, 6 hours per week), due to the complexity of the tasks together with the need to provide students enough time to understand all the programming concepts and to be able to apply them. The target group was 63 fifth-grade students coming from the same schools as in the previous project.

Research data was collected by evaluating students' games. For their evaluation, the technique of content analysis was utilized (conducted by three independent raters), and a complex scoring system was developed, containing both quantitative and qualitative criteria. The quantitative criteria included the number and types of commands used, if they were used properly, and if there were any programming errors. The qualitative criteria were those proposed by Consalvo and Dutton (2006), for example, the aesthetic integrity of the game, the complexity of the levels, the complexity of commands, the gameplay, etc. In addition, at the end of the project, a short questionnaire was administered in order to examine the attitudes and opinions of students regarding Kodu (15 Likert-type questions). The data analysis (available at http://opensimserver.aegean.gr/pilotproject2.htm) revealed an interesting finding. The teaching method did not have any statistically significant impact on students' scores. Also, all groups liked this programming environment, their enjoyment was high, the development of games seemed easy and like a game.

Pilot Project 3

The last study examined if it is possible to teach programming to younger ages than the official curriculum dictates. The target group was second-grade students (ages 7-8). Because Kodu could not be used by children of this age, tablets and an application, namely Kodable (https://www.kodable.com/), were used. Kodable was selected because of the simplicity of its interface, the game-like features, and the existence of ready-made and detailed lesson plans. Although it is in English, the interface can be easily understood rendering knowledge of English unnecessary. The student/user guides the application's character through labyrinthine levels, collecting as many coins as possible. Each level is completed when the character reaches the exit. The guidance is done by using the available commands as many times as the user wants. The commands are placed by dragging and dropping them to a limited number of empty slots, suggesting that the program must be completed using a limited number of commands. The user executes the program, sees the results, and, in case of an error, he/she can redo the programming. The levels are of escalating difficulty (e.g., more complex paths, fewer available commands). It is worth noting that there is no single correct solution to each level. Sequences, conditions (if/then) and loops were taught using this application. The lessons' plans and activities were translated and adapted into Greek. At the beginning of each session, the teacher made a short introduction about the programming concept that he was about to teach, drawing examples from students' everyday lives. Next, students worked, in pairs, using the tablets, resolving the levels of the corresponding concept. In-classroom activities followed, which required teamwork and included worksheets and games. Each session lasted for two teaching hours, and each programming concept required two sessions.

Immediately following the end of the teaching of a programming concept, students completed an evaluation sheet, consisting of three distinct parts. The first one had multiple choice, fill-in-the-blanks, and right-wrong questions. In the second part, students were instructed to transcribe, using programming terms and concepts, everyday life activities (as in the first pilot project). The third part followed Kodable's philosophy and presentation layout. Students were presented with a level, and they had either to complete the missing commands or to check whether the solution was correct (identifying any errors). Also, about a month after the end of the project, students completed a delayed post-test which had the same structure as the evaluation sheets but included all the programming concepts that they were taught. They also completed a short questionnaire for the evaluation of their experiences and views regarding the use of tablets/application (15 Likert-type questions).

For examining the significance of the project's results, two more groups of students were formed. The first one used board games instead of tablets. This method has been used by other researchers with noteworthy results (e.g., Mavridis, Siribianou, & Alexogiannopoulou, 2015). Each board game was a printed and enlarged Kodable's level. The same was done for the characters and for all the other elements included in the application. The students, working in pairs, placed the various elements/commands on the board and the teacher "executed" the "program" determining if it "worked" properly. The in-classroom activities, as well as the way students worked, were the same as in the tablets group. The second group of students was taught conventionally, using notes. These notes followed Kodable's philosophy and way of presenting the learning material. Once again, students worked in pairs. The in-classroom activities were also the same as in the previous groups. The sample size was 69 second-grade students coming from the same schools as in the previous projects. The data analysis (available at http://opensimserver.aegean.gr/pilotproject3.htm) indicated that the teaching of programming concepts using Kodable produced statistically significantly better learning outcomes in all cases except sequences, where the group that used Kodable and the team that used the board game had the same results. According to students' responses, conditions was the most interesting programming concept, followed by sequences and loops, while conditions were considered the most difficult one. In addition, they stated that they learned quite a lot and quite easily. They also found tablets easy to use and motivational. Finally, students made very positive remarks regarding their experiences while using the tablets and the application, noting its game-like features.

Discussion – Towards a New Framework for Teaching Programming to Primary School Students

Regarding Kodu, an important finding was that the results of the first study were in line with the findings of similar studies (e.g., Earp, Dagnino, & Ott, 2014; Shokouhi, Asefi, Sheikhi, & Tee, 2013). Their findings indicated that Kodu made the teaching of programming concepts more enjoyable, and, because of its game-like features, it helped students to have a better understanding of basic programming concepts and solve complex programming problems. After all, Kodu's main purpose is to develop games and games are compatible with children's mentality (Prensky, 2001). It should also be noted that students, although young, did not face significant problems while using it. Based on these findings, it can be argued that Kodu is an attractive and effective tool for teaching programming concepts to students. The third pilot demonstrated that the teaching of programming concepts, to very young students, using tablets and game-like applications, is more effective than conventional teaching methods. The results are in agreement with the existing literature that emphasizes the relationship between the use of mobile devices and the good learning outcomes regarding programming concepts (e.g., Armoni, Meerbaum-Salant, & Ben-Ari, 2015). The absence of usage problems was noted in other studies, which attributed this finding to the familiarization of -even very young- children with electronic devices (Goodwin, 2012).

As for the appropriate teaching method, one should take into consideration the results of the second pilot. It seems that the teaching method is not so important if students have enough time to study and practice. This is supported by the fact that all groups had the same learning outcomes. This finding may seem surprising and perhaps difficult to interpret. Additionally, from the literature review, no similar methodological approaches were identified that would have allowed the comparison of the findings. But a closer examination of the results can lead to an interesting conclusion. Unlike other studies, the games, developed by the students, were examined.

Therefore, what was evaluated was not an "instantaneous" effect, like in a test or in an evaluation sheet, but the result of many hours of work, trials and errors, testing, and exploring alternative solutions. It is quite possible that, initially, the three groups had differences, but these were eliminated as students had enough time to improve their games. So, even if a teaching method was not that effective, students (and their work) were the factor that balanced the results. Consequently, one must reflect on how the students worked. The dominant element, in all three pilots, was students' collaborative work. Applying constructivist views for the learning process (Papert, 1993), students expressed and discussed their views and collaborated with each other (Ertmer & Newby, 2013). Further, they had the opportunity to actively participate in the learning process, study the subject in-depth, and discover its basic principles, as suggested by inquiry-based instruction (Dostál, 2015). Important elements in this view are intuitive thinking, logical leaps, originality, and the conception of radical solutions to problematic situations.

The results noted can be attributed to the use of tools that raised students' interest. Indeed, this is evident in their answers to the relevant questions. This finding is common to many studies (e.g., Earp et al., 2014; Goodwin, 2012; Shokouhi et al., 2013). This seems to have led to increased incentives for learning and to a better understanding of the programming concepts, which, in turn, led to better learning outcomes, as noted by other researchers (e.g., Snell & Snell-Siddle, 2013). Students had the ability to control the outcomes of their work and could easily monitor their progress, either by running their games in Kodu or by executing their programs in Kodable. Thus, they had greater control over the learning process and greater autonomy, as West (2013) pointed out. On the basis of the above, education administrators and policy makers can consider:

- The incorporation of game-like programming environments, such as Kodu and Kodable, into the curriculum in order to improve the way that programming is taught to primary school students.
- A teaching framework can be derived from an analysis of the methodology applied to the pilots: (a) students' collaboration and (b) with increased autonomy so as students to have the opportunity to discover, by themselves, their own solutions to specific programming problems.
- On the basis of the results, it can be argued that programming can be taught at a very early age.
- Programming courses should have enough time allocated to them (in terms of teaching hours), so the necessary skills can be developed.
- Finally, a greater involvement of teachers in the whole process should also be considered. Training will probably be necessary, but this is not expected to be that difficult as the proposed programming environments are simple to use and easy to learn.

Conclusion

This study summarized the findings of three research pilots that resulted from the need to examine the effects of using game-like programming environments in order to teach basic programming concepts to primary school students. Despite the positive results, there are limitations that need to be acknowledged. Although the samples were sufficient for statistical analysis, they were relatively small; thus, the results cannot be easily generalized. The inclusion of more programming concepts would have allowed a deeper understanding of the problem. Finally, students may not have been completely honest in their responses, confusing the questionnaires with some form of evaluation. Future studies could utilize larger sample sizes and include additional programming concepts. In order to have a wider range of results, both quantitative and qualitative methods (such as interviews with students and teachers and observations) can be used. The use of other programming tools would allow their comparison and could lead to the selection of other appropriate environments. Finally, it would be interesting to examine the learning outcomes when teaching programming to even younger ages. In conclusion, it can hardly be said that the subject is closed. More extensive projects, in terms of duration and content, but also with the use of other tools and teaching methods, are planned for the near future. However, the evidence, so far, supports the view that game-like programming environments have a positive impact on the learning of programming concepts, especially at younger ages.

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CODING EDUCATION FOR KIDS: WHAT TO LEARN? HOW TO PREPARE TEACHERS?

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Abstract

In the area of science, technology, engineering and mathematics (STEM) education, coding has been highlighted as a core competence. Young children are required to start to learn coding. However, coding is not an easy skill, and early childhood educators usually lack relevant training. This paper suggests that the learning of logical concepts and sequential program are appropriate for young children. This paper also reports a case study of teacher training. Preliminary results suggest that early childhood educators are able to design appropriate learning activities of coding education for young children after receiving training.

Introduction

The new initiative of science, technology, engineering and mathematics (STEM) education has been advocated in recent years, and coding skill is particularly highlighted as an essential competence. It has been suggested that children should start to learn coding at age five (Department for Education, 2014; Smith, 2016). The importance of coding is considered comparable with reading, writing and arithmetic. However, to implement coding education in kindergarten is not a straightforward issue. As coding in computer science involves abstract concepts and complicated skills, and children are still in an early developmental stage, it is critical to explore appropriate learning contents that are suitable for young children. On the other hand, training on coding education is seldom included in a teacher training programme. Teachers, therefore, may have difficulties to design learning activities and deliver lectures on coding education for children (Bers, Seddighin, & Sullivan, 2013; Manches & Plowman, 2017). In consideration of the new initiative of promoting coding education to children, this paper attempts to discuss the role of ICT education, and particularly coding skill, in STEM education. The researcher then attempts to explore the learning contents of coding education that are appropriate for children at age five. Moreover, this paper reports a case study of a training program to prepare teachers for implementing coding education in an early childhood setting.

ICT Education in STEM Education

In the past few years, a lot of countries have proposed policies to promote STEM education. In the United States, the Department of Education (2017) clearly highlighted the aim to maintain global leadership by strengthening the learning and teaching of STEM contents. Government officials stressed that in a complex world, youth are required to know what can be done on the basis of obtained knowledge so as to achieve success. Youth are particularly expected to obtain knowledge and skills in STEM education to solve problem and process information. In response to the educational need, strategic policies for STEM education have been proposed in the United States. In Singapore, STEM education has been integrated into the Applied Learning Programme (Ministry of Education, 2017). The programme aims to provide learning opportunities for students to apply their knowledge and skills in science, mathematics and technology to solve real world problems. Learning contents include scientific inquiry and literacy, reasoning and problem solving, design thinking, computational thinking, data analysis and the use of technology. In Hong Kong, the Curriculum Development Council (2015) has published an official document to promote STEM education. Moreover, the Chief Executive stated in The 2017 Policy Address (HKSAR, 2017) that the Education Bureau planned to provide additional resources to schools to facilitate the implementation of school-based programmes related to STEM education. Also in England, learning contents related to STEM have been integrated in different key stages of the national curriculum (Department for Education, 2014).

Within the domain of STEM education, information and communication technologies (ICT) education has been recognized as an important area of learning (Manches & Plowman, 2017). To explore the relationship between ICT and STEM education, the author identified four key roles of ICT education to support the broader STEM education (Figure 1).

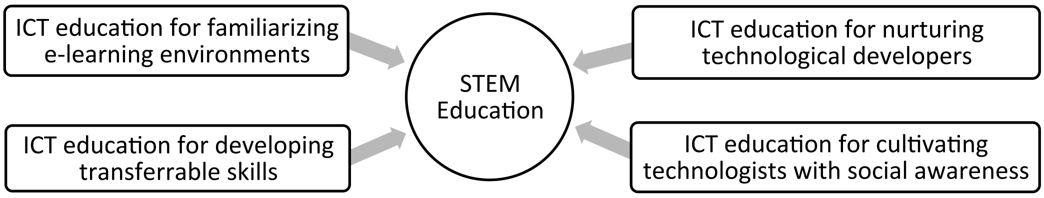

Figure 1. Roles of ICT education in STEM education.

The first role of ICT education is to help develop transferrable skills. It includes two important areas of transferrable skills, namely information literacy and computational thinking. With the advancement of technologies and rapid development of the Internet, information explodes in an exponential rate, and it boosted the formation of today's knowledge society. Students are, therefore, required to develop necessary literacy to deal with a huge volume of information in their learning. Information literacy refers to "the abilities to recognize when information is needed and to locate, evaluate, effectively use, and communicate information in its various formats" (State University of New York, 1997, para. 5). An information literate is expected with competence to manipulate a wide range of information processing tools. Students receiving STEM education are usually engaged in a process of inquiry by searching, comprehending, organizing, synthesizing and evaluating information for knowledge construction. For example in Oldknow's (2009) study, a lot of information processing tools, such as digital image and video editing software, 3D modeling software and data logger software, were effectively used in a series of ICT-based learning activities for learning mathematical concepts. In another study conducted by Awad and Barak (2016), simulation and sound editing software were adopted in STEM lessons to learn the concepts of sound waves. In addition, the WebQuest model that analyzes information obtained from the web for inquiry learning has been commonly used in STEM classrooms (Osman, 2014). Information literacy is, therefore, considered as a critical transferrable skill in STEM education. Another important transferrable skill that can be developed by ICT education is computational thinking. According to Wing (2006), "Computational thinking involves solving problems, designing systems, and understanding human behavior, by drawing on the concepts fundamental to computer science" (p. 33). Barr and Stephenson (2011) further expressed the idea with the following elaboration:

> Computational thinking is an approach of solving problems in a way that can be implemented with a computer. Students … use a set of concepts, such as abstraction, recursion, and iteration, to process and analyze data, and to create real and virtual artifacts. Computational thinking is a problem solving methodology that can be automated and transferred and applied across subjects. (p. 51)

In recent years, researchers have started to put forth efforts to design learning activities in school for developing students' computational thinking skill. For example, Lee and her colleagues (2011) designed learning activities for training computation thinking in the domains of modeling and simulation, robotics, and game design and development in STEM education. Computational thinking has been advocated as an essential skill for everyone in a digital age (Barr, Harrison, & Conery, 2011).

Another role of ICT education in STEM education is to enable learners to become familiar with e-learning environments. It includes the knowledge and skills to recognize the functionalities afforded by various e-learning platforms, to adapt or construct e-learning platforms, and to appropriately adopt them to support learning. For example, a wiki is a simple and easy-to-use web-based platform for cooperative work. Learners are encouraged to develop a wiki site to construct knowledge collaboratively (Ebersbach, Glaser, & Heigl, 2006). Wiki has been used as a learning environment to engage students in learning STEM related contents (Ng, 2016). In addition, a 3D immersive virtual environment was adopted to engage students in STEM lessons in the study by Roberts and Matzen (2013). A content management system, such as Moodle, is another example of an e-learning platform to support online learning. With a view to facilitate students' learning in STEM education, ICT education should equip students with knowledge on the functionalities of e-learning platforms and enable them to make good use of them.

The third role of ICT education in STEM education is for nurturing technological developers. It involves computer programming skill, logical reasoning skill and knowledge of software development. An important application of the computer programming competence is the development of mobile apps. Mobile devices have become very popular due to their strong computing capability, small size, Internet connectivity and multiple functionalities. People have paid more attention to the development of mobile apps due to their possibilities of gaining benefits (Hsu, Rice, & Dawley, 2012). On the other hand, computer programming is often associated with robotics. A series of instructions in a computer program is used to control the behaviors of a robot for a specific purpose. Recent studies can be found to integrate computer programming and robotics elements in STEM lessons to equip students with technological knowledge and skills (Park, Kim, Oh, Jang, & Lim, 2015; Sullivan & Bers, 2016). In that connection, ICT education paves the way for developing future technological developers.

The last important role of ICT education in STEM education is to cultivate technologists with social awareness. Although knowledge and skills are important, it is also critical to cultivate appropriate values and attitudes in STEM education (Rao, 2014). To address the issue of social awareness, ICT education should emphasize the appropriate use of technology, including proper netiquette in online activities, the respect of intellectual property, responsible use of technology, the awareness of equity and different cultures, and a good sense on the impact of technology on health and environment.

Coding in STEM Education

Computer programming and *coding* are two associated terms in computer science. According to Manches and Plowman (2015) coding refers to "the specific skills of inputting instructions using a particular language" while programming refers to "the wider design and implementation process of using code to solving particular problems" (p. 3). Coding can be regarded as a set of fundamental skills for computer programming. In response to the need of STEM education, the previous President of the United States, Barack Obama, initiated the Computer Science for All policy in 2016 (Smith, 2016). This policy aimed to educate students to be technological developers and active citizens in the technology-driven world. Students are required to learn computer science from kindergarten to high school. Particularly, the importance of coding education in the digital economy was highlighted. In England, a new curriculum has been developed to mandate the inclusion of computer science learning contents for students at age five. The importance of coding is considered comparable with reading, writing and arithmetic (Department for Education, 2014). Therefore, it is generally believed that students can benefit from the learning of coding. However, the implementation of coding education for children at age five is not a straightforward issue. Efforts are required to tackle some challenges in the implementation.

Challenge on the Difficulties with Coding

Coding is not an easy skill to master. Among different aspects of difficulties, the hurdle coming from the linguistic intricacies of computer programming language has been addressed by many researchers (Gomes & Mendes, 2007). As mentioned by Gomes and Mendes, computer programming languages were developed for professional use with many complex syntactic details to memorize. The languages used for programming are hardly suitable for novices. In addition, learners are required to have good logical reasoning skills to deal with logical operations and control flow in a computer program. In this regard, many researchers have proposed methodologies and tools to help students master the difficulties on learning computer programming (Gomes & Mendes, 2007; Robins, Rountree, & Rountree, 2003,). Therefore, if children at age five are required to learn coding, it is critical to identify the learning elements and tools in coding education that are appropriate for their learning needs, and suitable for their cognitive development.

Challenge on Teachers' Competence for Coding Education

Another challenge refers to teachers' competence in the implementation of coding education for kids (Bers et al., 2013; Manches & Plowman). Due to different phases of technology development, early childhood educators are unlikely to have experiences of computing and particularly coding education from their own education or career (Manches & Plowman, 2017). They usually lack knowledge about technology and engineering, and they also do not have sufficient pedagogical knowledge to bring technology into the classrooms (Bers et al., 2013). As a consequence, they are not confident in their teaching, and it is hard for them to deliver high-quality STEM lessons.

Methodology

In view of the challenges, the author designed a teacher training program with a series of workshops on coding education for pre-service teachers in an early childhood educational setting. The training program was implemented in the 2015 – 2016 academic year in Hong Kong. This study aimed to investigate the effectiveness of the teacher training program. Details of the implementation and preliminary results of the case study are elaborated in the following sections.

Learning Elements in Coding Education for Kids

The first step of designing the teacher training program on coding education for kids was to identify the most appropriate learning content contents. To achieve the purpose, it is necessary to understand the cognitive development of children. According to the cognitive-development theory suggested by Piaget (1971), children aged five are at the preoperational stage. In this stage, a child begins to understand the world using mental representations with words and images. This kind of symbolic thinking goes beyond the connection of sensory information with physical action. Dewey (1938) and Piaget (1947/1960) believed that children develop knowledge through active participation in their learning based on their own experiences. Piaget (1971) particularly highlighted that the thinking of a child at the preoperational stage is characterized by the lack of logic. Although the results of some studies (Au, Sidle, & Rollins, 1993; Gelman, 1972; Rosen & Rozin, 1993) showed that children at preoperational stage could demonstrate satisfactory logical concept and reasoning ability, children are usually unable to produce accurate logical reasoning when faced with unfamiliar topics, too much information, or contradictory facts that they cannot reconcile (Berk & Meyers, 2016).

As reflected in the literature, the logical concept and reasoning skills of children at five are weak and still to be developed. Since logical concepts are critical in computer programming, the learning of fundamental logical concepts, such as logical AND, OR, NOT, and reasoning skills, such as IF, THEN deductive reasoning, are considered appropriate for children of age five. Additionally, almost all computer programming textbooks help learners start to learn with a simple program of sequential execution of statements (see for example, Deitel and Deitel, 2015). It suggests that a computer program with instructions in a direct sequence is the simplest structure and the learning of sequential programming is appropriate for children.

Teacher Training Program

Since children of age five are attending kindergarten in Hong Kong, a group of pre-service teachers taking the higher diploma of early childhood education programme in The Education University of Hong Kong were invited to participate in this study. Since this project was considered as a new initiative, the case study research method was adopted as it enables a group to be "studied extensively and varied data are collected and used to formulate interpretations applicable to the specific case or to provide useful generalizations" (Fraenkel, Wallen, & Hyun, 2012, pp.13-14). It also "aims to understand the case in depth, and in its natural setting, recognizing its complexity and its context" (Punch, 2009, p.119). A total of 10 pre-service early childhood teachers, 5 from year 1 and 5 from year 2, participated in this study. In addition, an IT team comprised of 2 year 4 students taking the bachelor of information and computer technology programme was formed to provide training on coding education. The researcher with strong background on IT in education and early childhood education served the role of overall supervisor of this project.

The training program consisted of three workshops.

Workshop 1. In the first workshop, to strengthen basic logical concepts and to master elementary coding skills were the main objectives. The design of the workshop was underpinned by the theory of the zone of proximal development (ZPD) and scaffolding suggested by Vygotsky (1978). Vygotsky recognized that the development process lags behind the learning process, and this results in the ZPD, which is critical for learning. In this concept, an essential feature of learning is to identify the ZPD and equip learners with the capacity to proceed to this zone by interacting with more knowledgeable others. In the workshop, the researcher delivered a lecture on some basic logical concepts. Although the participants would have developed basic logical concepts in their life experience, the lecture aimed to provide formal training to strengthen their logical concepts and reasoning skills. Participants then received a training session on elementary coding skills. Hands-on practices were integrated in the training workshop using technological tools for the purpose of scaffolding.

Workshop 2. In the second workshop, the researcher introduced some learning resources that are suitable for coding education for children. The researcher together with IT team members then provided a demonstration on how to apply related resources to design learning activities on coding education. As computer programming language is highly complicated, and not appropriate for the cognitive developmental stage of the children, a simple robot, Bee-Bot (Figure 2), was chosen as a learning tool to develop the children's ability to compose sequential instructions. A Bee-Bot is an easy-to-operate robot that can be moved on a mat based on inputted instructions. It has been adopted as a learning tool to develop programming skills in early childhood education (Eck et al., 2013; Janka, 2008). Since children learn better if learning activities are related to their life experience, the researcher intentionally designed a mat for the Bee-Bot with daily life objects (Figure 3). In the design of learning activities, children are required to answer logical questions and instruct the Bee-Bot to move to a specific location. An example of a logical question was "if today is a sunny day, please instruct the little bee to meet the sun." The overall design of learning activities served as a scaffolding example to facilitate teacher training. After this second workshop, the pre-service teachers were asked to design learning activities on coding education for kids.

Figure 2. A Bee-Bot robot movement.

Figure 3. A mat for Bee-Bots.

Workshop 3. In the third workshop, the pre-service teachers carried out a micro-teaching. The purpose was to engage participants to work together and to promote collaborative learning between pre-service teachers who have similar levels of conceptual understanding (Fernandez, Wegerif, Mercer, & Drummond, 2001). During the preparation of the learning activities and the micro-teaching, participants were encouraged to discuss with each other, to exchange ideas and to learn collaboratively. The design of the learning activities was evaluated by the researcher to serve as evidence to reflect on the effectiveness of the training program.

Results

In the micro-teaching, the participants designed a 3x3 square mat for the Bee-Bot with scenarios related to children's life experience (Figure 4), and they also designed a card, "Timetable of Little Bee," to facilitate the learning activities (Figure 5). In the design, the early childhood educator would first declare the day of week in the scenario and request a child to evaluate the statement like "If it is Tuesday, the little bee should go to the hospital and the market." The child would consider whether the day in the scenario is Tuesday. If it is Tuesday, the child should instruct the little bee to move to both locations consecutively. If it is not Tuesday, no action is required. If the child successfully completes the task, it suggests that the child understands the logical concept and is able to construct a series of instructions for developing fundamental coding skill.

Football Court	Library	Garden
Post Office	Bakery	Police Station
School	Supermarket	Hospital

Figure 4. A mat for Bee-Bot' movement designed by the participants.

Timetable of Little Bee							
Day	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
Place	Library	Hospital	School	Garden	Post Office	Football Court	Garden
	OR	**AND**	**AND**	**OR**	**AND**	**OR**	**AND**
Place	School	Supermarket	Football Court	Supermarket	Library	Police Station	Bakery

Figure 5. A card to facilitate the learning of coding education

As reflected in the learning package, the participants demonstrated their ability to design learning activities based on what they learned in the workshops. The design of the learning activities that required children to actively manipulate the Bee-Bot for learning aligned with the learning theory of active engagement suggested by Dewey (1938) and Piaget (1947/1960). The activities focused on the learning of logical concepts and the development of a sequential program. The design included a clear learning and teaching process. The participants made adjustments to the size of the mat from 4x4 (Figure 3) to 3x3 (Figure 4). They opined that a mat of smaller size could reduce the difficulties of composing instructions and that was more suitable to the cognitive development of children.

Conclusion

Coding skill has been emphasized in recent years in the STEM initiative. Preliminary results in this study suggests that pre-service early childhood teachers were able to master fundamental coding skill and they were able to design coding education activities for children after receiving some training. However, since a small number of pre-service teachers participated in this study, another study in a larger scale may be required. Nevertheless, this study highlighted the need to consider appropriate learning contents for kids and an urgent need to provide teacher training on coding education.

Moreover, the researcher suggested that the learning of logical concepts and a sequential program are appropriate for young children. This study also contributed to the field by providing an elaboration of an approach to implement teacher training in an early childhood education programme for future reference.

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EXPLORING STUDENT ENGAGEMENT IN PROGRAMMING SESSIONS USING A SIMULATOR

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Abstract

The classification of programming as an art brings the importance of creativity as a requirement to become an effective programmer. However, the learning and teaching of programming subjects have been widely perceived to be difficult. Subsequently, students tend to be less engaged in programming classes, which in-turn results in significant dropout rates for programming related courses. This research investigates the use of a simulator for learning and teaching of programming topics with a specific focus on the embodiment of student engagement and disciplinary pedagogies.

Keywords: student engagement, programming, simulator, learning

Introduction

Programming is often classified as art rather than science based on its unique nature of contents and learning procedures. Teaching programming to university students reflects a high level of skill orientation where students are required to possess strong intuition on how things should work. Also, the learning of this subject requires a significant correlation between meaningful learning and student engagement. These requirements have also been mentioned by other researchers, such as Kujansuu and Tapio (2004), who have advocated that meaningful learning is ensured to effectively gain programming related knowledge and skills. Meaningful learning is in fact a catalyst for student engagement and quality education (Willingham, Pollack, & Lewis, 2002). However, the perspectives of student engagement, and, also, non-engagement issues, in the programming field has neither been extensively discussed nor publicised.

In this paper, we explore the extent of student engagement in learning and teaching of programming topics, particularly using a simulator. We chose a UK University's programming oriented module as our target context and investigated student perceptions and reflections on its educational procedures.

Student Engagement: Considerations and Challenges

The term *student engagement* gains varied meanings and contains multiple components in educational research (Lawson & Lawson, 2013). Whereas, in broader dimension, it covers student retention at educational institutions, a more focused discussion indicates student participation and performance in learning activities in specific classes (Darling-Hammond, 2010; Eccles & Wang, 2012). However, in all these cases, student engagement addresses one of the key educational goals which is the transmission of knowledge and skills through learners' time, uptake, resources and involvement (Krause, 2005).

The importance of student engagement in learning is indisputable (Trowler & Trowler, 2010). Students only learn when they are involved (Astin, 1985). In a formal educational setting the engagement of students may indicate the overall quality of learning and teaching (Kuh, 2009). Particularly, in a higher education context, this may directly refer to students' achievements and competences (Kahu, 2013). Additionally, student engagement contributes to their persistence and satisfaction in the process (Pascarella & Terenzini, 2005).

Student engagement is multi-layered, and there are different angles of vision to look into it (Fredricks, Blumenfeld, Friedel, & Paris, 2005). One of the approaches is to see it through students' internal conditions, such as behavioural, affective and cognitive phenomena (Appleton, Christenson, & Furlong, 2008). Conversely, the external or ecological factors, such as learning culture and the influence of peers, family and society can be considered to realise their engagement in learning (Lawson & Lawson, 2013).

Nature of Engagement in *Meaningful Learning*

The key objective of student engagement in a classroom environment is to gain knowledge by following teachers' delivery, answering questions and solving problems through the exploration of subject matters (Mayer, 2002). In many cases, this happens via *rote learning*, which is limited to remembering the instruction or information provided in classrooms. Conversely, *meaningful learning* involves cognitive processes, such as critical thinking, active discussion and problem solving (Mayer, 2002). In this process students get opportunities to plan, reflect and share knowledge.

In a classroom situation, student engagement is a dynamic process that happens through personal acts of attention or motivation of students and their interaction with teachers and peers, which are commonly termed as *social-cultural acts* (Lawson & Lawson, 2013). More precisely, there may be three major dimensions of the engagement for meaningful learning in a classroom, namely behavioural, emotional and cognitive ones. These dimensions and relevant factors, elaborately explained by Fredricks and McColskey (2012), are briefly mentioned below.

First, behavioural engagement refers to students' attention to class activities and attempt to participate in those. These can also be negative when students pretend to be attentive, or they come in a class without preparation, resulting in failing to achieve meaningful learning. Second, students' self-belief, personal motivation and peer support for learning indicate their emotional engagement in a classroom learning environment. The relationship of students with teachers and peers are two important indicators that can help measure this kind of emotional or affective engagement. Students' cognitive engagement, the third dimension, includes their planning or strategies for learning, self-regulation and recognition of the value of engagement.

Student Engagement in Programming Sessions

Learning to become an effective programmer requires a substantial level of imagination and creative skills. While creativity is not well represented in literature, the key characteristics that promote creative skills have been interpreted to include pedagogical approaches, physical environment, relationship between teachers and learners, availability of resources, use of time and the use of other environment outside educational institutes (Davies et al., 2013). Severally, a reasonable link between students' motivation and engagement and creativity has been highlighted in literature (Craft, Chappell, & Twining, 2008). Not only has this strengthened the assumption of high level engagement as a requirement for students to acquire programming skills, it subsequently reflects the impact of engagement as a necessary condition to become an effective programmer.

However, students may be confronted with different problematic situations in a creative and imaginative programming class. An impactful characteristic might be students' behaviours, which strongly influence their problem-solving skills, reflective practice and an exchange of feedback (Perkins, Hancock, Hobbs, Martin, & Simmons, 1986). Additionally, there may be challenges related to learning styles, learning speed and motivation (Jenkins, 2002). By acknowledging these problems, we decided to gain the following baseline information about student engagement in a programming class where a simulator was used:

- Types and nature of student engagement
- Roles of teacher and students in the process

Methodology

As the issues and dimensions of student engagement are vast and complicated, for the convenience of a context-specific and target group focused investigation it is important to set some research boundaries in this study. Therefore, it was essential to choose a particular teaching/learning unit and associated factors related to student engagement. Subsequently, 32 students of Level 5 on a programming module in a UK University were included as research participants. Besides, we decided to explore only the classroom environment related to student engagement in our study.

Approaches and Tools

The study followed a mixed-method research approach. Several benefits were assumed by following this methodology, such as a greater scope of convergent validation or triangulation of research data (Fielding, 2012), possibility of gaining richer perspectives and arguments in relation to relevant theories and practices (Johnson, Onwuegbuzie & Turner, 2007), and being able to draw comprehensible conclusions (Teddlie & Tashakkori, 2009). A technology-enhanced survey and a written open-ended questionnaire were used to collect qualitative and quantitative data respectively with the students in two classes. In the class a simulator was used for the learning and teaching of Programming. A simulator is a virtual machine that imitates real-world actions and processes. In this instance, the tool imitates the steps of a 'program event', indicating the procedures to be followed in completing such processes.

Survey. We administered an 18-item survey questionnaire using technology among 32 students of a programming unit. The statements were in three areas, namely behavioural, affective/ emotional, and cognitive. A PowerPoint document was prepared where each slide contained a statement. At the end of each Web Application session, students were given clickers for voting synchronously and anonymously. The statements appeared on screen consecutively providing with sufficient time for responding.

Table 1

Survey Questionnaire Items

Behavioural	1. I actively participated in the class.
	2. I was more attentive in this class compared to other classes that did not use a simulator.
	3. There was no opportunity to work with classmates.
	4. I was able to link my learning with own experiences.
	5. This class motivates me to share my ideas with others.
	6. I asked questions about the simulator tool for clarification.
Affective/ Emotional	7. Using a simulator made the class fun.
	8. The simulator tool has motivated me to participate in the given tasks.
	9. The class did not have any clear learning goal.
	10. I feel the class is useful for my future profession.
	11. There was clarification when I had doubts.
	12. I would recommend today's session to my friends.
Cognitive	13. The session provided me with challenging tasks.
	14. I knew what I was supposed to learn.
	15. I learned things that might be useful in the practical world.
	16. The learning I have gained is valuable.
	17. I was able to link my learning with other lessons.
	18. After attending the session, I feel I now understand the concept of client server programming better.

Responses included student perceptions and self-assessment in a five-point Likert scale (Likert, 1932), and were processed using a statistical software, SPSS. Item 3 and 9 are negative statements, so reverse coding was applied.

Critical Incident Questionnaire. We also used a widely accepted five-item open ended questionnaire as a post-class learning assessment tool (Brookfield, 1995). The tool, as Brookfield explained, can collect "vivid happenings" of a class, particularly the experiences of students on critical moments of learning progression (Brookfield, 1995, p. 114). In addition, this is helpful to realise the extent of student engagement and the associated reasons, through student reflections and feedback (Hedberg, 2009). A paper-based handout with the questions below were administered among the student participants for their responses (the questions are modified from Brookfield, 1995, p. 115).

- When did you feel most engaged with what was happening?
- When did you feel most distanced from what was happening?
- What action of your teacher/classmates did you find most affirming and helpful?
- What action of your teacher/students in the class did you find most puzzling or confusing?

- What element/activity of the class surprised you the most (for example, something that someone did in the class, your own reactions, or anything else that occurs to you)?

The Critical Incident Questionnaire allowed students to reflect on personal engagement events, moments and to identify the contributing factors, such as the role of teacher and peers. As the participating students responded just after their sessions, the data have been more specific and reliable. The responses were processed and analysed by NVIVO software.

Findings

The survey and Critical Incident Questionnaire provided qualitative and quantitative data. Whereas the survey data revealed the states of targeted students' behavioural, emotional and cognitive engagement in a programming class, the Critical Incident data described similar aspects with specific examples and clarification. The data sets individually and together reveal three aspects of student engagement leading to scopes and recommendations about enhancing student engagement in similar learning context.

Survey Results

We calculated the mean scores (the *arithmetic average* as defined by Fink, 1995) of the responses of survey statements (see Table 1). The results are interpreted in four chronological categories: low (1 to 1.99), average (2 to 2.99), modest (3 to 3.99), high (4 to 5).

The findings related to the behavioural dimension of engagement show a modest engagement of the students in active participation and attention in class activities as these were fairly motivating. The students perceived that the class greatly linked to their personal experiences. However, they did not find adequate opportunities to work with classmates, or even to ask questions for clarification or further information (see Table 2).

Table 2

Mean Scores of Behavioural Engagement

		Statement 1	Statement 2	Statement 3	Statement 4	Statement 5	Statement 6
N	Valid	32	32	32	32	32	32
	Missing	0	0	0	0	0	0
Mean		3.38	3.03	2.97	4.00	3.13	2.84
Std. Deviation		1.338	1.150	1.307	1.344	1.238	1.370

Data revealed a high level of students' emotional engagement in class activities as they thought those as relevant to future professions (Table 3). Their reflections showed a modest engaging environment in terms of a pleasant, motivational, target-oriented, and comprehensible learning situation.

Table 3

Mean Scores of Emotional Engagement

		Statement 7	Statement 8	Statement 9	Statement 10	Statement 11	Statement 12
N	Valid	32	32	32	32	32	32

	Missing	0	0	0	0	0	0
Mean		3.38	3.41	3.50	4.00	3.72	3.31
Std. Deviation		1.264	1.292	1.368	1.107	1.085	1.306

As to cognitive aspects, the students mentioned a modest level of engagement in areas including value and usability of learning, connection with the contents of other topics, and clarity of learning points (see Table 4).

Table 4

Mean Scores of Cognitive Engagement

		Statement 13	Statement 14	Statement 15	Statement 16	Statement 17	Statement 18
N	Valid	32	32	32	32	32	32
	Missing	0	0	0	0	0	0
Mean		3.00	3.59	3.28	3.72	3.50	3.94
Std. Deviation		1.295	1.388	1.486	1.143	1.391	1.216

To explore the linear relationship among the behavioural, emotional and cognitive dimensions of student engagement we also conducted the Pearson Correlation Coefficient test which is the Bivariate Correlation measurement. We applied five cut-off points: < 0.1: weak, < 0.3: modest, < 0.5: moderate, < 0.8: strong, > 0.8: very strong (Muijs, 2011). The findings show a very strong relationship among these three dimensions of student engagement (see Table 5).

Table 5

Correlation among Behavioural, Emotional and Cognitive Dimensions

		Cognitive	Behavioural	Emotional
Cognitive	Pearson Correlation	1	.973**	.922**
	Sig. (2-tailed)		.000	.000
	N	32	32	32
Behavioural	Pearson Correlation	.973**	1	.927**
	Sig. (2-tailed)	.000		.000
	N	32	32	32
Emotional	Pearson Correlation	.922**	.927**	1
	Sig. (2-tailed)	.000	.000	
	N	32	32	32

** Correlation is significant at the 0.01 level (2-tailed)

Critical Incident Questionnaire Results

The critical incident questions were theme-based, so the gained data explain the following five areas of student engagement. In our description, we have used the words *a few*, *some* and *most*, which represent about one-fourth, half and three-fourth of the total research participants respectively.

Most engaging moments. There were several highly engaging moments for the students in class. First, most of the students thought that they were highly engaged when they had the opportunity to work practically, such as while creating CSS pages, coding HTML, creating a website and solving the given worksheet. Some students also found a number of teacher activities engaging, for example, while the teacher explained and demonstrated the simulator tool, and instructed the procedures of uploading their work on server.

Least engaging moments. Most of the students mentioned that the beginning of the session was the least engaging moment for them. The teacher seemed to have a pre-assumed idea that all the students knew the basics of HTML which was not correct. A very few students found themselves engaged while the teacher was lecturing, particularly while introducing a new content. There was also a delay in some points, such as while distributing the passwords and at the time of uploading the work to server. Some students faced problems as too much information was given in the beginning. A few students also felt that the physical aspects of the classroom, such as room temperature and the seating arrangement at the back made them dis-engaged to learning activities.

Most helpful activity. Several teacher and student activities helped the programming students to be actively engaged in learning processes. The most engaging teacher activities were monitoring the student work, recapping the previous sessions, checking of student responses, and offering assistance when the students requested it. Some students also found the on-screen instructions and question-answer sessions engaging. Additionally, according to some students, the individual tasks with the worksheet and the discussion with their classmates for information and clarification were engaging.

Most confusing activity. More than half of the students did not find any confusing activity, either done by the teacher or students, in the class. Some however mentioned that the linking of two files in the simulator and the complex functioning of the simulator response editor were confusing as there was lack of direction and guidelines by teachers before and during their work. Yet, it was also thought by a few students that the reason for the confusion was themselves as they came in that class without required preparation.

Most surprising event. For most of the students the demonstration of the simulator, uploading the work on server and the HTML activity were surprising. They were also surprised as the class required several learning points to be remembered from the previous year. Some students were astonished as they found the teacher doing less teaching. Some students mentioned that the class was not a revision one, although it was supposed to be like that. A few students were amazed with the voting system using clickers which we used to conduct our survey in the classes.

Key Learning

The quantitative and qualitative data provided important explanations about student engagement in the programming class using a simulator. Among varied layers of student engagement (as explained by Fredricks et al., 2005), the study explored the levels of correlation of three dimensions, namely behavioural, emotional and cognitive, and identified a strong interrelated connection. According to this finding, if the engagement elements of any dimension change, there is a possibility that the other dimensions will change proportionately. It is therefore important in a programming class with a simulator to maintain proper quality of activities that can effectively contribute to students' behavioural, emotional and cognitive engagement in a balanced manner. As meaningful learning on programming depends on student engagement (Kujansuu & Tapio, 2004; Willingham et al., 2002), the findings indicate a possible high level of meaningful learning gains by students through engagement and participation. However, this finding does not confirm a similar trend in a low engaged class because other associated environmental factors, such as learning culture and the surrounding factors, may accelerate or hinder student learning gains there (Lawson & Lawson, 2013). Besides, the number of respondents was small, so in case of an increased number, these relationships may vary, even any of the dimensions may become more or less influential in student learning.

Teachers and educational resources play an important role in engaging students in learning processes (Davies et al., 2013; Mayer, 2002). In this study, a broad set of roles for teachers and students have been revealed that can help university faculty members design and facilitate more effective programming lessons using a simulator.

Firstly, we found that the use of a simulator can help teachers link learning contents with students' personal experience resulting an improved behavioural engagement. Students expect to share and collaborate in these classes and want to ask questions for clarification. Teachers, therefore, need to transform their lessons into inquiry-based and collaborative ones. The classes will then be motivating for students which is essential for their engagement in learning activities (Craft et al., 2008; Lawson & Lawson, 2013).

Secondly, from student perspectives, simulator-driven programming lessons are highly engaging as there is a connection with relevant professions and work. The students identified the learning environment less threating and more dialogic. These features along with student reflections and inquiry are essential for higher student engagement (Perkins et al., 1986). Students also opined that they became more engaged in their class when their teachers made lesson progression plans comprehensible and target-oriented.

Thirdly, this study shows that the students are keen on understanding the usability of their learning, and, according to the findings, a simulator-based programming class can supply this. In the process, they expect to discuss relevant issues and see an association of the content with other topics and subjects. Students also get engaged when the teacher ensures clarity of learning points and justifies the need for class activities.

Conclusion

This study provides evidence that the use of a simulator in programming lessons can improve student engagement for meaningful learning. The engagement would contain varied dimensions including behavioural, emotional and cognitive aspects, which need to be addressed in lesson planning and implementation. As the dimensions are interrelated, teachers need to be careful in addressing their individual elements in a proportional manner. They should also identify the lacks in any of these dimensions of engagement and can overcome the teaching and learning related drawbacks by exploiting other dimensions following systematic approaches. However, in our study we have not investigated the quality of student learning in this particular type of lesson; thus further investigation would be needed to understand the ranges of student learning gains along with the difficulties they face in achieving those. The future work is intended to look at the most suitable way to design simulation tools for learning and teaching programming topics.

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INTRODUCING INTELLIGENT EXERCISES TO SUPPORT WEB APPLICATION PROGRAMMING STUDENTS

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Abstract

Using computer based tutoring software to assist students to learn traditional programming languages has been widely explored. With the widespread growth of the Internet, universities are teaching more web specific programming languages. Computer based tutoring systems provide limited support for such languages. This paper presents a prototype system that aims to support students in learning the web language JavaScript. The potential of this system is explored by using a mixed methods survey design completed by 40 students and 10 staff members. Results show that our system can aid students in learning to program the web-based language JavaScript.

Keywords: computer-based learning environments, intelligent tutoring systems, JavaScript, introductory programming course

Introduction

Within the computing department at Southampton Solent University, we share a widespread and yet to be solved problem: the challenge of teaching first year students to program.

While programming is a fundamental topic taught in university computing courses, most agree it is a complex skill to master. It is widely accepted that it takes an estimated ten years of experience to progress from a beginner to an expert programmer (Winslow, 1996). It is therefore imperative that the start of a student's programming journey is as smooth as possible. Evidence would suggest however this is not the case. A study by Bennedsen and Caspersen (2007) presents the finding that the worldwide pass rate for introductory courses is just 67%.

Compounding this problem is the proliferation of a variety of courses including a programming element into their syllabus. For example, around 120 students a year undertake the introductory web programming unit at Southampton Solent University. The participants are diverse, not only in initial ability, but also in their areas of study. Courses range from the more business aligned business information technology to the more technical discipline of software engineering.

The issues we encounter delivering the unit goes beyond just the pass rate and expands into the variability of the results, with some courses averaging over 70% and others below 37%. Herein lies a familiar dilemma when teaching programming to a diverse group of students (Cooper, Dann, & Pausch, 2000). A seemingly contradictory problem presents itself, how can we move at a pace such that the weaker students do not fall behind, while at the same time challenging the stronger students? Remarkably, there is a solution to this seemingly paradoxical problem proposed by (Bloom, 1984).

Over 30 years ago Bloom (1984) presented a seminal study demonstrating that providing certain conditions are met, almost all students can learn topics regardless of complexity. Firstly, what Bloom calls *mastery of learning* must be applied. Mastery of learning involves breaking subject matter down into manageable progressive chunks. Each chunk must be mastered before the next one is attempted. Secondly, each student must receive high-quality one-to-one tutoring (Bloom, 1984). In meeting these two conditions Bloom demonstrated that students could outperform those in a traditional classroom setting by 2 standard deviations. This equates, to the average student exposed to previously mentioned conditions, to outperforming 98% of students receiving traditional classroom teaching.

Such an increase in learning is indeed a tantalising proposition. However, it has been difficult to find replication studies that incorporate both tutoring and mastery of learning. Vanlehn (2011) found that although tutoring has a positive effect, Bloom's (1984) claim of 2 standard deviations might be too high. Kulik and Fletcher (2015) compared five meta analyses looking at the effects of peer tutoring in secondary and primary schools. The median effect of the improvement was 0.4 standard deviations.

Given the economic constraints faced by most higher education institutions, the cost of rolling out one-to-one support for all students is prohibitive. Bloom (1984) therefore derived the "two sigma problem." The premise is simple: Can group instructional methods be as effective as one-to-one tutoring? A more cost effective alternative is to utilise computer based technology and develop software that will provide students with enhanced feedback while at the same time still maintaining the traditional classroom setting.

In this paper, we present a proposed solution that demonstrates the implementation of portable intelligent exercises and trial them on our introductory web programming course at Southampton Solent University. We then go on to validate our system by surveying staff and students. Our initial findings are positive, suggesting that using such exercises support a diverse range of programming abilities.

Background

In order to set the scene of the problem we are trying to solve, Southampton Solent University must firstly be explored from the context of its place in the wider higher education ecosystem.

Southampton Solent University

Southampton Solent is a post-1992 UK based institution[1]. Typifying its post-1992 counterparts, the university has a strategy of widening university participation (Solent University, 2015). As such, the university has a diverse student population, with many of the students being considered *non-traditional* in terms of socio-economic and educational background (Read, Archer, & Leathwood, 2003). The widening higher education sector has presented challenges that were previously not encountered by more traditional institutions. A study by Thomas and Quinn (2006) found that non-traditional students, when compared to their traditional counterparts are often unprepared for their university experience. It is therefore not surprising that universities most successful at widening participation have some of the highest dropout rates (HESA, 2016). This problem is amplified when trying to teach complex topics such as programming, where even more traditional institutions have low pass rates (Bennedsen & Caspersen, 2007).

Computer Assisted Learning

The use of computer based instructional software to assist students in learning is not new. Computer based tutoring software can be traced back to the late 1960s (Atkinson, 1968). Vanlehn (2011) broadly categorized such systems into two groups, *computer based instruction* and *intelligent tutoring system*. Computer based instruction (CBI) aims to provide immediate feedback to students around some problem they are trying to learn. Intelligent tutoring systems (ITSs), aim in part to simulate a human by giving feedback and hints in the form of natural language (Vanlehn, 2011).

Both CBI and ITS systems generally consist of three core models (Hamed & Abu Naser, 2017).

> **Domain model.** This represents the body of knowledge that assists the students in learning.
>
> **Student Model.** This represents the actual student. It contains information that measures the student's mastery of specific topics belonging to the domain model.
>
> **Dialog Model.** This is the interface between the intelligent tutor and the student. It facilitates communication with the user of the system.

There is no agreed consensus on the increased learning effect that such systems have. A widely cited meta-analysis suggested that CBIs increases test scores 0.3 standard deviations over a standard classroom setting (Kulik & Kulik, 1991). A more recent meta-analysis by Kulik also Fletcher (2015) also recognised this to be the case.

The analysis by Kulik and Kulik (1991) had wide inclusion criteria and reviewed 245 studies. The studies covered a wide range of subjects, with participants ranging from every level of education. Kulik and Kulik stated the limitation of such large-scale meta-analysis is the time it takes to set up. When such studies are being constructed, rapid advancements in computing power and technology can occur. The consequence of the speed of such advancements means that the latest studies are often omitted from the analysis.

The latter meta-analysis by Kulik and Fletcher (2015) had a more stringent selection criteria. Studies were required to have a control group receiving conventional instruction, and CBI achievement outcomes must have been measured quantitatively. Like the earlier studies by Kulik and Kulik (1991), subject selection and age was wide ranging. Vanlehn (2011) revealed that the

ITSs are thought to outperform their CBI counterparts, producing increased test scores of 1.0 standard deviations. Vanlehn went on to note that these beliefs stem from an influential article by Anderson, Corbett, Koedinger,and Pelletier (1995) that summarised several ITS studies in a higher education setting. Studies were run with a programming, geometry and algebra ITSs over the course of a decade.

Given the generally accepted learning benefits of using such systems, their use in supporting higher education students to learn programming has been widely explored. Some examples that have shown positive feedback include a ITCs developed by Al-Bastami and Abu Naser (2017). It aims to assist university students in learning the programming language c#. A further example is JTITS, an ITCs system to assist in learning the programming language Java (Sykes & Franek, 2003). BITS is an example of a web based ITCs system (Butz, Shan Hua, & Maguire, 2004).

It must be noted that computer tutoring systems in the context of higher education are generally based on supporting traditional programming languages such as C, C#, C++ and Java. Such languages existed long before the widespread growth of the Internet. This has led to the ever-increasing popularity of web applications. At the time of writing, two web programming languages PHP and JavaScript are ranked as the 7th and 8th most popular programming languages used in industry (TIOBE, 2017). More and more universities are therefore teaching web-focused languages to beginner programmers. Surprisingly, considering the widespread use of such languages, computer based tutors to support students in a higher education setting have been lightly explored. Weragam and Reye (2013) claimed to have developed the first PHP intelligent tutoring system. However, there are no current systems to support students in learning JavaScript. We therefore deemed it necessary to investigate if such a system can be used to teach the specific web focused programming language of JavaScript.

System Architecture

When creating our system, we not only wanted to assist students in learning to program the web based programming language JavaScript, but also to encourage them to engage with the course content. We therefore decided to create an intelligent tutoring system that was not tightly coupled to the domain model (the course content).

The goal is to complement the body of information being delivered rather than replace it with an automated tutor. We shall refer to our system as smart intelligent exercises, as unlike the more traditional intelligent tutoring systems, it consists of only two modules; a domain model and dialog model.

Domain model. To create the domain model, the course content was broken down into standalone sections and subsections. The goal is to keep the students focused on a very specific concept at a time. Breaking a subject matter down is such a way is one of the cornerstones of Bloom's mastery of learning (Bloom, 1968).

The entire body of information was structured using a tool called gitbook[2]. This tool allows notes to be distributed over the Internet. Students are not required to download any specific content to access the material. Furthermore, the content is device and operating system agnostic.

Dialog model. The interface for our intelligent tutoring system (Figure 1) had to be easily embedded into a web page. It was developed to be stand alone, in that it can function with or without the domain model.

The interface was developed from scratch using the programming language JavaScript, along with a number of freely available JavaScript tools. The ace text editor[3] was utilised to provide a realistic programming environment. The reader will note when observing Figure 1, that the code used to complete the exercise is multi colored. This is known as syntax highlighting and greatly increases the readability of programming code. Another key tool was a sandbox environment[4]. Such a tool allows the compilation of code and the evaluation of that body of code; this enables the correctness of a solution to be processed.

In order to create the questions, the operator must first define a problem and then map that problem to a solution. When student complete that problem, they are provided with instant feedback. Due to time constraints and the early stage of this research, the feedback is simplistic, indicating if the question is correctly answered and if any programmatic errors exist. Once the questions are created, they can simply be embedded into any web based content. See Figure 2.

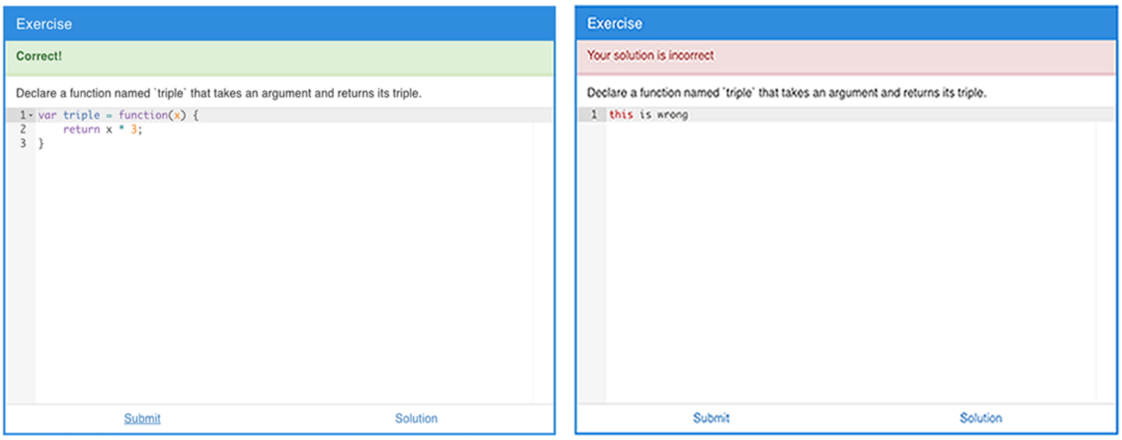

Figure 1. Example of a how the exercises appear to students.

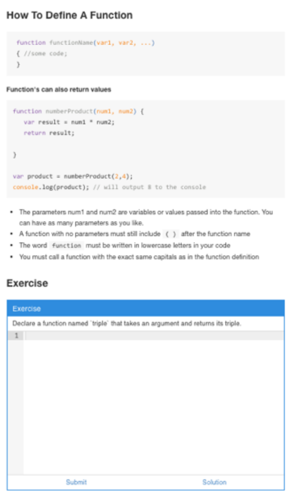

Figure 2. An example of a smart exercise embedded into the notes.

Evaluation

To validate the potential of our smart exercises, a study was conducted at Southampton Solent University during the academic year of 2016-2017. The study was delivered to first-year undergraduate students undertaking an introductory web-programming course. A total of 40 participants opted to take part in our evaluation survey.

Over a 4-week period smart exercises were embedded into subsections of the notes. Each subsection of the notes contained the necessary information to complete its corresponding embedded exercise (Figure 2).

The exercises were used in the weekly 2-hour practical sessions. At the start of the session the tutor would instruct the student to complete the smart exercises and demonstrate their solutions. They were required to complete these exercises before getting on with a main larger task. The hope was to in effect force the students to re-engage with the course content.

At the end of the 4-week evaluation, an ethically approved survey was distributed. The aim of the survey was twofold: firstly, to determine if students found intelligent exercises useful and secondly to tie this sentiment to their programming ability. We also distributed the survey to staff members who had experiences of delivering technical topics. Staff were asked to fill the survey out from the perspective of a novice programming student.

The survey questions were split into three sections. The first section was designed in order to determine how strong students are at programming. It consisted of six questions whereby students were required to rate how well they understood various fundamental programming concepts. Respondents were required to rank their understanding on a 5 point Likert scale, of 1 no understanding to 5 total understanding. Questions for this were based on a similar survey by Lahtinen, Ala-Mutka, & Järvinen (2005), which in part measures student's understanding of various programming techniques. Questions for the second and third sections were specific to our system and therefore developed by the authors.

The second section was developed to measure if the exercises were well received. Respondents were required to answer three questions. Questions were about the usefulness of the intelligent exercises. A 5-point scale was again used, with 1 meaning total disagreement to 5 meaning total agreement. The third section was a single open-ended question, asking for any further opinions. This allowed us to combine qualitative and quantitative feedback into a mixed methods single survey.

Results

The survey was distributed via email to 120 students: 40 students and 10 staff members completed it. The mean answers were calculated and are presented in Table 1..

Table 1

Mean Survey Results

Question	Student (40)	Staff (10)
CURRENT UNDERSTANDING OF PROGRAMMING		
(1 no understanding to 5 total understanding)		
1) Loop structures such as for and while loops	3.55	2.25
3) Understanding how to structure a program	3.55	2.28
4) Using variables and their scope	3.44	2.4
5) Designing a program in order to solve a given task	3.47	3.12
6) Designing and using functions	3.55	2.22
USING EMBEDDED EXERCISES TO SUPPORT YOUR LEARNING		
(1 strongly disagree to 5 strongly agree)		
7) Do you feel using embedded exercises could make JavaScript easier to understand?	4.00	4.50
8) Do you feel embedded exercises enhance the notes?	4.13	4.52
9) Do you feel using these exercise would make the learning process more enjoyable?	4.28	5.00

In Table 2, two sub student groups are identified: those that feel they understand the fundamental programming concepts and those that do not. We assumed students who scored 3 or above for each of the programming understanding questions feel confident in all the core programming topics. Those scoring below 3 on each of the programming understanding questions, we categorised as not confident. This process yielded a group of 24 confident programmers and 10 not confident programmers.

Table 2

Confident vs. Not Confident Programmers

Question	Confident (24)	Not Confident (10)
USING EMBEDDED EXERCISES TO SUPPORT YOUR LEARNING		
(1 strongly disagree to 5 strongly agree)		
7) Do you feel using embedded exercises could make JavaScript easier to understand?	4.16	4.2
8) Do you feel embedded exercises enhance the notes?	4.33	4.2
9) Do you feel using these exercise would make the learning process more enjoyable?	4.04	5.00

Discussion

Students overwhelmingly felt they had a stronger grasp of programming than the academic staff felt they had. Students consistently rated their actual understanding higher than that of the perception of the students.

The feedback both from the lecturers and students was positive. There was a slight weighting with regards to lecturers thinking that students would find the system slightly more useful than they actually did. Interestingly, when we split the students into groups that understood and did not understand the fundamental programming concepts, there was little difference in terms of sentiment. This promising result, suggests that our exercises can support programmers of all abilities. In fact, students who felt they were strong at programming thought they would get slightly more use out of the exercises than their not so confident counterparts. The only question where weaker students rated higher was question 9, which assesses whether using such a system is more enjoyable. One potential inference from this result is that perhaps weaker students want a more enjoyable learning experience whereas the stronger ones want greater challenges.

Out of the 40 student responses, 15 responded to the open question. Again the general feedback was very positive with comments such as:

> "This is definitely something I would use."
> "Makes learning to program much easier."
> "It's similar to codecademy which I like and find very useful."

With regards to academics, a similar sentiment to that of the students was shared with comments such as:

> "This will encourage students to engage with content."

Conclusion

We began this paper by presenting the widespread problem of students struggling to learn to program. We then proposed that the solution came in the form of the "two sigma problem" (Bloom, 1984), which presents us with the challenge of creating group instructional methods as effective as one-to-one tutoring.

In our search for a solution, we explored several computer based tutoring tools. We identified that such tools had limited support for web programming languages. Subsequently, smart exercises that could be embedded into the content were developed to assist students in learning to program in the web based JavaScript language.

Students used these exercises over a 4-week period. The feedback was overwhelmingly positive, and we therefore consider these exercises to have potential in the wider context of our web-programming course.

Limitations

Our survey was distributed to 120 student participants, however only 40 responded. Due to this sample not being a randomised, selection bias is a potential issue and must be taken into consideration. To gather qualitative data, students were required to respond to optional open-ended questions. Responses in this case were 15 students, this allowed for only limited inferences due to lack of responses.

Future Work

As future work we plan to implement two further modules into our system. The first is a student module that can map students' learning paths and make recommendations based on their ability and performance. The further additional module will be an analytics module that will measure student engagement with the system. Such data will allow continual feedback to academic staff on how the cohort of students are performing. Following the implementation of these modules, long-term research addressing previous limitations could be run on the effectiveness of our system. The analytics module would allow us to come up with a measurement of student engagement, which could further enhance our research methodology.

Notes

1. The Conservative Party first issued university charters to a number of former polytechnics and higher education institutions in1992.
2. www.gitbook.com
3. ww.ace.c9.io
4. https://github.com/gf3/sandbox

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GAMIFICATION FOR ASSESSMENT OF OBJECT ORIENTED PROGRAMMING

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Abstract

There has been a focus in the ICT industry on the education of programming during the last decade, given that a lot of students who have taken programming courses at the third level, could not meet the industry requirements in related fields, due to lack of engagement or motivation. Java programming language, in an online setting, requires the provision of special gamification components, in order to lead to a better quality of teaching and learning. The aim of the project was to gamify, test and evaluate a specific course on Introduction to Java within GeNIE, a portal for gamification of higher education.

Introduction

Gamification, which means using game elements in non-game environments, was studied a lot in recent years and was used in a lot of fields, such as education, marketing, and business (Burke & Hiltbrand, 2011). In recent years, educators began to investigate the effects of different gamification elements within the context of education (de Sousa Borges, Durelli, Reis, & Isotani, 2014). There has been a considerable debate regarding the actual effects of gamification on the intrinsic motivation of students towards learning, and much research has been conducted to discover the results of *gamifying* in any specific course curriculum (von Ahn & Dabbish, 2008). Each research study has in turn revealed another impediment, whereas multiple review studies revealed significant problems with some of the methods of most studies in the research area now known as *the gamification of education* (Lee & Hammer, 2011). This project's aim is to implement and gamify a course online for teaching the object oriented programming language Java, using a portal for gamification in higher education (Çubukçu, Goodman, & Mangina, 2016).

First, the project focused on the review of gamification concepts, especially for online education and programming, the recommendation system and the GeNIE oriented framework. Second, the Introduction to Java module for undergraduate students was embedded within GeNIE, and software components for the implementation of the gamification functionality towards the learning task of Introduction to Java were designed and developed. Third, this project built a recommendation system to filter information according to student's profile and peer learners. Also, justification and evaluation of the game elements and the game design techniques applied were executed. The project also processed the software evaluation regarding the software components and the user's interactions for students within the third level institution.

Gamification for Programming Education and Online Teaching Environment

For university education, especially for teaching a computer science course, engagement seems to be of high importance, and gamification is likely to be a way to deal with this issue (Wood & Reiners, 2012). Gamification could let the system be "more fun and engaging" (Zichermann, 2011). Shahdatunnaim, Noorminshah, and Norasnita (2015) did a literature review on gamification in online collaborative learning for programming courses, where they analysed the challenges for programming students, discussed the elements for students' participation in the OLC (Online Collaborative Learning) environment and game elements for facilitating it, and then presented the methods on gamification in OLC. The authors claimed "Gamifying learning activities for programming language subjects is an effective solution to solve the programming challenges faced by first-year computer science students." pg. 18091, (Shahdatunnaim et al., 2015). Knutas, Ikonen, Nikula, and Porras (2014) presented a case study on "Increasing Collaborative Communications in a Programming Course with Gamification" utilizing a gamified communication system to motivate and improve the communication among students. The study was very successful, and they found that collaboration was increased and students' response time was decreased, while the course communication was made 88% more efficient. Gamification is also helpful in terms of lectures. In Sazkia, Gumilang, and Hasibuan, (2015) the authors claimed that the lecturer could also benefit from the platform by monitoring the progress of students, seeing missions, levels and badges for students. Dubois and Tamburrelli (2013) proposed a method for understanding the gamification about software developing in different cases. They found that for their software engineering courses in Politecnico di Milano, gamification worked well, and the work of students using the gamification approach was of higher quality than that of those without it.

Olsson, Mozelius, and Collin (2015) have identified in an online education environment some specific problems, such as the boredom and loneliness. The authors claimed that learner control and motivation seems to be the key for the success of online education, and gamification is a method to improve the motivation of study. But gamification could not work well for every subject, since students have various learning styles, and some extra specific methods could be used to deal with special problems. Besides, the content of the gamification needs to be set carefully and be nearly, even totally impossible, to use the system just for fun. The designer should manage to avoid a situation where, although gamification seems to have larger effects on them, students' attention is more easily turned away from gamified content (Erenli, 2013).

Recommender Systems for Online Education

Recommendation systems provide users with personalised information and recommendations among a lot of items or services. These can be divided into three categories: content-based, collaborative, and hybrid recommendation approaches (Adomavicious & Tuzhilin, 2005). The content-based system uses the information of the items or users to make recommendations. Differently, the collaborative technique does not use any detailed information about the items. Instead, it uses the similarity between users or items to make the recommendation. The recommendation system has been used in a lot of contexts, including education. Zaïane (2003) made a recommendation system in the online education environment to make recommendations depending on the history of students' activity. The system could then navigate students to experience a better learning path and make the continuous assessment more convenient. This study presents the potential of a certain method of using the recommendation system in the e-learning environment.

The recommendation system might also be used in education with gamification. For example, Gondova, Labaj, and Bielikova (2016), presented a method of navigation in a gamified education system that used two recommenders. They chose questions for students from simpler to more complex and questions that made the students navigate between different spaces, which included a set of items. They did an evaluation in a software engineering course that showed the activity of students grew by a considerable level with the inclusion of the recommendation system.

GeNIE

There are many gamification platforms that help learn to program, from those for beginners such as Codecademy with badges and achievements or FightCode for JavaScript, to those for advanced learners, like Checkio, which encourage people to share their problems and deal with them together. There are various forms of gamification. For example, CodeSchool combines video content, coding in the browser and gamification altogether, while TreeHouse includes quizzes, and CodinGame uses actual games to help in the learning process. There are also some platforms for learning Java, such as the Code Hunt, which improve the programming skills of users through a game (Thom, 2016).

The platform this project uses is GeNIE: a portal for gamification of higher education (Çubukçu et al., 2016). GeNIE is an enterprise level web portal for gamification of higher education developed for providing computerised assistance to enable instructors to implement gamification for their classes easily. This is for dealing with the shortage of the software assistance in terms of gamification for some advanced education courses. GeNIE has User Pages including Login, Register, Password Recovery Page, Profile Page, and Setting Page. Game Elements are controlled by the gamification management page, which also controls gamification settings. GeNIE uses Java, Spring, Apache Software Foundation, PrimeFaces and JSF, Hibernate and MySQL. It uses Model-view-Controller (MVC) model as the architectural pattern.

Gamifying Java

There are two recommenders in this project. One of them is for selecting MCQs for students. After a test starts, the MCQBean judges whether it is a test page or test result page. Then, if it is a test page, the recommender would select the questions at a certain difficulty level that belong to the selected topic. The students who take the MCQ test records decide the difficulty level. If the latest record of the student who is doing the test shows a correct ratio no less than the *Difficulty Border Percentage* for that topic, the higher difficulty level than that for the record would be used. The order of the difficulty level is from the lowest one, *easy*, to *medium*, then to the highest level, *hard*. On the opposite, a lower difficulty level would be used if the record shows a correct ratio lower than the *Degrade Border Percentage* for the selected topic. A student without any record for that topic would be shown the questions in the *easy* level. Ten questions would be shown for each test. If the number of questions for a certain difficulty level were not enough, questions in a relatively lower level in other levels would be selected.

The second recommender developed is for the topics. A hidden button named "*Test past, Try Other Topics*" would appear in the test result page when a student passes an MCQ test with a correct ratio higher than the *Difficulty Border percentage*. By clicking this button, the student could see all other topics in this course and set to be Used ordered by the recommendation level in descending order. The most recommended topic is on the top of the new window and separated from other topics. They are ranked by the overall correct ratio for each topic. The overall correct ratio is calculated depending on all the students who have tested for that topic and would be updated on each test. By clicking a recommended topic, the student would be led to a new test page for that topic as shown in Figure 1.

Points, leader boards, badges, and achievements are used in this project. First, the gamification part was further developed, and three different types of achievements are developed and become possible to be added by an instructor. The mechanisms for judging and recording their progress and rewarding them are also further developed in this project. The leader board only shows the top 10 students, and the username is set to be displayed on the leader board. Four different badges are used in this project for different stages of study process. The one for new learners is called *Start*, while the one for the students in the medium of the study process is named *GoodWork*. A badge called is relatively harder to get and getting the *Unbelievable* badge would still be a challenge for those who have completed the learning of that course. Each badge has a title, image, and description of itself.

Achievements are also divided for different stages of the study. This is because earning rewards early and continuously would let the "game" be more attractive and motivate students more. Their engagement is expected to increase because of this. The premise is giving rewards even in an early stage would not only encourage students who are easy to be or already motivated, but also let those who are harder to be motivated feel they are engaged and motivate them. Otherwise, these students with lower motivation would not feel so much difference by having this gamified course.

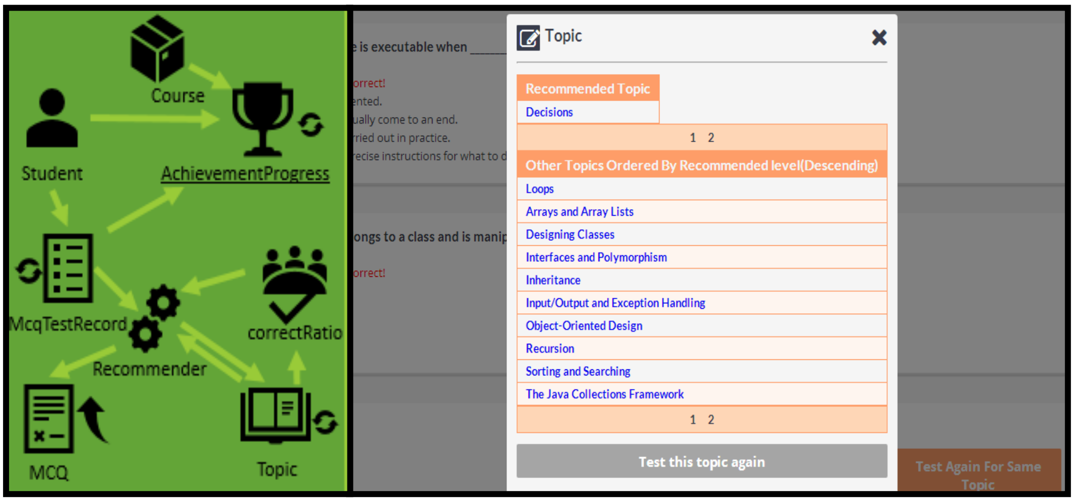

Figure 1. Flow for MCQ testing and the recommendation for topics' page.

The achievements for a starter are the *AnswerStart* for students who answered MCQs for at least 1 topic with the rewards of 10 points and 1 score, and *CorrectStart* for students who answered MCQs with at least a 40 percent correct ratio for at least 1 topic, with the rewards of 15 points, 2 scores, and the *Start* badge. The achievements for the next learning stage are *Answer* (answering MCQs for at least 10 different topics in this course), *Pass* (answering MCQs with at least 60% correct ratio for at least 2 topics in the hard level), and *Correct* (answer MCQs with at least 80% correct ratio for 3 topics in any level). The rewards for the *Answer* are 150 points and 5 scores, while the rewards for each of the other two achievements are 50 points, 10 scores, and a *GoodWork* badge. The achievements for next learning stage are *Master* (answering MCQs with at least 80% correct ratio for at least two topics in the hard level), and *Precise* (answer MCQs with at least 90% correct ratio for 8 topics in any level). The rewards for each of them are 150 points, 15 scores, and an *Expert* badge. The achievements for the next stage are the most difficult to get and are only set to be a challenge leading the students to continue to study to some degree. They are *Legendary* (answering MCQs with at least 90% correct ratio for at least 13 topics in the hard level), and *Perfect* (answer MCQs with at least 90% correct ratio for 13 topics in any level). The rewards for the *Legendary* are 250 points, 25 scores, and an *Unbelievabl*e badge while the rewards for *Perfect* are 200 points, 20 scores, and an *Unbelievable* badge. For the students, they could change the preference to enable or disable each gamification element in the course detail page. In the evaluation, all of these four game elements are enabled. The leader board, grades, badges and achievements are shown to students in the course detail page. The ranking of top 10 students is shown with their points. For the badges, all badges are shown with name and description of them, while only those badges received by the student would show the image. For the achievements, the name, image, description, rewards for each of them would be shown in this page. The image of an achievement would be filled with colour (black) after that achievement is completed. What is important is that the progress bar of the student is also shown for each achievement, so that students know what they have done and what is needed to be done to complete each achievement. When a student submits the answers for a MCQ test, McqBean would call the method in the GamificationService to record the process of achievements. The criteria and process for achievements are judged during this process, and DAO (Data Access Object) classes are used for coordinating with the database. The different gamification elements are shown in Figure 2.

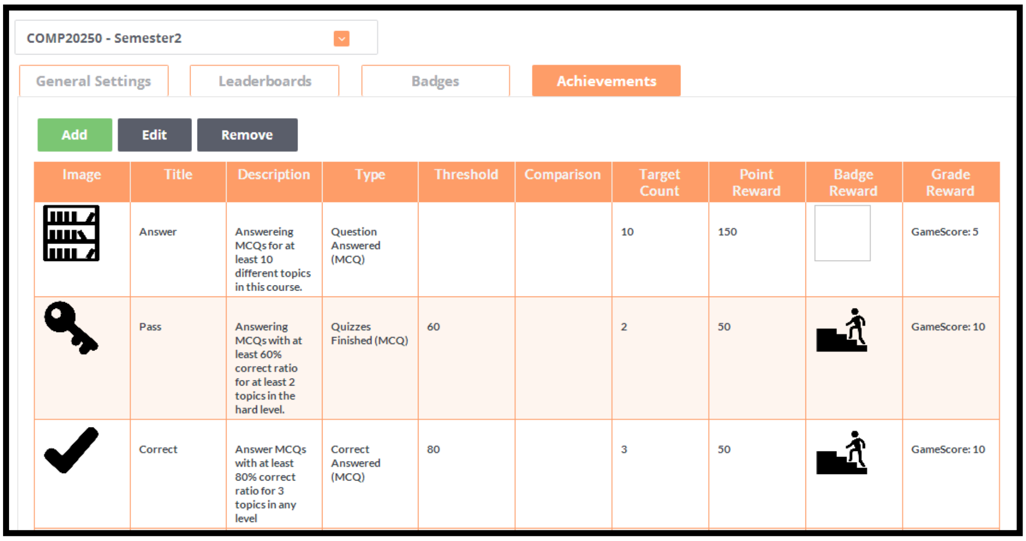

Figure 2. Gamification elements.

Evaluation

The evaluation is among the students in a School of Computer Science in higher level education. Since most of them have completed the module on Introduction to Java, their feedback tends to be relatively more reliable. Students in the evaluation had an experience of GeNIE in terms of the embedded course module on Introduction to Java and used the MCQ system. Then, their feedback was collected through a survey created using Google forms. There are eight multiple-choice questions in this survey asking the opinion of the students towards GeNIE. The evaluation lasted 20 days, and till the end of the evaluation, 27 responses were collected.

Table 1

Average Value and Standard Deviation for Questions 1-8

Questions 1-8	Average	Standard Deviation
1. Does the system help you understand the concepts that are being taught better?	4.185185	0.721985
2. Can you relate the activities to the subject matter?	4.185185	0.862255
3. Would you put in more time and effort to achieve a Badge?	4.185185	0.721985
4. Would you put in more effort and time to see your name on the Leaderboards?	4.555556	0.566558
5. Do you want other users to be able to see your progress?	3.518519	1.10119

6.	Would you put in more effort and time to unlock an achievement?	4.074074	0.899627
7.	Does the points system have any effect on your usage behaviour?	4.111111	0.955814
8.	What is your opinion about using achievements as overall progression indicator?	4.037037	0.744435

From the results of the evaluation, the project seems successful since most students in the evaluation gave positive feedback. The standard deviation is less than 1 for all questions except for question 5, which means for all question except for question 5, students have similar ideas. Question 5 is about showing the progress to other students, which is not accepted by some students. But generally, the responses for other questions about the improvement of motivation, engagement, and knowledge learning showed relatively positive results.

Understanding. Responses indicated that most students understand related course knowledge better. Nearly 90% of the students said this system helped them to understand the concepts that are being taught better, while 33.3% strongly agreed with this idea. Most of them also claim that they can relate the activities to the subject matters as Figure 3 indicates.

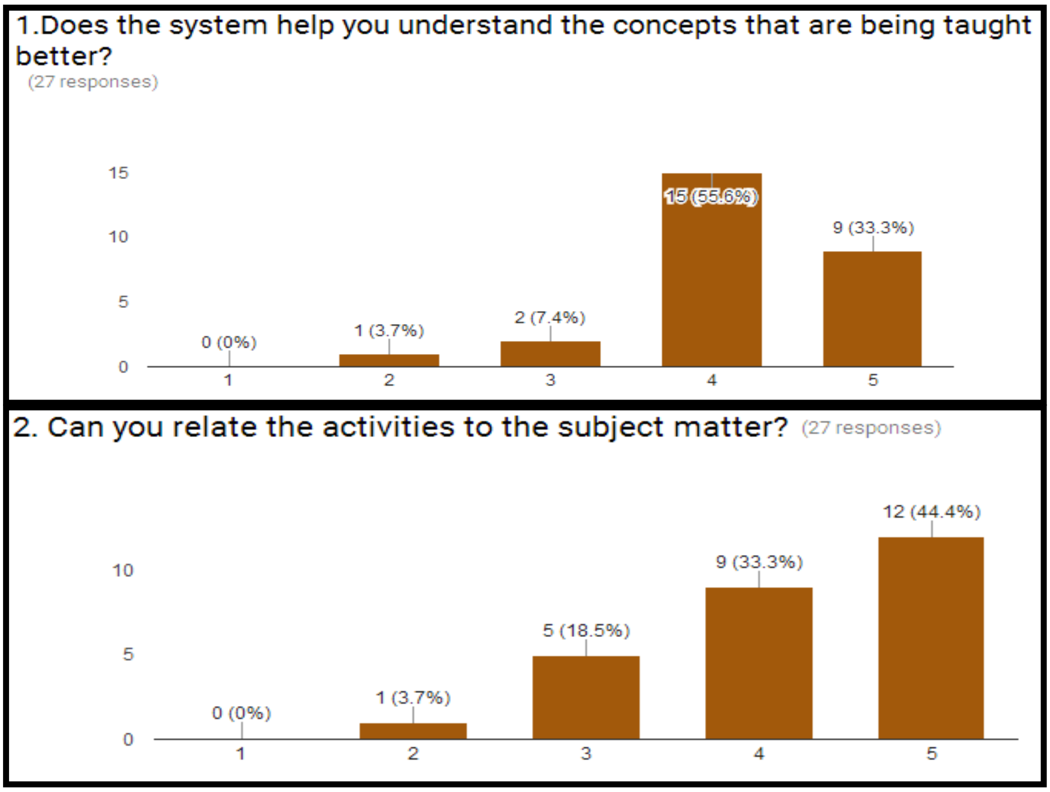

Figure 3. Responses for the evaluation from students - Questions 1 & 2.

Extrinsic Motivation. The data shows that most students are motivated by the badges and leaderboard elements. But nearly half (44.4%) of the students are not so willing to show their progress to other students, where 25.9% of the students explicitly claimed the disagreement for it as we can see in Figure 4.

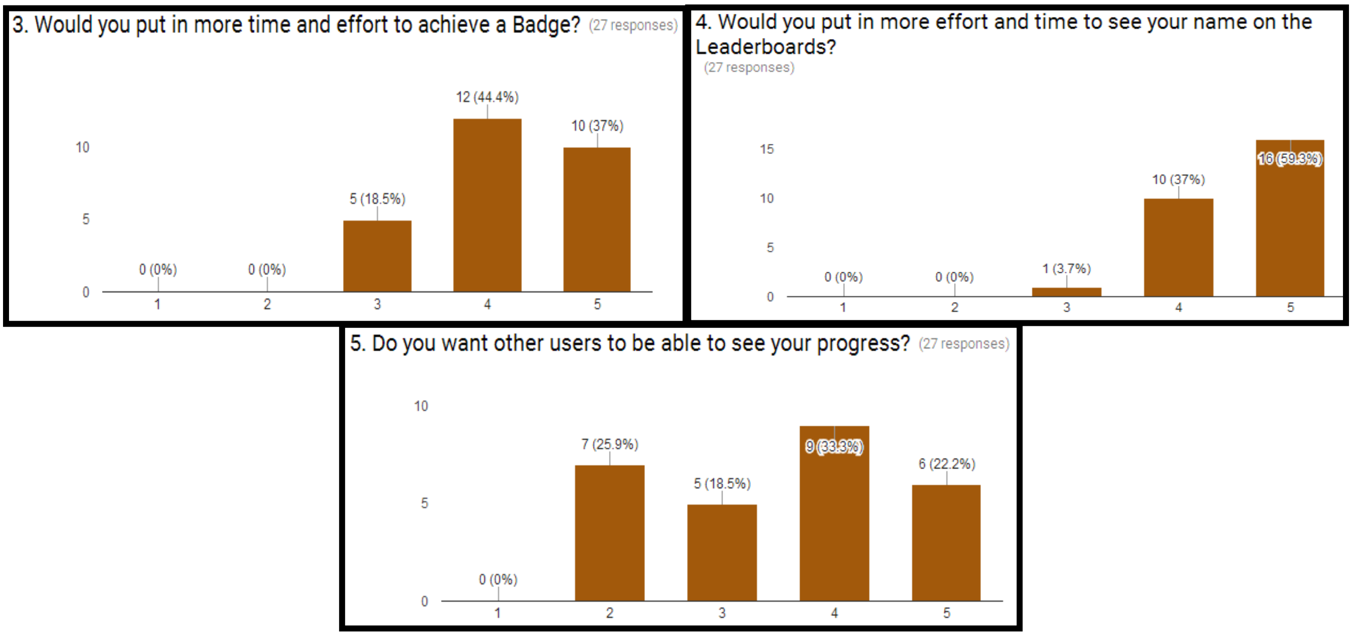

Figure 4. Responses for the evaluation from students - Questions 3,4,5

Intrinsic Motivation. Based on the responses, most students are motivated to get achievements and think it is a good idea to use them as overall progression indicator (see Figure 5).

Behaviour Change. Many people strongly agreed that they would continue to use this system because they want badges or achievements as Figure 5 indicates

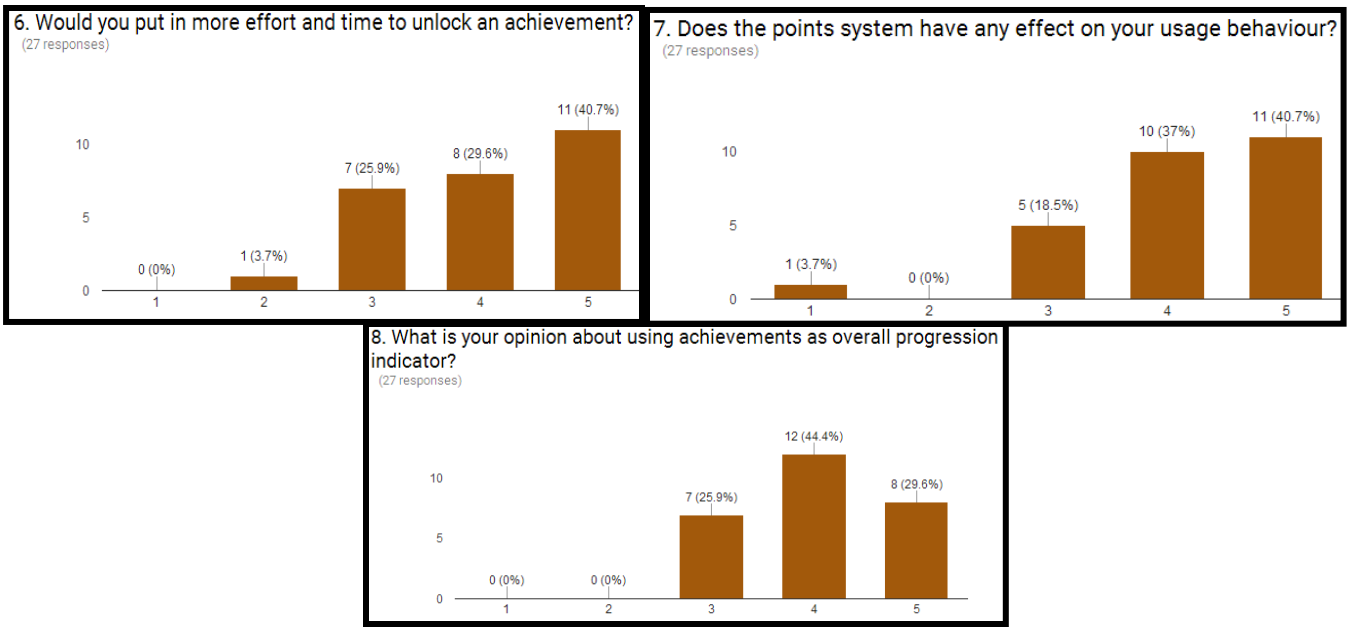

Figure 5. Responses for the evaluation from students - Questions 6,7,8

Reasons to use the system. Question 9 asks students why they would continue to use the system in this project and each of the seven reasons mentioned in the question has a similar average value of the extent of agreement. However, learning something useful and higher rank on the leader board have slightly higher value, as shown in Figure 6.

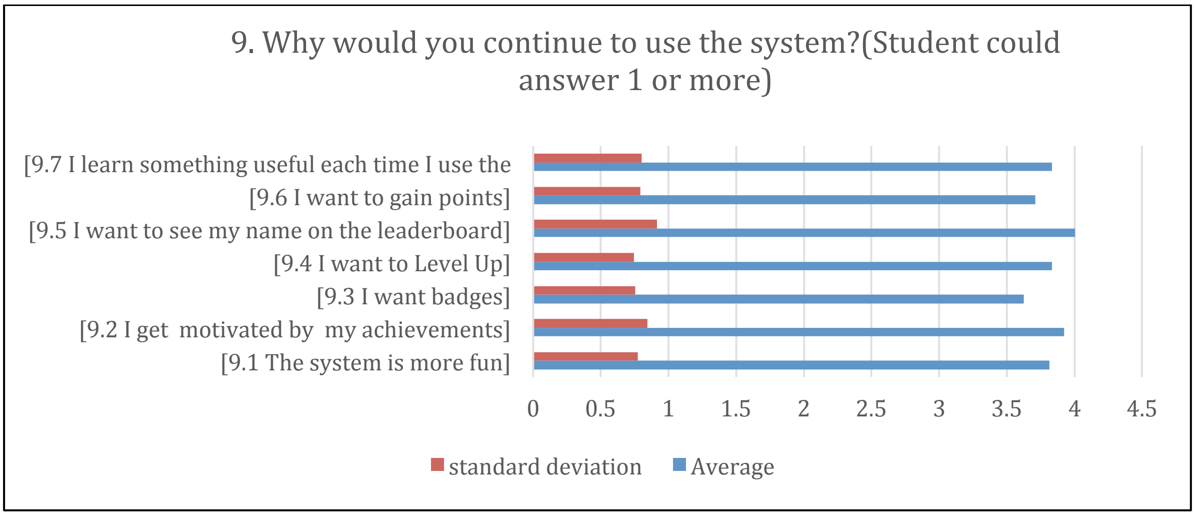

Figure 6. Responses for the evaluation from students - Question 9.

Conclusions and Future Work

This project embedded an Introduction to JAVA course in GeNIE and developed a MCQ system, recommender system and related game elements within an online tutoring mechanism. Object-oriented testing was used and showed the system works well regarding usability and the performance, with the small response time that could be ignored by the users, except for seeing the result of MCQ tests or uploading/downloading files.

An evaluation was done among the students, who are in a related major and tend to have completed the learning for that course. Responses showed that this system works for improving the motivation and engagement of the students. Nearly 90% of the students claimed they understand the knowledge that is taught better because of this system. In conclusion, GeNIE could be used in the Introduction to JAVA course and tends to work well for improving the motivation, engagement and the understanding of knowledge for the students. But 12 (44.4%) students said they did not support showing their progress to other students, while 7 of them showed obvious disagreement. So, in the future, the gamification should also be possible to be set for each student to be only visible to the user himself/herself and the instructor.

Besides enabling the setting to not show the progress for each student to other students, there are some other further developments in progress. The MCQs for the course need to be uploaded by the instructor now, although it is both possible to add questions in the MCQ management page and upload multiple questions from RTF files. In the future, it should be possible for students to add MCQs. If a question uploaded by students were set to be valid by the instructor or those students with a special badge, this question would be used for the tests. This type of special badge could be allocated or removed both automatically and by the instructor.

If GeNIE is used in multiple colleges, the content of the MCQs should be also distributed and shared. The questions could be filtered and selected by the first recommender, which is only a simple content-based recommender system for now. It would be changed to be a complex adaptive recommender when the number of questions increases to a large number. The similarity of students' behaviour would also be considered in that system. If the number of questions is still not enough, technologies for finding questions from the Internet could be added.

For showing the badges or achievements in the future, those special images would be shown following the name of the students in GeNIE on the leader board and other places where the students' name could be shown. Besides, these images should be possible to be simply shown in some popular social networks, like Facebook or Twitter. A picture could be shown after the username or automatically shown on the corner of the profile photo. This, of course, would involve sharing content of the user profiles with social networks' databases. More achievements would be set for the progress of the students, which tends to motivate all students to a larger degree, especially those who lack motivation.

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A FLIPPED GAMIFIED CLASSROOM

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Abstract

The flipped classroom is a learner-centred pedagogy in which out-of-class activities focus on delivering instruction and in-class activities are repurposed towards problem-based enquiry and group learning. This paper explores the design of one such classroom. The study draws on the results of a survey investigating the perceptions of students and tutors towards the flipped approach and details the findings of a focus group and a flipped gamified classroom for a postgraduate computing course module. The findings suggest that participants favour a flipped and gamified approach where learners are rewarded for progression and have opportunities to collaborate with others.

Keywords: flipped classroom, learner-centred pedagogy, gamification, engagement

Background

Recent years have seen a rapid trend towards learner-centred pedagogy. This has in part been driven by technological advances in educational research, but global trends have also been propelling educational reforms. Present reforms are focused on developing problem-solvers and lifelong self-directed learners to meet the challenges of the modern society. Educators have therefore been turning to learner-centred models to address these challenges.

The flipped classroom is a learner-centred pedagogical approach that reverses the traditional roles of in-class instruction and out of class activities. The approach uses video lectures to deliver instruction outside of the class whilst class time is repurposed towards group learning and problem solving. This means that students encounter instructional content before the class, which in turn frees up class time to be utilised for other deeper learning activities. The theoretical basis for the flipped classroom can be found in the learner-centred and social learning theories of Piaget (1967), Bandura (1977) and Vygotsky (1978). There are a growing number of studies investigating the flipped classroom approach although most of these have focused on student perceptions rather than performance, and so little evidence exists on the impact of flipped classrooms on student performance (Goodwin & Miller 2013). Nevertheless, recent studies have found that students generally perceive the flipped classroom approach positively, and that there are differences in student empowerment (Yujing, 2015) and achievement (Osman, Jamaludin, & Mokhtar, 2014) between a traditional class and a flipped classroom.

The Study

The purpose of the study was to investigate the attitudes of students and teachers towards a flipped gamified classroom. The study attempted to address three research questions:

1. What are the perceptions of students and teachers towards a flipped classroom?
2. How can gamification be incorporated into a flipped classroom?
3. Is there a difference between students' attitudes towards a traditional and a flipped gamified classroom?

Methodology

The study took place at Southampton Solent University between January and May 2017 and consisted of three stages. Firstly, current perceptions of students and teachers towards the flipped classroom were investigated. Qualitative data regarding the perceptions of participants towards the flipped approach was captured through an online open-ended survey. Stratified sampling was used to select participants with the population divided into two stratums, namely, students and teachers. The resulting data was analysed using thematic analysis (Braun & Clarke, 2006).

The survey was then followed by a focus group tasked with considering the design of a flipped gamified classroom. Convenience sampling was used to select the student participants for the focus group, and thematic network analysis (Attride-Stirling, 2001) was performed on the resulting data.

Finally, the flipped gamified classroom was delivered over a duration of six weeks on a level seven Web Technologies module. The same cohort of students from the focus group was sampled. Prior to the flipped gamified classroom approach, the delivery model for the Web Technologies module revolved around practically based two-hour tutor led sessions. The delivery model was modified so that videos and notes related to each session were made available prior to the session. Activities were also made available for completion outside of sessions using a gamified environment in the form of *Code Academy*. Each session was refocused on student demonstrations and student led activities related to the module assessment. Quantitative data was captured through a questionnaire consisting of three Likert scales related to *engagement* (behaviour), *understanding* (cognition) and *feelings* (affect).

The Survey: Participants

Table 1 indicates that a total of 102 individuals took part in the survey. The participants mainly consisted of males (~67%), students (~73%), those under the age of 25 (~53%) and of a white or white British (~80%) ethnicity.

Table 1

Demographic Data of Participants

Demographic	Variables	N (%)
Age	Under 25	54 (52.94)
	25 – 55	38 (37.26)
	Over 55	5 (4.90)
	Not specified	5 (4.90)
Gender	Male	68 (66.67)
	Female	30 (29.41)
	Not specified	4 (3.92)
Ethnicity	White / White British	82 (80.39)
	Mixed / Multiple Ethnic Groups	4 (3.92)
	Asian / Asian British	6 (5.88)
	Black / African / Caribbean / Black British	6 (5.88)
	Not Specified	4 (3.92)
Role	Student	74 (72.55)
	Teacher	28 (27.45)

The sample included teachers and students from a range of disciplines. Amongst the teacher respondents, there were 18 (~64%) males and 8 (~29%) females with the remaining specifying no gender. Whilst none of the teachers taught exclusively at the postgraduate level, at least 50% of the teachers taught at the undergraduate level, ~25% taught at both undergraduate and postgraduate levels and 11% taught at the foundation, undergraduate and postgraduate levels.

Amongst the student respondents, there were 50 (~68%) students who identified themselves as male and 22 (~30%) as female with the remaining specifying no gender. A majority (~70%) of the students were studying an undergraduate course with the remaining studying a foundation course (~14%) or a master course (~16%).

The Survey: Students' Perception

Only 13.5% of the student respondents had experienced a flipped approach to learning as illustrated in Figure 1. However, all of these students found the approach useful, with ~90% indicating that they wished to experience it again.

Even among the students who had not experienced a flipped approach to learning, ~61% of the students believed that it would be useful, and ~75% of the students expressed a desire to experience it. By contrast, only ~16% believed the approach would not be useful and did not wish to experience it.

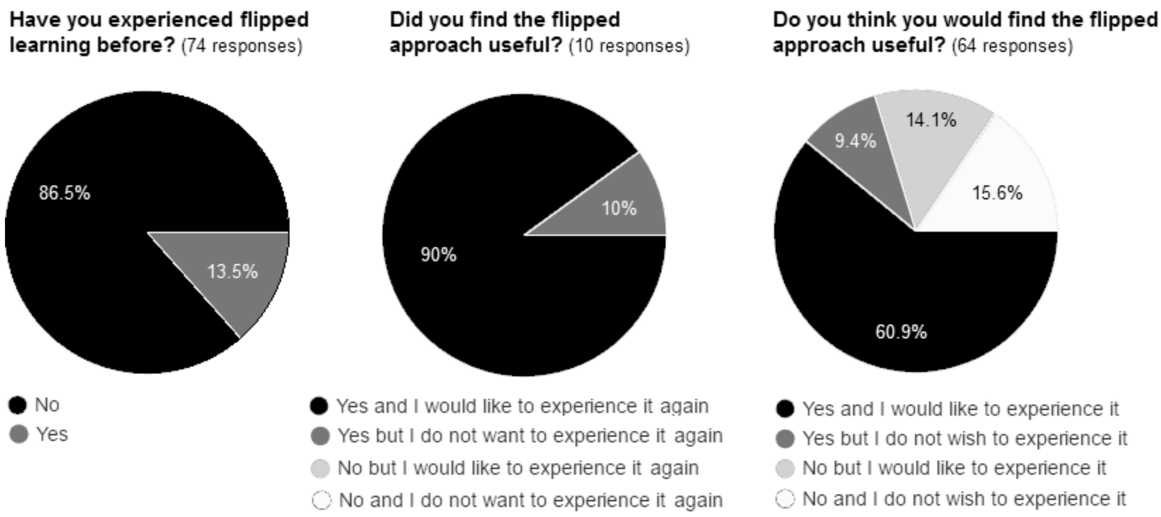

Figure 1. Students' experience and attitudes towards the flipped approach.

Students in this latter group expressed uncertainty as to the implications of the approach and raised concerns regarding access and support as well as value for money:

> *"I go to university to get lectured and taught by someone, if I wanted to have lectures online I wouldn't bother going to university and use online courses."*
> Student 23

> *"I don't pay 9k a year for a YouTube experience ;)"*
> Student 13

Interestingly, only 10% of students who had experienced this approach indicated they did not wish to experience it again despite finding it useful. These students expressed a different set of concerns relating to stability. They had either grown accustomed to current approaches or were in the final stages and hence wary of experimentation:

> *"Finishing this year so ready to move on from uni"*
> Student 12

> *"The current method works fine and I would rather stick to what I already know this far into the year."*
> Student 55

Students that had experienced flipped learning and wished to experience it again cited a variety of reasons for their preference. These included the ability to seek support and build up confidence in tackling difficult tasks as well as gaining deeper understanding:

> *"Means I would have more assistance with the higher learning then the standard approach."*
> Student 73

> *"I never liked homework and sometimes it is hard to learn by yourself, but with someone to help you with your problem it may be easier to understand the subject at later stages instead of copying work from different sources on the internet and not understanding how it works."*
> Student 63

An analysis of the responses of the students on the benefits and limitations of a flipped approach identified several themes. Developing a deeper understanding of concepts and their application was cited by ~38% of the students as a perceived benefit of the flipped approach. Having autonomy to determine the pace of activity and being better prepared prior to sessions were also cited as benefits by ~26% of the students. The responses also revealed a propensity for utilising the expertise of the teacher, with ~26% indicating the opportunity to access and engage in dialogue as additional benefits. Furthermore, ~16% of the students believe the approach leads to a more inclusive environment, introduces novelty and encourages greater practical application.

The flipped approach, however, is not without its perceived challenges. The responses indicate that ~47% of the students feel that a lack of prior preparation, unavailability of support outside class and unsuitable technology at home could result in them being unable to participate in class activities. Students are concerned about progression in the class with ~27% suggesting that a lack of structure and contribution in the class could hinder progress. Motivation related challenges are a concern for ~30% of the students who feel that the approach may diminish incentives, reduce challenge and stifle interest in the subject matter.

The Survey: Teachers' Perceptions
In the case of the teachers, ~61% of the teachers had utilised flipped learning with ~82% having done so in the past year as illustrated by Figure 2.

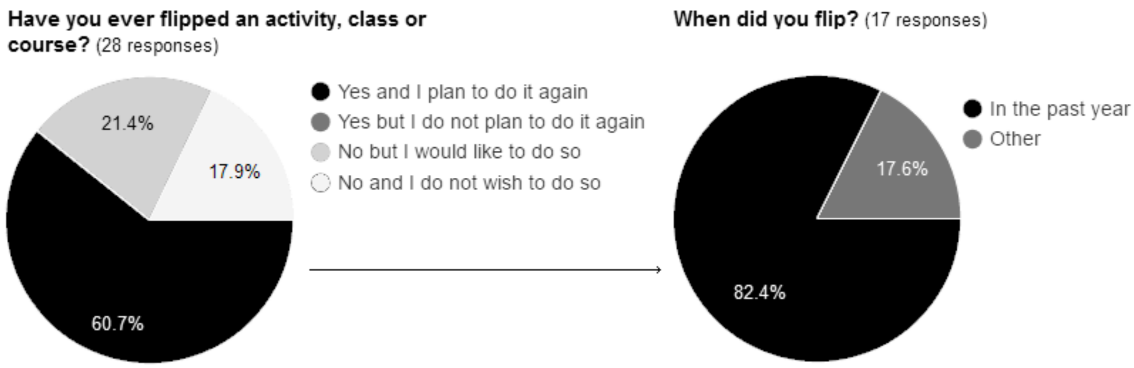

Figure 2. Teachers' experience and attitudes towards the flipped approach.

Amongst these teachers ~43% had flipped an activity, ~36% had flipped a class and 4% had flipped an entire course. In each case, themes of engaging students, encouraging group work and developing deeper understanding dominated their rationale for flipping:

"To encourage more student engagement through taking ownership of their own learning, i.e. reading around the subject and preparing for it and also to encourage a different type of engagement in the class room. I also used this when I introduced a new model not previously covered in the teaching."
Teacher 27

"Because I feel that it maximises the opportunity for students to practice the 'intellectual bit' of what we are doing (be it analysis, critical thinking etc)"
Teacher 19

Each of the teachers that had utilised the flipped approach indicated that it had been beneficial and that they planned to utilise the approach again in the future. However, when asked what barriers or challenges they encountered when flipping, some indicated that not all students prepared adequately:

"The students need to do preparation for the session this is built in to the class plan but not all students prepare sufficiently."
Teacher 3

"Some students do not take time at their home to learn the things we want them to learn."
Teacher 5

Similar concerns were raised by teachers who had not experienced the flipped approach and did not wish to do so. This group of teachers expressed concerns regarding student preparation and felt that the approach would require too much time to develop suitable resources:

"The resources take time (that I don't have) to prepare and I'm concerned about the quality of the learning."
Teacher 11

The final group of teachers that made up ~21% of the sample had not experienced flipped learning but expressed an interest in applying the flipped approach. This group shared similar motivations as others who had adopted the flipped approach in that they were interested in better engaging students and encouraging deeper learning:

"Interested in trying new ideas which may encourage deeper learning."
Teacher 12

"To create better engagement and encourage learner autonomy."
Teacher 13

The Survey: Summary

The findings of the survey indicate that overall the students and teachers have a positive expectation of the flipped approach and its potential benefits.

Where this approach has been taken, it has typically resulted in a desire for further utilisation. However, students and teachers alike have expressed concerns, primarily regarding the motivation to complete tasks outside of class and being adequately prepared to engage in class activities. These concerns support a need to address student motivation. Games are powerful motivational mediums that can be effective pedagogical tools, and so there is arguably a case for the use of games or game mechanics to address at least the motivational concerns raised by the students and teachers.

The Focus Group

A total of six computing students studying four difference master conversion courses took part in the focus group. All six participants studied a common master module in Web Technologies and were selected using convenience sampling. The focus group was presented with a proposal for a flipped gamified classroom and questioned on its makeup. The response data from the focus group was then analysed using thematic network analysis as illustrated in Figure 3.

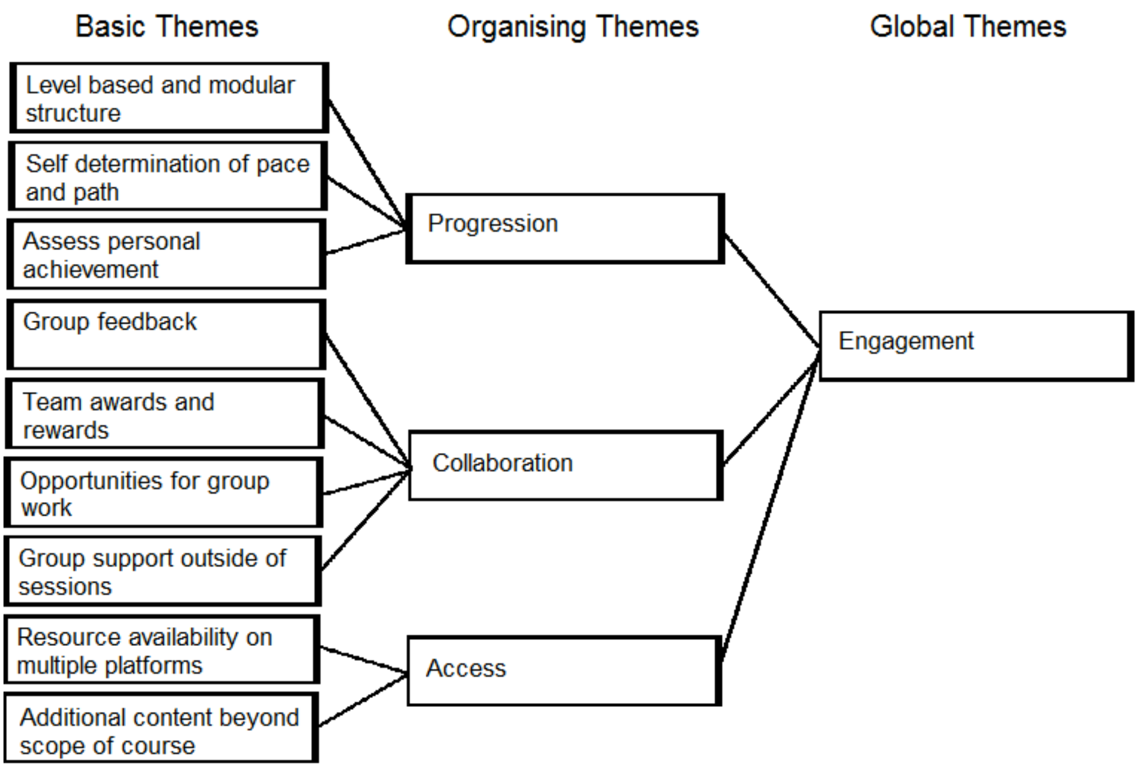

Figure 3. Thematic network derived from focus group data.

The results indicate that the students preferred a modular approach that allowed them to progress at a self-determined pace and in a structured manner and that did not restrict them in terms of path and access to resources. The students favoured mechanisms by which they could assess their personal achievements and review their own progress but also take part in group work. They preferred a flipped classroom where they could gain team awards that encouraged collaboration rather than competition and one that provided opportunities for group feedback and support inside and outside of the class.

Furthermore, the students preferred resources that could be accessed using multiple platforms and allowed exploration beyond the scope of the course.

The Flipped Gamified Classroom: Design

A flipped classroom was then designed based on the outcomes of the focus group and informed by the COCO framework (Butt & Wills, 2015) as illustrated in Figure 4. Whilst this framework has been devised for evaluating collaborative serious games, it can be used to inform the design of gamified collaborative learning environments.

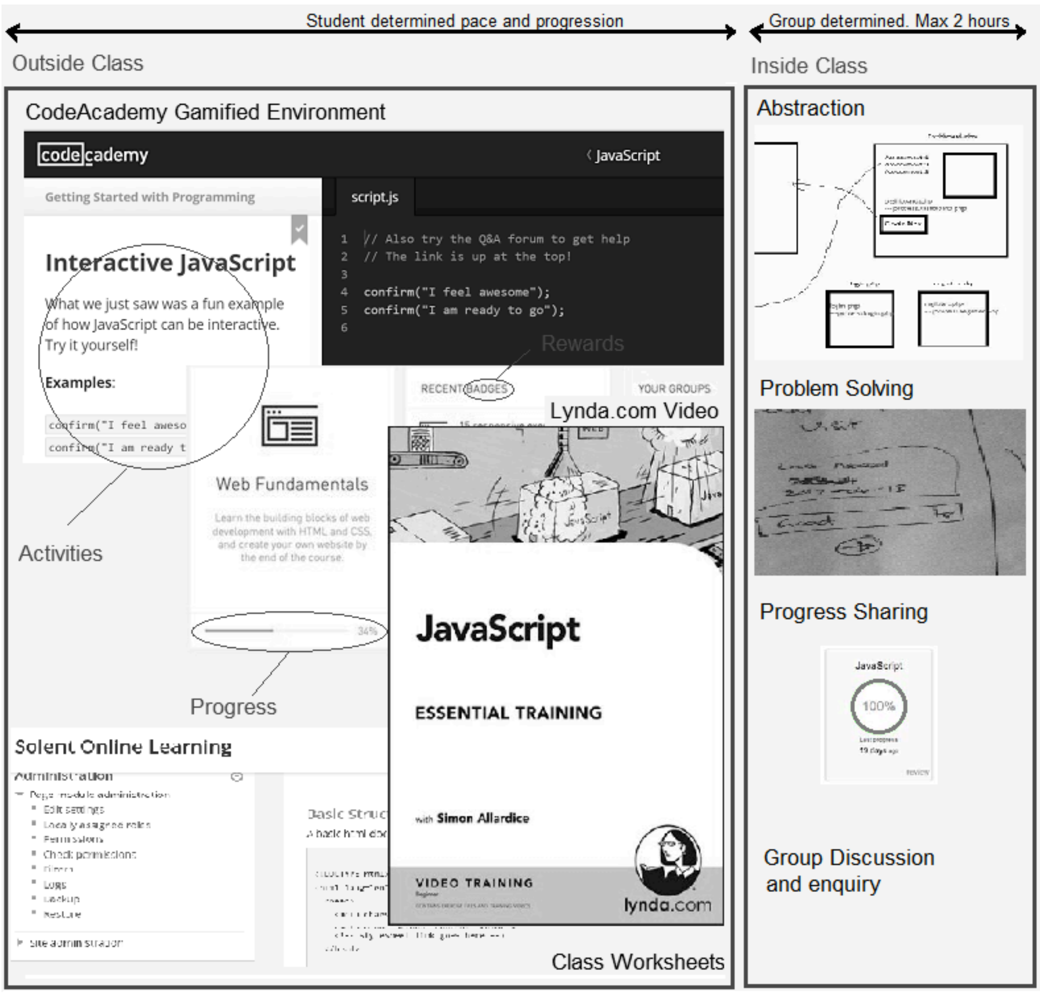

Figure 4. Flipped classroom design.

The flipped gamified classroom was designed for the Web Technologies module which is a common module taken by students studying computing master conversion courses at Southampton Solent University. The module is practically based and introduces students to a range of web related technologies.

The design of the flipped gamified classroom consisted of several technologies and techniques. Firstly, for out of class activities, a web-based gamified learning environment known as Code Academy was utilised for out of class instruction. This environment was selected after evaluating it against the COCO framework and the learning outcomes of the Web Technologies module. The environment utilises a range of game mechanics to gamify the learning experience including points, badges, progression bars, profiles, performance charts and groups. The environment also allows the sharing of progress. Suitable instructional units in Code Academy were then mapped to carefully selected videos from Lynda.com – a large and popular resource of training videos – and made available through the university's virtual learning environment along with class notes and work sheets. In-class activities were then focused on sharing progress, group discussion and problem solving with the Web Technologies module assessment brief used to guide activities.

The Flipped Gamified Classroom: Results and Analysis

The flipped gamified classroom was introduced mid-way through the teaching period for the Web Technologies module for a six-week period. Table 2 details the results of a questionnaire completed by the students at the start of this period.

Table 2

Student Attitudes at the Start of the Flipped Gamified Classroom

Item (5 point Likert item. 1 = strongly disagree to 5 = strongly agree)	1	2	3	4	5	Mean Response (N=6)
I prepare for class by reviewing material prior to class	0	0	1	2	3	4.3
I ask questions in class and contribute to class discussion	0	0	1	3	2	4.2
I review work completed in class and reflect on my learning	0	0	2	2	2	4.0
I discuss ideas from class with students or my teacher outside of class	0	0	4	1	1	3.5
The activities challenge my understanding of the subject	0	0	0	3	3	4.5
The activities help me think critically	0	0	2	4	0	3.7
I find the resources helpful	0	1	1	4	0	3.5
I find the resources easy to use	0	1	2	2	1	3.5
I enjoy attending class	0	0	0	2	4	4.7
I feel comfortable sharing my views with other students	0	0	1	4	1	4.0
I feel confident discussing the subject matter	0	0	3	1	2	3.8
I find the learning experience pleasurable	0	0	2	3	1	3.8

The results indicate the attitudes of the students before the flipped gamified classroom. They suggest that the students are generally motivated and engaged in their learning and comfortable asking questions in class and contributing to discussion. They also enjoy attending class and believe the activities challenge their understanding of the subject matter. However, only ~67% of the students felt confident discussing the subject matter and ~67% thought the resources were helpful. Furthermore, only ~33% of the students discussed ideas from class with students or the teacher outside of class.

Following the initial questionnaire, the students engaged in a flip gamified classroom for a duration of six weeks. At the end of the six weeks period, the students completed the same questionnaire again. Only five of the six students completed the second questionnaire as detailed in Table 3.

Table 3

Student Attitudes at the End of the Flipped Gamified Classroom

Item (5 point Likert item. 1 = strongly disagree to 5 = strongly agree)	1	2	3	4	5	Mean Response (N=5)
I prepare for class by reviewing material prior to class	0	0	0	1	4	4.8
I ask questions in class and contribute to class discussion	0	0	0	2	3	4.6
I review work completed in class and reflect on my learning	0	0	1	2	2	4.2
I discuss ideas from class with students or my teacher outside of class	0	0	0	4	1	4.2
The activities challenge my understanding of the subject	0	0	0	1	4	4.8
The activities help me think critically	0	0	0	4	1	4.2
I find the resources helpful	0	0	1	2	2	4.2
I find the resources easy to use	0	0	1	3	1	4.0
I enjoy attending class	0	0	0	1	4	4.8
I feel comfortable sharing my views with other students	0	0	0	3	2	4.4
I feel confident discussing the subject matter	0	0	2	2	1	3.8
I find the learning experience pleasurable	0	0	0	4	1	4.2

The results of Table 3 show that 100% of the students agreed or strongly agreed that they prepared for class by reviewing material prior to class, discussed ideas with students or the teacher outside of class and felt the activities helped them think critically compared to ~83%, ~33% and ~67% respectively at the start. Additionally, 100% of the students agreed or strongly agreed that they found the learning experience pleasurable compared to ~67% at the start. Whilst these results may seem encouraging they are obscured by the fact that only five out of the six students completed the second questionnaire. As the samples are too small for reliable statistical inference to be made it can be concluded that the skew in the data is at least partly attributable to a difference in the sample sizes.

Discussion

This study investigated the attitudes of students and teachers towards a flipped gamified classroom. Whilst the study is limited by small sample sizes and no generalisations can be made beyond the scope of this study, some interesting observations can be made. Firstly, the study considered the perceptions of students and teachers towards a flipped classroom. The findings revealed that most of the students and teachers viewed the flipped classroom favourably and even more so where they had previous experience of this approach. This is consistent with other recent studies, which have reported similar findings.

Secondly, this study explored how gamification could be incorporated into a flipped classroom. Earlier findings had revealed that the main concerns students and teachers raised were related to motivation for completing tasks outside the class and being adequately preparated for in class activities. These concerns present an ideal case for the application of games as motivational mediums. The findings from the focus group revealed that the incorporation of game elements that encouraged progression, collaboration and access present the best opportunity for harnessing student motivation in a flipped classroom.

Finally, this study investigated if there was a difference between students' attitudes towards a traditional classroom and a flipped gamified classroom. Whilst the findings were inconclusive, they do present a case for further investigation. Future research should consider student attitudes and the impact on student performance and outcome achievement in a flipped gamified classroom.

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THE STORY MACHINE: TRANSMEDIA GAMES IN EDUCATION

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Abstract

The paper reports on the design process of a transmedia game driven by narratives mixing fact with fiction. The aim of the game was to enhance student motivation, collaboration, multiliteracy and local history learning. A total of 378 students ages 14-16 from three municipalities in Sweden played the game in their local school, providing content, reflections and suggestions for this type of gamification in school; thus supporting the design. The game improved students' multiliteracy skills while physically visiting and exploring local historical sites. Working in groups to solve tasks improved collaboration skills. Being placed in a fictional setting supported engagement.

Introduction

One of the core professional practices for teachers concerns student motivation and how to stimulate engagement to improve student learning. Numerous efforts in how to motivate and engage have been developed through practice and research. One such approach is linked to storytelling, and more recently computer games (Prensky, 2001). Computer games in education have attracted a lot of research attention. In an ambitious literature review of computer games in education Connolly, Boyle, MacArthur, Hainey and Boyle, (2012) show that while numerous publications talked about the potential of computer games for learning (they found 7,392 in their systematic literature review), only 129 provided empirical studies of computer games in educational practice. Therefore, research regarding games in education should be grounded in empirical investigation, preferably in close collaboration with schools. In order to authentically capture the situated practice and relevance of games in schools there is a need to investigate how games are experienced and used by students that have actually had a situated experience of gaming for learning in their own school setting. Situated practice in and with digital technologies in education expands its boundaries outside of the classroom due to network connection and other types of arrangements for gaming in school. One such expansive approach for gaming in schools for learning can be found in transmedia learning, combining storytelling techniques with multiple platforms to create a comprehensive learning situation with many and varying entry and exit points for learning and teaching (Gronstedt & Ramos, 2014; Thornburn & Jenkins, 2003).

Aim

The aim of this paper is to identify motivation triggers for student engagement found in a story-driven transmedia game during its iterative and contextualized design process in order to further support multiliteracy development, collaboration and local history learning among secondary school students.

Previous Research on Mobile Technology and History Education

Mobile devices have been discussed as potential tools for improved learning. Usually the role of the technology as a change agent has been addressed. The technology has been described as having potential to play a crucial role in empowering students to demonstrate authentic, meaningful learning (Schrum & Glassett, 2009). Mobile technology has also been presented as having the potential to transform classroom practice providing unique and innovative teaching and learning, for example, to develop 21st-century social interaction skills (Sung, Chang, & Liu, 2016). Still, these technology-centric ideas do not really capture the more complex issues of how to integrate mobile devices into the specific learning situation. According to Zimmerman and Howard (2013, p. 2), “mobile devices can situate and connect learners by supporting authentic, context-specific, immediate learning.” Integrating mobile technology enables educators to customize student learning by creating learning activities to engage students beyond schedules and physical classrooms (Hess & Gunter, 2013). These views enhance the need for more fine-grained and integrated approaches to learning when mobile technologies are used. Additionally, the situated practice mentioned by Zimmerman and Howard and Hess and Gunter is not only linked to the classroom but also to surrounding contexts where learning can take place, whether online or offline. Still, good intentions and technological potential need to be put in action (Connolly et al., 2012) and specifically linked to curricula in educational settings.

The transmedia game developed and reported on in this paper was oriented towards local history learning, aligned with curriculum for secondary school students in Sweden. Recent research shows that the subject of history is often one of the least favorite subjects among students (Turan, 2010). Many students find history irrelevant and boring (Turan, 2010), but studies have found that the use of ICT increases students’ active participation, recall rate and achievement (Haydn, 2001; Turan, 2010). Different studies show that the use of technologies in teaching history has a positive effect on students’ historical and critical thinking and their understanding of various historical subjects (Brown, 2001; Taylor, 2003). However, problematic issues have been identified such as finding out how to improve history education when using ICT (Haydn, 2001). These difficulties are related to planning for and using suitable ICT tools to support rather than distract student learning and goal achievement in history (Hofer & Swan, 2008; Lipscomb, 2002) as well as to enhance rather than decrease motivation to learn history, since ICT in itself is not enough to trigger motivation (Huizenga, Admiraal, Akkerman, & ten Dam, 2008). Taking previous research into consideration, it becomes clear that we need practice-based studies of such situated practices incorporating mobile technologies in specific ways to further identify and systematize when such arrangements serve their purpose and clarify what obstacles such customized learning situations need to address to provide the intended learning effect.

The Game

The learning situation studied here is a three-day participation in a transmedia game designed for educational purposes with contextual connection to local historical sites within the municipality where the participating schools are. A transmedia game, or alternate reality game, uses the real world as its game world and blurs the lines between fiction and reality. It is played on social media, dedicated websites and in real-world locations. This type of game has been around for some time (Klopfer & Squire, 2008), but in our project, The Story Machine, we are using this type of game mechanism as an educational tool to enhance multiliteracy skills, collaboration and local history learning. The difference between a transmedia game and a video game is that a traditional video game is played on a screen, within a virtual world, and exists only within that space. As the game uses mobile devices and social media, the students are supposed to enact all sorts of literacy activities as they both document their progress during the game sessions through blog texts, photos, films, podcasts and other media, and have to interpret the often mysterious texts and character interactions they encounter. They have to be active in the digital world, but also visit places in the real world, taking education outside of the classroom but still connected to local historical sites found in their municipalities. These predetermined game elements were driven by the insight of situated practice to contextualize the learning situations for students integrated with details in the game (Collonay et al., 2012). The predetermined game design and game element was also closely aligned with the curriculum, in this case local history, but also generic skill enhancement in the Swedish curriculum such as multiliteracy and collaboration.

Design Process

The design process was originally driven by the game designer who also had the role of game master when students played the game in school. During the ongoing design process the school developer, business developer, game designer and researcher increasingly collaborated, combining diverse competences with unique expertise and points of reference. Together with student comments and post-session reflections, the game was iteratively adjusted to incorporate game elements to enhance motivation and engagement among students with a continuous focus on intended learning outcomes such as multiliteracy, collaboration and learning local history. In that sense, we claim that the design process can be associated with what recently has been described as bounded creativity in design science research in information systems (Baskerville, Kaul, Pries-Heje, Storey, & Kristiansen, 2016). This perspective enhances how a design process can be informed by both rigorous processes from scientific approaches and at the same time have creative elements that drive innovation connected to relevant issues for the challenge at hand that the design intends to tackle during its cyclic work process (Majgaard, Misfeldt, & Nielsen, 2011).

Three Cycles in the Design Process

In this game design process, three cycles of situated practice in combination with cross-competence analysis among the diverse group of expertise were involved. The game was played by students in schools during regular school hours with support to participate from their schools and teachers. During each session, a researcher shadowed students while playing, taking field notes that were later analyzed. After each session, the game was evaluated and discussed by students. Their thoughts and comments were then analyzed and led to the incorporation of adjustments to the game and different elements in it. Details regarding lessons learned and implemented changes will be presented below. After each session, the blogs and the interactions between the game master and students playing were analyzed in order to find out specific problems and derive solutions from these identified problems.

Three different municipalities from the south of Sweden were involved in this project. During the first design phase, it was played in Botkyrka municipality (east coast). In the second phase, it was played in the city of Mölndal (west coast), and in the third it was played in Lund (far south of Sweden).

In this paper, we focus on the lessons learned regarding identified triggers for motivation and engagement to support multiliteracy development, collaboration and local history learning. The continuous design of the story-driven transmedia game was in particular inspired by the students' actual use of the game. In the section below we will describe each game session at each location and some typical remarks from students that informed the change in the story-driven design.

Game Session I: Botkyrka. The first game was made in 2015 and played by 180 students. The original rationale for the game development was that this particular municipality struggles with low motivation among large groups of students. This municipality has a high unemployment rate and low student scores in standardized tests and grades. The idea was then to use drama pedagogy as a trigger for motivation (Jaquet, 2011). In drama-driven pedagogy, students are invited into an imaginary situation where the teacher leads the learning and literacy activities from within as a part of the imagined context (Heathcote & Bolton, 1995; O'Neil, 1995). In such a pedagogical approach, imagination becomes an important part of learning. To further trigger engagement, visiting local historical sites for authentic learning and leaving the classroom were part of the original game design. Additionally, using mobile technology and social media would create a possibility to develop multiliteracy also among low achievers, as it was argued that being able to document and share pictures and not just written text could facilitate participation from a larger group of students, thus including them in literacy schoolwork (Jaquet, 2011). Several literacy studies find that only some students have the opportunity to integrate their literacy experiences in school, while others, often students whose literacy deviates from the school norm, need to leave their literacy experiences behind (Fast, 2007; Gee, 2003).

In order to use the drama-driven mechanism of getting into an "as if" mode while learning (Huber, Dinham, & Chalik, 2015), the game had a story inspired by Swedish crime genre. By collecting clues that were physically left in various places in the municipality by the game master, and solving riddles online on Twitter, the students' goal was to stop a pyromaniac from burning down historical buildings in their community. To do that they had to do research about local history, solve the pyromaniac's riddles that led to a certain place or building, and get there before him.

The students actually met the characters in the game as real actors in the original game design. At one point the pyromaniac (the game designer himself) stalked the students during a mission. In the last game session, actors were present at the location, portraying both the helpful characters and the pyromaniac, whom they could arrest and interrogate at the end of the game.

After the game, students were interviewed about their experience. They typically liked the game features and the drama setting, saying things like: *"I thought it was fun and a little bit exciting to learn who the pyromaniac was. It was also fun to find the 'fire mark' and to find different places."*

However, they also shared some suggestions to improve the game regarding game content and game organizations: "*Do more tasks and don't let everyone get the same tasks in order to prevent groups from asking others for answers."*

Comments like that were interpreted as indications that the narrative in the game was rewarding, that the tasks were considered as meaningful and that students really wanted to have a "fair game" that supported problem-solving for all and not copying each other to get the right answer. Therefore, the design of the game was continuously worked upon to address the students' thoughts and suggestions.

Game Session II: Mölndal. The second round of games in the Story Machine project was played in Mölndal, a community with a rich history and folklore that also became the theme of the game. This municipality has a low unemployment rate and students score well on standardized tests. This time, rather than hunting down a criminal, they explored supernatural beings from local legends to stop an ancient conspiracy. This game was made in collaboration with the local museum knowledgeable in the area of local folk tales and myths. The rationale for changing the narrative was that the rich stock of local folk tales and history lent itself to this theme.

In September 2016, 84 students from two local schools had to investigate strange disappearances that had happened in Mölndal throughout the centuries. The game in Mölndal was the first time where the interaction between the players and the characters portrayed happened only online, in contrast to Botkyrka when they also interacted with real actors. The online interaction was to see if the game could be interesting without physical artifacts and take the first steps towards creating an automatic transmedia game where no trained game master is necessary, thus allowing for teachers in schools to drive the game.

The students worked in groups to find locations and solve tasks as well as try to come up with a plausible narrative regarding the strange disappearances. The fact and fiction division in this game was linked to actual places and historical events but also fictional stories and myths. This time, the student tasks were distributed to the groups in a system that made them start with different tasks to avoid crowding, as in the Botkyrka game session. This time, the game used a blog tool in combination with Twitter to allow students to expand thoughts and ideas while documenting their tasks and their own narratives. The Twitter text restriction was considered too limiting for the game intention of providing multimedia content together with textual narratives for the missions; however, it functioned well for sending out tasks and chat interactions between groups and game master. The game master monitored various Twitter accounts and blogs while also playing different characters in the game.

Students that were able to follow the game and had well-functioning groups said things like: "*I thought it was really fun since all the group members participated and contributed ideas. I came up with about four ideas! I did not really enjoy walking that much all the time, but all the rest was fun."*

"I did not like the first mission just searching for facts at Gunnebo. But then, walking around in Kvarnbyn, it became 100 times more fun since then you needed to be like a detective. The mission about Fleskepetter in particular gave me the creeps! It was also more fun to interact with the supernatural guy than the journalist [characters in the game managed by the game master]*."*

This time, field observations, i.e., shadowing students as they played by walking and running with them during the full game session taking field notes, was added to the investigation of the function of the game while playing. The method allowed for more insightful understanding and there were various results regarding whether the game was motivating and collaborative or not. Some groups worked well, but others struggled, not only with the tasks but also with group dynamics, literacy issues and being able to enter into an imaginary game mode while playing in the factual situation (Spante, Jaquet, & Lindquist, 2017). During the game students also commented that the response time from the game master was too slow. They became somewhat demotivated by the waiting time for new tasks when they had accomplished one and wanted to move on to the next.

Analyzing both the game process and the blog contributions in combination with the chat interaction between groups and game master, showed that the more mysterious story with no clear main objective or antagonist in the beginning of the game, became too hard for the students. Some of the student groups appreciated it a lot, but because of the more obscure theme, some thought it was too unclear and gave up.

This was a valuable lesson: participating in this kind of game is a novel situation in itself and confusing to start with, so the stories should be kept simpler, or at least be more self-explanatory than the Mölndal game turned out to be. However, the combination of a blog tool and Twitter functioned well in supporting multiliteracy development among students.

Game Session III: Lund. After the lessons learned in Mölndal, the game narrative returned to the "Purified by fire" story used in Botkyrka, with the pyromaniac, but this time played in the city of Lund in south Sweden during November 2016. This municipality has a low unemployment rate and students score well on standardized tests. This game was played by 150 students from one school.

In Lund, we also used a new system to hand out tasks to the players. Instead of manually sending out tasks by direct messages on Twitter, the game designer built a puzzle chain for each group. By submitting the right password on a custom-built webpage the groups could progress in the story at their own pace and get automated feedback. The game master could therefore more intensively focus on the social interaction between the students and the characters, proven to be highly motivating for students and a trigger for engagement (Spante et al., 2017). The game element of puzzle chains was also to take a step towards a more automatic transmedia game. This is a goal we are aiming for to make one version of the game less dependent on a skilled game master and easier to access and play for any teacher without previous game master experience.

In combination with digital footprints on the groups' blogs as well as in chats with the characters in the game, we made field observations following different groups during the game. In the field observations, it was evident that engagement varied within groups, but these variations were invisible in the group blogs. Had only blogs been analyzed, such student behavior would have been overlooked, as it was in the first game session in Botkyrka where only Twitter feeds were analyzed in combination with student interviews after the sessions. Here we can see that the combination of research methods and bounded creativity in design processes made a valuable contribution to the continuous improvement of the game (Baskerville et al., 2016). However, despite the varying levels of engagement, students typically liked the game sessions, saying things like: *"that the game was different from normal lectures and that you used the tablet/mobiles and that we were outdoors"* or *"we were free from lectures. We had to find places that were unfamiliar to me"* as well as *"I really enjoyed chatting with the editorial office in order to get information. It felt more real than getting instructions on paper. I appreciated the theme of the game, and that we were supposed to visit different places and not just stay in a classroom."*

The students' comments and feedback, both during and after the game sessions, based on their actual experiences was one of the most important triggers for game development and re-design.

General Evaluation from Students

In general, the transmedia game experience made students reflect upon their own activities and estimated contributions. A total of 378 students ages 14-16 from three municipalities in Sweden have participated, providing content, reflections and suggestions for this type of gamification in school. Of course, such measures are difficult to take as robust evidence for the benefit of transmedia games. However, they signal that these students as a group were generally in favor of this type of educational practice. The students also appreciated how the game made them work together and stimulated purposeful use of digital tools, social media platforms and supported multiliteracy skill development. See Figures 1-3.

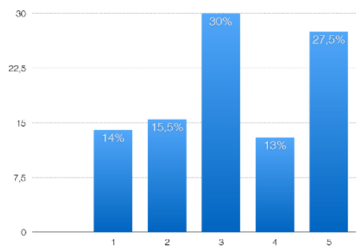

Figure 1. I have discovered and can use more digital tools than before I played the game (1 disagree, 5 totally agree).

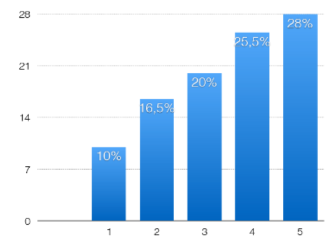

Figure 2. I have learned more about my local history (1 disagree, 5 totally agree).

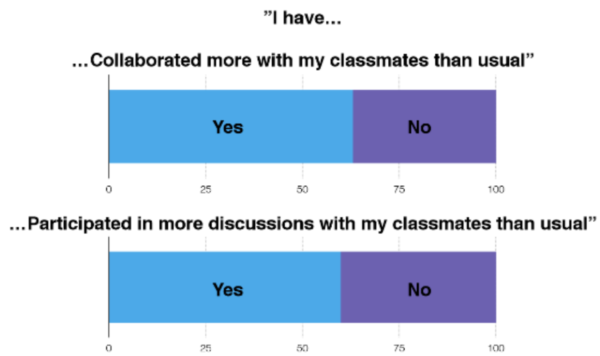

Figure 3. Collaboration and communication.

Student participation, contributions and reflections made us motivated to continue with the design work in order to further improve the design of the game as well as script suggestions on how to involve teachers in the game sessions. Such developments are currently in the making so we do not yet have actual data on these further initiatives in the Story Machine project.

Discussion

In the Story Machine, transmedia games as a socio-technical assemblage (e.g., Cecez-Kecmanovic, Galliers, Henfridsson, Newell, & Vidgen, 2014; Orlikowski, 2009), where social interaction among peers and with the game master as characters in the game, combining interaction with digital artifacts having a narrative to work alongside with while visiting local historical places, becomes a motivating situation for students, despite varying levels of engagement. Rather than viewing the digital artifact as something seamlessly implemented in the game experience, the use of the digital artifact was regarded as something important in itself despite the fact that is was highly integrated into the whole game experience. This positioning of the digital artifact in the story-driven game design shares similarities with what has been framed as “seamful” interaction where the artifact becomes intertwined with the overall experience (Chalmers, Dieberger, Höök, & Rudström, 2004). This view is important since the thoughtful integration of ICT for gamification in school has been called for (Connolly t al., 2012; Huizenga et al., 2008).

In order to enable further support for students that do not readily get involved for various reasons, there is a need for an engaged teacher that can guide students while gaming. This is important since despite its merits, the game itself is not a stand-alone education structure detached from pedagogical professional practice. Still, the transmedia game becomes a supportive dynamic structure and arrangement for enhanced motivation and learning also outside of the classroom walls attached to local historical places supporting learning about history while developing multiliteracy skills. For authentic local history learning, a transmedia game design seems fruitful as a means to both integrate ICT in the subject matter as a support rather than a distraction for the intended learning as discussed in previous research (Huizenga et al., 2008). In sum, it seems that the story-driven game design did make students engage in a range of literacy skills while visiting and exploring local historical sites. Working in groups with tasks aligned with the game narrative supported collaboration among students and written interaction with the editorial office (i.e., the game master) was highly appreciated by students. Next step for game improvements is to design for teacher participation during the game to facilitate teacher involvements.

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PROJECT “TOPOGNOSIA”: STRENGTHENING LOCAL IDENTITY THROUGH DIGITAL GAMES IN EDUCATION

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Abstract

This article presents a pilot project introducing a new learning subject named “Topognosia” (*Knowing the region*) that incorporates cultural, historical, and geographical aspects of the local society students live in. Its purpose is to enrich the basic knowledge of students about their region and strengthen their awareness and notions towards local identity. The specially designed accompanying material includes a textbook, a website with online lessons and a collection of digital mini games, one of which is hereby demonstrated in detail.

Postmodern Relativism and Identity

Since its appearance, the postmodern condition has evoked both laudatory and critical reaction (Mackenzie, Good, & Brown, 2014). Whether it is viewed as a liberating or a problematizing force, its tendency to challenge preexisting limits, dispute established terms and call cultural and political norms into question, causes a general feeling of indeterminacy (Harvey, 1990). From a pedagogical point of view, this widespread relativism does not contribute to the stable socioemotional environment required for the balanced development of children as it may expose them to confusion, account for a deficit of trust and even affect their adaptation process by disrupting the formation of the cognitive schemata. Additionally, it influences cultural identities by constantly reinterpreting them, thus affecting all individuals; mostly young adolescences -whose social identity is still under development- making them vulnerable to distress and internal conflicts. As Bendle (2002, p. 1) puts it, in our age, “the acquisition and maintenance of identity has become both vital and problematic.”

Regionality could be used as a base for the formation of a stable, socio-cultural identity, since the belonging to a region calls upon a sense of community that can merge together with an array of coexisting and overlapping elements like gender, sexuality, class, religion, race, ethnicity, etc. (Tomlinson, 2003). However, this merging procedure is not to obtain the homogenizing character that spatial conditions implied in the pre-modern situation, often leading to isolation and subjection (Paasi, 2002). In the current historical context, individuality and freedom of choice are considered essential: The constant movement of people through increasingly porous borders into ever growing “global city-regions” (Scott, 2001) calls for an intercultural consciousness that doesn’t conflict with the semantics of the postmodern and for a new local identity addressing the question *Where do I live* instead of *Where do I belong*. This new type of local identity appears less associated to origins and is oriented towards the inclusion of difference and heterogeneity (Paasi, 2003).

Research Steps and the Project "Topognosia"

These contemplations involve many issues that could be further investigated: Is it possible for up-to-date education to promote a new type of local identity, combining traditional and modern elements? Can that identity be at the same time clearly defined but also tolerant to the difference and focused to inclusion, corresponding to the plurality of the urban populations? What characteristics should it incorporate in order to represent the hybrid culture of the multimillion metropoles? And could technology contribute to the attractiveness of such an identity so that students will embrace it voluntarily for self-description purposes? The above discussion has led to the formulation of a main research question: Can the use of digital games in education assist in enhancing the local identity of 9-year-old pupils in an urban region like Galatsi of Attica?

After specifying the question, literature review followed, as well as designing of a pilot new subject named "Topognosia" (*Knowing the region*), that incorporated cultural, historical, and geographical aspects of Galatsi region into printed and online material. The project, product of thorough research, was approved by the Ministry of Education and distributed to the elementary schools of the area with the help of the local authorities. Then, the implementation of the project was designed. The total number (397) of 4th-grade pupils studying in Galatsi's public schools was divided into three groups: The first to be taught by use of a printed textbook including 20 hourly courses of "Topognosia"; the second to be additionally given access to a website with online lessons and a collection of digital mini games; the third group was not educated on the subject.

At the same time, a survey was designed (and is still on-going), in order to evaluate the effectiveness of the project. Individual pre- and post-questionnaires were addressed to the target group, containing questions referring to three groups of information: demographic ones (like gender, parents' level of education, etc.), attitude toward tradition (responders' opinion about folk dances, etc.), and views on aspects of local life (perceived efficiency of local authorities, etc.). The main focus was to collect data that will allow a comprehensive assessment of the pupils' local identity status before and after the educational intervention. Based on this information, a set of indicators (like level of knowledge about the region, perceived area's desirability, level of social attachment, etc.) will be developed to monitor the changes occurred.

As the survey was conducted on a voluntary basis, and written consent of the parents was needed in order for the students to participate, only 285 of the total 397 fourth grade students of the local area's elementary schools completed the first questionnaires. This may affect the results, as it is possible that only parents who were interested in the survey allowed their children to take part in it. Moreover, as the subject material includes online lessons and games, the pupils of the second group without internet access at home wouldn't be able to take advantage of the digital elements. After the completion of the program and the gathering of the post questionnaires, the collected data will be analyzed in the light of the above-mentioned limitations, so that the research question can be answered.

Employing Digital Games for Educational Purposes

Digital games are interactive rule-based systems involving challenge to reach a goal while providing feedback on the progress of the player (Lieberman, Chesley Fisk, & Biely, 2009). As they have become an important part of most children's leisure life and at the same time an important aspect of our cultural landscape (Kirriemuir & McFarlane, 2004), they started being incorporated in formal teaching, after the appearance of serious games: a branch of video games especially developed for a purpose other than pure entertainment.

There are several reasons digital games are implemented in education. Most importantly, they were proven to have high educational value as effective learning tools (Gee, 2005; Heins, 2017; Robertson, 2009). Well-designed games can provide rich, fun and interactive experiences, promoting pupils' learning (Thai, Lowenstein, Ching, & Rejeski, 2009). Furthermore, as games make the learning process more fun, they can be used to create a mood that corresponds better with students' interests (Prensky, 2001). Finally, as students come to school with increasingly enhanced digital literacy, gaming applications can be considered as ways to harness their experience (et al., 2008).

When students enjoy a game, they may spend hours of playing without any regrets or complaints (Alshanbari, 2013). However, high attractiveness doesn't make an educational game equally beneficial: In order to be considered well-developed, a game needs to be pedagogically designed and conceived following the game-based learning principles, while its content has to be appropriate in terms of matching students' learning needs. It is also clear that educational games are not a panacea: not all students learn better via games and not all lessons are best taught through them. Therefore, games on this project have a supporting role and are not the only way through which students acquire the desired information. All the content displayed in-game is also available to students as text, through online lessons. Digital games could solve many of education's key challenges, but there is a need for continued research, as well as evaluation of the efficacy of game-based approaches. One of the aims of this research is to add input to this direction.

Developing Games that Strengthen Local Identity

According to Zimmerbauer, Suutari and Saartenoja (2012), local identity -- the regional consciousness of the inhabitants -- consists of three essential features: a cognitive one that refers to awareness, in the sense that local citizens are familiar to regional characteristics; an affective one, that concerns people's emotional ties to a place; and an instrumental one, having to do with the use of the region as, for instance, a basis for mobilization. The nature of digital games allows them to focus only on the first and the second element, but the wider "Topognosia" project comprises all three of them, through various activities like school visits to nearby hills, the municipal library and the city hall, cleaning of communal areas, meeting events that take place outdoors, etc.

The games feature attributes of the key area, combining real life graphics based on the district's surroundings as they look presently, but also as they appeared in the historical past. They are designed to help users identify with the avatars, understand how the landscape changed over time to reach its current, familiar appearance and aim to trigger them to learn more about the area. The scenarios are inspired by the region's history and folklore, making wide use of what Lyotard described as "petit récit" (1984, p.60), or little stories. The mere fact that digital narratives of the area are turned into online games, could boost students' conceptions about the area's esteem in the eyes of the "Others."

Taking into consideration that different types of games are better for different areas of learning (Van Eck, 2006), various game genres are included: The quizzes and puzzles focus on improving users' ability to recognize patterns and thus are targeted on characteristics of the area like names and locations of the neighborhoods, position of its monuments, names of surrounding hills, etc. Other games that belong to the arcade style, are adequate for more complex scenarios and thus deal with issues like the different origins of the first inhabitants and their interaction, which gradually caused the formation of the hybrid local culture. One of the titles refers to a volunteer project by local citizens, who, after gathering sour oranges off the street trees, processed them to produce vases with sweets, eventually offering them to people in need. This scenario demonstrates the importance of civic solidarity and aspires to stimulate pupils to act alike. Another game presents the hard work done by the municipal workers and officials, aiming to affect pupils' notions towards the local authorities. Finally, a title blending strategy with action is inspired by the destruction of an ancient local monument by ignorant inhabitants, encouraging students to learn more about their regional history, so that they can prevent similar incidents in the future. In short, most of the games use, as a background, historical facts concerning the area. This information, apart from directly strengthening users' awareness and emotions concerning the region, aims to enrich the collective memory of the community, uniting students through the common past of the area they live in, regardless of their descent.

Presenting the Games

The software used for the development of the games was Clickteam's Fusion Developer version 2.5. An HTML5 export module add-on was then utilized to ensure compatibility with web browsers. All games are two dimensional with screen resolution of 640 x 480 pixels, and, in some cases, using horizontal scrolling. The image files were edited using Adobe Photoshop 7.0 CE, and the sound files were edited using Audacity v. 2.1.2. The games, after their development and testing, were uploaded to the game hosting webpage (https://itch.io) and links to them were placed on the "Games" section of another website specially created to promote the online part of the project, located at https://sites.google.com/site/galatsigames/.

As it isn't intended to present all the titles of the collection, in the paragraphs to follow, one representational game is introduced, accompanied by details on how it was created and comments about the reasons the specific elements were chosen.

"Wolves in Turkovunia Hills"
This title (Figure 1) belongs to the platform genre, meaning that the user guides the avatar to jump between platforms in order to collect objects and advance to next levels. The player controls the movement using the keyboard or his finger, trying to avoid letting the avatar miss jumps or collide with the enemy.

Figure 1. Screenshot from the game

Plot. It's the year 1877. After an attack of wolves to a sheepfold located in Turkovunia hills, a young shepherdess is called by the shepherd to pick up the remaining sheep before the wolves return and attack again. The game consists of three levels of similar difficulty, each with 10 scattered sheep for the player to pick up before the wolf attacks.

Plot background. The plot was inspired by a true event, published to a 19th century newspaper. Specifically, the newspaper *Aletheia* (Truth) on January the 13th 1877, reported that a wolf attacked a sheepfold located in the area, killing 120 of the 140 animals that belonged to shepherd Kostandellos from Lidoriki, while he was absent.

The specific story was chosen for the game plot for many reasons. To start with, it contains the first known press report on the area's name and is therefore considered of certain historical value. Secondly, it presents a part of the first settlers' life during modern times, thus offering a motive to display useful information about their origin and way of living. Additionally, the date of the event provides the players a chance to learn about the early days of their home area and observe its original appearance, before the extensive quarrying and the expansion of the city changed its morphology. Finally, the story was chosen because it involves Turkovunia hills, which are considered a key element, since -- as a landmark -- they form a natural border of the area and connect the past to its present and the future.

Visuals. The text appearing on the title and in the information screens is typographically enhanced (Peters, 2012) and uses vivid colors, in order to draw the attention of the pupils (Zettl, 2005). However, much of the material used is artificially colored, as the original dates back to the first half of the 20th century. For example, the pictures from Turkovunia hills are from the early 1930's, attempting to regenerate the image of the area when it was still uninhabited, and the quarries had not yet started distorting the landscape. Moreover, the drawing of the medieval church of St. George is dating back to 1921, displaying the temple's appearance before the restoration of its roof, which took place in 1956 (YCBS, p. 438, §5). Finally, the avatar of the shepherdess appears wearing a dress created by the combination of two traditional costumes from Attica district. (Figure 2).

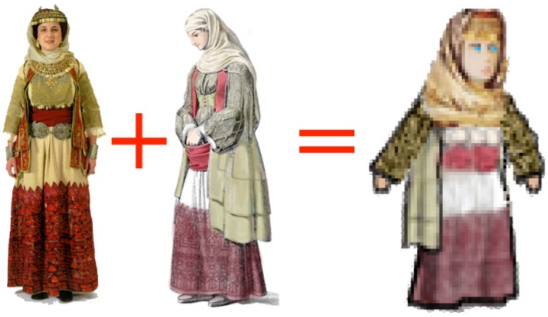

Figure 2. Two traditional costumes combined for the avatar's dress. The first is acquired from http://www.e-istoria.com/147.html and the second a colorized drawing depicting an Athenian peasant woman by Stackelberg (1831, p. 45).

Soundtrack. The music heard in the background of the game is the tune "Skaros" (available at https://www.youtube.com/watch?v=MMNvJn0QqQE), belonging to the Greek folk music tradition of the central and northern highlands. It's an instrumental piece in free rhythm, usually played by clarinet or flute in the early morning or late afternoon hours, while the shepherd leads the flock to the pasture or back. It was chosen for the specific game because it is representational for the areas of origin of the first settlers and, at the same time, deeply associated with the main theme of pastoral life, to the extent that it has been characterized as the "national anthem" of herdsmen. Its inspiring melody and the accompanying sounds of bleating sheep, ringing bells and barking dogs, blend well with the images and contribute to a balanced aesthetic experience, both entertaining and informative.

Accompanying information. Three screens containing simplified data about the early history of the area appear after the title screen. In the initial one, the first ever reference to the area's name is cited, accompanied by some information based on the 1840 census. Additionally, a short description of the first gatherings of houses and the surrounding landscape is included, obtained from a sale contract dated 1833, while the bad condition of the streets is depicted thanks to a newspaper article (Skrip, 1904, p.1). On the second screen, a short synopsis of an old legend is cited to explain how the local spring of Agia Glykeria started flowing around 1678 and why it was considered important, according to folk tradition. The third screen informs the user about the origin of the first shepherds that arrived in the area, and the reason for their migration (Hatzoudis, 2016). If the user manages to finish the game successfully, a "bonus" screen with additional information explaining how the region acquired its name appears.

"Celebrating Koulouma in Galatsi"
This title (see Figure 3) belongs to the Breakout style games, a subcategory of the bat-and-ball genre, dating back to 1967. In this type of games, the player controls a paddle on the bottom of the screen and uses it to hit a ball, guiding it against various target objects. In this version, the original paddle is replaced by an avatar, the ball by a traditional diamond shape kite, while the target objects are bricks of various colors and durability.

Figure 3. Title screen of the game.

Plot. On Clean Monday, a boy and a girl (Panayiotis and Anastasia), with origin from Naxos and Crete respectively, are enjoying the outdoors at the popular recreational park of Galatsi area, Alsos Veikou. The wind takes away their kite, and the user's mission is to help them control it and direct it against a block of bricks. The game consists of two levels of increasing difficulty, the second one containing more bricks, including some of higher durability, which require a double hit to dissolve, thus creating a more complex playfield.

Plot background. Clean Monday, also called Koulouma, marks the end of carnival season and the beginning of the spring. It's the first day of the Great Lent, a seven-week period which prepares Orthodox Christians for the greatest feast of the church year, Pascha (Easter). In Greece and Cyprus, it's considered a public holiday and people celebrate it with picnics in the outdoors, consuming fasting food and flying kites.

Koulouma was chosen as a background for this game for various reasons. First of all, it's a family celebration and one favored by children, since it involves excursions in nature and flying a kite with the help of the parents. Second, the Alsos Veikou Park is among the most popular destinations for celebrating Clean Monday in Athens, offering a reason to the local residents to feel proud and take care of their home environment. Additionally, the tradition of Athenian families choosing Galatsi area to spend a weekend in nature can be traced back to the early 20th century, a fact that can be used to connect the past to the present day.

Naxos and Crete, mentioned as places of origin for the two avatars, are islands where many of the current residents of Galatsi originate from (Hatzoudis, 2016). Thus, the game offers a chance to show the user how two local civilizations have interacted in an urban area, finally merging in an hybrid civilization combining elements of many areas around Greece.

Visuals. Again here, the text on the title and the information screens is typographically enhanced and using vivid colors. The background of both levels depicts the Alsos Veikou Park as it looks in the present day, so that the pupils may identify easier with the two avatars.

On the other hand, the images chosen to represent the original civilization of the two islands, belong to characteristic historical monuments: For Naxos, the "Portara" gate of Apollo's temple; for Crete, a red column from the ruins of Knossos Palace. In one of the final screens of the game, these two structures combine to create the main entrance of the Alsos Veikou Park, showing metaphorically how the two distinct cultures blended into something new.

Soundtrack. The music chosen for this game is connected both to the tradition of Clean Monday and the two islands of Naxos and Crete. At first, the opening theme of the folk song *Horepsete – Horepsete* (Let's Dance), introduces the user to the spirit of the wider Aegean Sea area, while its swift and festive tune was selected to create a celebrating mood. The piece was orchestrated by V. Konitopoulos for the Y. Parios 1992 LP record "Ta nisiotika" and retrieved from https://www.youtube.com/watch?v=vv-NUo6l5G0.

The music accompanying the first level is a folk song from Naxos called *Voskistikos* (herder's tune), heard usually during the carnival period, satirically referring to the love troubles in the life of a shepherd. On the second level of the game, representing the culture of Crete, the chosen song is again satirical, escorting a carnival dance game called "skoupa" (broom). The sound was extracted from a local television channel broadcast where the dance was demonstrated with the help of the folk dancing group "Lazaros and Manolis Hnaris" and the music ensemble of Petros Maroulis. It was retrieved from https://www.youtube.com/watch?v=pmSszwiU9rs.

Accompanying information. The title screen is followed by one containing information about the celebrations on Clean Monday, the accompanying activities and the traditional menu of the day. A small picture of the "Lady Lent" (Κυρά Σαρακοστή) appears, showing a doll with seven legs -one for each week of the Great Lent- but no mouth, the absence of which is representing the fasting of the period. The next screen informs the user about the popularity of the area among the Athenians and offers instructions on how the game is played.

After the user successfully completes the first level, another informative screen appears, including data about the area's inhabitants originating from Naxos: The date when they founded their first cultural association, their main fields of employment and their important contribution to the local society. After the end of the second level, a similar "bonus" screen containing information about the people of Cretan origin living in the area, appears, explaining how their neighborhood was named after Crete.

Conclusion

Postmodernism has been accused of causing destabilizing effects on society, influencing cultural identities and indirectly affecting the socioemotional development of school age students and adolescences. It is therefore claimed that present-day education should focus on assisting pupils obtain a strong local identity that will function as a secure shell, allowing them to develop in a less unstable and fragmented environment and at the same time enhance social cohesion. However, the meaning of *local* appears to have drastically changed during the last decades. The constant flow of people possessing heterogenous cultures to the cities, calls for an intercultural consciousness, an identity less associated to origins and more oriented towards the inclusion of difference.

Can the use of digital games in education assist in enhancing a new type of local identity that combines postmodern and traditional elements? The current article presents a project aiming to investigate that hypothesis by introducing a new teaching/learning subject named "Topognosia" (*Knowing the region*), which includes printed and online material, supported by a collection of specially designed digital mini games that incorporate cultural, historical, and geographical aspects of the key area students live in. The implementation of the project on the schools of the region is expected to result to a substantial improvement in all the three elements that constitute local identity: (a) advanced knowledge about regional characteristics, (b) increased desire to stay in the area and contribute to its improvement by dealing with the local issues in collaboration with the authorities and other inhabitants, and (c) enhanced use of the area through activities like school visits -- to nearby hills, the municipal library and the city hall.

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TRANSITIONING FROM TRADITIONAL TO 8-WEEK BLENDED DELIVERY: A CASE STUDY IN ADULT EDUCATION

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Abstract

This paper describes the implementation and preliminary results of a new delivery method for all adult education courses at a small, 4-year, liberal arts institution of higher education in Ohio. Beginning in Summer 2016, all courses in Professional and Graduate Studies transitioned from a 12-week or 3-week face-to-face format, which ran parallel to courses offered in the Traditional College, to an 8-week blended format, with two sessions offered every semester. We address the economic and pedagogical rationale for this change and report on challenges and successes in the first year of implementation.

Introduction

Many adult learners continue their education for job advancement but struggle to balance the demands of work, family, and education. In 2011, 72% of U.S. undergraduate students worked, and 20% worked full-time (Davis, 2012). In the Professional and Graduate Studies (PGS) program at Hiram College (HC), a private liberal arts institution in NE Ohio, the percentages are more pronounced: 93% of the students work, with 52% working full-time or more. Blended learning can help meet the scheduling needs of these students. In the state of Ohio, it is defined as “the delivery of instruction in a combination of time in a supervised physical location away from home and online delivery whereby the student has some element of control over time, place, path, or pace of learning” (33 Ohio Rev. Code, 2005, 3301.079 K1). Blended learning provides a flexible option for continuing education, and research has shown it is as or more effective than other delivery methods in student engagement and learning outcomes (Gross, Pietri, Anderson, Moyano-Camihort, & Graham, 2015). In addition, research reveals that students who begin at a two-year college with the intent to complete at a four-year institution, and students who take more than four years to graduate, prefer a blended approach (Fleming, 2015); both populations are represented in PGS. For these reasons, for the last six years the *NMC Horizon Report* has included blended learning in its list of top trends in higher education, noting in particular its role in “increasing flexibility and convenience for students” (Adams Becker et al., 2017, p. 18).

There were multiple goals for a transition involving both the academic calendar and delivery mode. Those goals included: to create more opportunities for students to start a degree program with HC throughout the year; to create more flexibility for students through both the calendar and the blended delivery mode; to increase student access to course content and activities; to better align HC's calendar with those of our academic partners; and through all of these efforts, to increase enrollment.

There has been a recent move among some two-year institutions to abandon a traditional 15-week semester followed by a finals week in favor of two back-to-back eight-week sessions. One reason is that the increased scheduling choices available in "fast and furious" eight-week sessions allow students to utilize their time more efficiently and therefore create more "flexible pathways to graduation" (Chernikova & Varonis, 2016, p. 3). In addition, such a format provides benefits to faculty as well, including the ability to take several months off instead of an entire semester (Reed, 2017).

A significant part of the PGS population includes students who are completing their degrees through a community college partnership completion program. Community colleges in Ohio are limited to offering the associate degree; however, articulation agreements between institutions at the state level have provided a pathway for students to optimize transfer credits from their two-year degree in completing a four-year degree at another institution. HC has three program partners: Lorain County Community College, Lakeland Community College, and Cuyahoga Community College.

As each of HC's two-year college partners had 8-week session terms in place, in Summer 2016 HC's PGS transitioned from traditional face-to-face delivery to blended delivery in eight-week sessions in order to provide more flexible scheduling options and to increase enrollment. Courses are now offered face-to-face and online format alternating weeks, with the first meeting always taking place face-to-face. Implementation included face-to-face and online professional development for faculty in best practices for blended learning, including use of the learning management system (LMS), as well as an online module for students on the use of LMS tools.

Hiram College: A Long History of Innovation in the Liberal Arts

Hiram College is a small, private, non-profit liberal arts institution of higher education in NE Ohio established in 1850 as the Western Reserve Eclectic Institute. James Garfield, who later became President of the United States, was a student from 1851-1853 and returned in 1856 as a teacher and then principal. The college has a firm commitment to liberal arts education and encouraging innovation in both the curriculum and its students. Its mission is "to foster intellectual excellence and social responsibility, enabling our students to thrive in their chosen careers, flourish in life, and face the urgent challenges of the times" (Hiram College, 2017, para. 1) with its core values identified as: community, learning, responsibility, diversity, and innovation (Hiram College, 2017, para. 3-7).

In 1931, faculty introduced a novel plan for short, intensive summer courses that allowed students to focus on only one subject for six weeks, frequently off-campus, and earn full credit. After two additional summer pilots, the "Hiram Plan," standardized to seven-week sessions, was adopted in 1934 for all courses year-round. The success of this plan led to Hiram College's identification by the *Saturday Evening Post* in 1954 as "The Happiest College in the Land" (Clark, 1954).

While the College eventually returned to a traditional 15-week semester, it innovated again in 1995 by introducing a new "Hiram Plan," a split semester including a 12-week session followed by a 3-week session each semester. In the 3-week sessions, students enroll in one intensive course, many of which involve study abroad and internships. Until 2016, both Traditional College and PGS students followed the same 12-3 schedule, though for reasons of scheduling it proved a better fit for the Traditional College than for PGS. Many of the PGS students simply "skipped" enrolling for the three-week term, which resulted in decreased credits earned each semester. This prompted a re-examination of the schedule in order to help PGS students continuously move forward on a pathway towards graduation.

The Traditional College

The Traditional College (TC) represents the largest student group at Hiram College. The TC is composed of traditional students (ages 18-24); they are recent high school graduates, and approximately 80% live on campus. While the TC offers courses only during the fall and spring semesters, PGS offers courses year-round.

Professional and Graduate Studies

Professional and Graduate Studies began as the Weekend College in 1977. It was the first evening and weekend program aimed at working adults in the state of Ohio and the second in the country at the time of its founding. Today, the program has expanded to include the Weekend College at the HC main campus, three community college partnerships, and two fully online degree programs. The population PGS seeks to attract are non-traditional students who balance family, work, and school. To accommodate their schedules, all classes are held on Thursday and Friday evenings and on Saturday mornings and afternoons. It is possible for students who begin their academic career with a community college partner to complete their undergraduate degree by taking courses offered by HC on the community college campus.

PGS currently includes eight full-time employees: Associate Dean of Academic Affairs (first author); Director of Enrollment; four Program Counselors; an Academic Support Coordinator, and an Instructional Designer (second author). Most faculty are adjuncts, but some full-time TC faculty teach for PGS during the summer or as part of their regular load during the academic year. The courses they teach are the same as those offered during the regular academic year.

When the Weekend College began, it operated on the same 12-week, three-week term schedule as the Traditional College. During the 12-week term, classes met face-to-face every other weekend, allowing working adults to take classes on the weekends and balance work and family responsibilities. At the same time, in the absence of an online presence for the courses, students typically worked in spurts every two weeks rather than by interacting steadily with course content and activities throughout the term. In contrast, during the three-week part of the term, classes met for a demanding eight-hour day three weekends in a row with no weekends "off." In the early days of the Weekend College, enrollment in the three-week term was comparable to that in the 12-

week, but in the last five years, enrollment in the three-week steadily declined. While the intensive three-week format is a good fit for traditional, residential students who can utilize those short sessions to take a single course, study abroad, or engage in experiential learning, PGS students had difficulty managing the intensive time commitment, and the fact they did not enroll in the three-week term tended to increase the time expected for degree completion.

PGS had also developed two fully online degree programs, in Accounting and Financial Management and in Business Management. Online courses were always offered on an 8-week schedule, further complicating the academic calendar. While online courses have always been directed at PGS students, TC students are permitted to enroll in them during the summer, but must seek special permission to take online PGS courses during the traditional academic year.

Transition to Blended 8-week Courses: Summer 2016

There were multiple reasons to consider an alternative schedule and method of delivery for PGS courses. The primary reason for an 8-week schedule was to provide more starting points within a semester to attract new students on a consistent, rolling admissions cycle. A second reason was to provide more flexibility for working adults. For example, if job commitments made it impossible for a student to attend class for a portion of a 12-week term, the student would have to wait until the next semester to enroll and thus delay steady progress towards a degree. However, with eight-week terms, the same student could enroll in a course during the part of the term not affected by the work commitment. This possibility would therefore enhance student opportunities for course and degree completion. Another reason was to drive enrollment by offering a schedule that aligned with the schedule of community college partners and the current online calendar. Transitioning to an eight-week schedule could address all of these concerns. Transitioning to blended delivery mode within the eight-week format provided several other benefits. First, despite the shorter term, students would maintain much-needed opportunities to enjoy other aspects of their lives during the weeks they were not on-campus and better balance work, school, and family life. Second, technology-enhanced learning would give them 24/7 access to course materials and the ability to complete assignments from a distance, thus allowing a more even distribution of activities and assignments throughout the course.

Blended delivery necessitated the use of a Learning Management System (LMS) in all PGS courses, including those taught by faculty who had never used an LMS before. While an LMS was introduced at HC in 2007, and the Moodle LMS adopted in 2012, neither TC nor PGS faculty were required to utilize it. The College experimented with several measures to support faculty in the use of the LMS including an instructional designer (ID), a cadre of faculty mentors, and an Instructional Technology administrator. These varying positions provided individual faculty support, faculty development sessions, and the creation of support materials such as written documents and resource videos. Over time, however, the college cut the initial instructional design position.

When the decision was made to shift PGS to an 8-week, blended format, we began with a pilot that involved three courses in spring, 2016. The transition involved planning class sessions that involved meeting students face-to-face in the odd-numbered weeks, beginning with Week 1, and interacting with them solely online in the even-numbered weeks, including the final week. Following the pilot, the blended delivery format was introduced throughout PGS in a “soft” rollout with the summer 1 8-week session in May 2016. To help faculty prepare for the new format, we held an all-day faculty development workshop in March. The associate dean interviewed instructors in the pilot program to seek advice regarding successes and challenges and planned sessions for the faculty development day to support these early lessons.

In May 2016, the senior administrators of HC supported the hiring of a new ID for PGS to: provide professional development to PGS faculty in the use of the Moodle; to assist PGS faculty with the design and development of their own courses; and to create a Moodle orientation for PGS students. Several weeks after her arrival, the Instructional Technology administrator left the College, and therefore the ID assumed full Moodle admin privileges and became the point of contact for all Hiram College faculty requesting assistance with Moodle and other learning technologies.

Student and Faculty Training Resources

The transition to blended delivery was primarily motivated by the desire to facilitate student interaction with their courses by providing online access to course resources and activities during the "online" weeks. However, some faculty and students had limited or no experience with Moodle and therefore training resources were planned for both groups.

For Students: Moodle Module 0

An orientation to student Moodle use was designed as a Moodle module (section) and then added to every PGS Moodle site beginning in fall, 2016. This orientation was created using the Moodle “page” tool, which provides an html toolbar and the ability to create original text and include multimedia. The aim was to provide an overall orientation to the use of Moodle, including user preferences, and a demonstration of the steps for submitting work through commonly used Moodle activity tools. Topics included: Getting Started; The Moodle Homepage; Your Course Homepage; Participants and Profiles; News Forum; Course Content; Assignments; Quizzes and Exams; Forums; Grades; Activity Reports; Communicating with Your Instructor and Peers; and The Hiram College Helpdesk.

The Orientation was intentionally designed as a resource, not as a tutorial with assessments that students were required to work through, so its use was optional. However, faculty informally reported that they directed students to the Orientation and that it facilitates student use of Moodle tools.

For Faculty: Professional Development Workshops
A variety of professional development opportunities helped to prepare faculty for the change in delivery, provide continuing opportunities to focus on tools and pedagogy, and reflect on the change at the end of the first year.

Spring 2016. A one-day workshop to prepare faculty for the change in delivery was offered in March 2016, with sessions offered by the Associate Dean and faculty experienced with utilizing Moodle. Seven formal session topics included:

1. An opening session that focused on learning objectives and balancing face-to-face and online time in the blended environment
2. Moodle basics
3. A lunch address by the Vice President of Enrollment on the economic driver for transitioning to blended
4. Lecture capture
5. Building quizzes and tests
6. Leading online discussions
7. Using the Moodle Gradebook.

Concurrently, additional informal sessions provided workshop time during which faculty could work on their own courses under the guidance of "floating" staff from the Computer Center and Library; however, most faculty attended the formal sessions instead.

To encourage further reflection on best practices in teaching and learning, the 23 faculty who attended were given a copy of a book focused on increasing student engagement with the aim of helping them develop strategies for engaging students both during the face-to-face weekends and the online weekends. Presentations and support materials were made available in the Moodle Resource Center following the workshop.

Summer 2016. In August 2016, workshops offered by the ID were advertised to PGS faculty only and delivered in two-hour sessions twice a week for four weeks, for a total of eight hours of professional development. They were delivered face-to-face and simultaneously via web-conferencing from noon to 2 PM on four consecutive Mondays and repeated from 6 to 8 PM on Thursday evenings; they were also recorded using a web-conferencing recording feature and made available in the password-protected Moodle Resource Center. The first session included an introduction to blended learning and a discussion of learning objectives and alignment with institutional goals and course components; subsequent sessions focused on specific Moodle tools and how they could be utilized to enhance teaching and learning, as well as accessible course design and copyright compliance. Nine faculty members attended these sessions. Although there was no formal assessment of the workshops, informally participants indicated that it would have been helpful to have time available to practice the skills in their own courses.

Fall 2016. For fall, the workshops were expanded to all faculty and re-envisioned as an hour of presentation followed by an hour of “open lab” where participants could work on any aspect of their own courses. They took place over ten weeks on consecutive Mondays, noon-2 PM and 5-7 PM, and were billed as “Moodle Monday” to establish a predictable pattern. The series launched during the 2nd week of the semester and continued for ten weeks. The schedule was announced in advance, and a reminder invitation was sent the morning of each Moodle Monday. The topic focusing specifically on “blended courses” was dropped since faculty attending might be teaching face-to-face, blended, or totally online; other topics were added, and the final session was a “Five Minutes of Fame Instructor Showcase” during which faculty members highlighted the use of learning technologies in their own courses. As before, sessions were recorded using a web-conferencing recording tool and were made available online. Twenty faculty members participated, including three who had also attended summer sessions.

While attendance “maxed out” at seven for any session, throughout the semester faculty responded to any of the reminder e-mails when they had problems with Moodle or specific questions about its use. For example, there were many questions about use of the Gradebook towards the end of the semester, and some took the form of a “reply” to a workshop announcement or reminder sent at the beginning of the semester. Thus, advertising the workshop schedule and sending weekly notices provided a way to remind faculty of the support they had available to them, and they took advantage of the support even if they did not attend the workshops.

Spring 2017. In Spring 2017, the fall workshop schedule was repeated, with some updates, and shared in advance with the new topics clearly identified. Six faculty members attended in the spring, four of whom had also attended sessions in the fall.

In addition to the Moodle Monday sessions, another daylong faculty development day was offered on a Saturday in March 2017, with eight formal sessions offered by HC staff and faculty:

1. An overview of the 8-week initiative
2. Library resources
3. Beyond the nuts and bolts of Moodle
4. Best practices and pedagogical concerns
5. Round table discussions during lunch on balancing face-to-face and online time and engaging students in the blended environment
6. Best practices in setting up a Moodle site and utilizing the Workshop tool
7. Best practices using web-conferencing to work with students remotely
8. Universal Design for Learning

PGS faculty who attended were offered a stipend, with half the amount being offered to TC faculty attendees who did not also teach for PGS. A total of 34 attended.

Summer 2017. Several sessions were offered to introduce faculty to a new mobile-responsive Moodle theme, which was implemented college-wide in May and first utilized in seven summer I PGS courses. The new theme is designed to facilitate use on mobile devices and allows greater personalization of courses, but also includes a number of changes, including resource and activity display and access to admin functions. The sessions were publicized to the HC community, recorded, and made available online.

For Faculty: Online Training Resources

Based upon faculty questions and needs, the Moodle Resource Center was expanded and then re-organized into sections, which currently include:

- **Moodle Instructional Video Library** – videos that demonstrate use of Moodle tools, created by a faculty member who is also a "volunteer" Moodle Mentor.
- **Moodle Moment Task Aid Documents** – documents with text and images that offer step-by-step directions on the use of Moodle tools.
- **Moodle Monday Workshops** – PPTs and video recordings of workshops offered on multiple Moodle topics.
- **PGS 8-week Resources** – documents that focus on teaching and learning in an online environment or blended environment, including presentations made at the PGS Professional Development Days in spring 2016 and 2017 and workshops in using Moodle in a blended environment offered summer 2016. In addition, the site includes a syllabus template focused on PGS courses that includes "boilerplate" information on college and course policies as well as course-related information designed to meet the standards of the Quality Matters 5th edition Higher Education Rubric. (Quality Matters, 2014; Varonis, 2014).
- **Rubric Repository** – sample rubrics on different topics that could be used or modified as documents or converted for direct use within Moodle to facilitate grading.
- **WebEx Resources** – task aids that describe the process of using WebEx in order to web-conference in real time.

The ability to direct faculty to these resources has allowed them to be more independent in their own course design and development. Resources, in particular the Moodle Moment Task Aid documents, are created and/or updated as the need arises.

For Faculty and Students: Personal One-to-One Support

In addition to online resources and workshops, faculty are encouraged to request ID assistance with course design and utilization of learning technologies or with troubleshooting course delivery. A major focus of collaborating on course design is to ensure that learning objectives are the same as those for a face-to-face course, that the course is designed to guide students in achieving those learning objectives, and that students remain engaged and active during the weeks they do not meet face-to-face. Design meetings with faculty take place face-to-face, via web-conferencing, and over-the-phone. Questions related to development and implementation are addressed similarly and via e-mail, typically during work hours but also during the evening or on weekends when time is critical. When necessary, the Director of the Computer Center is consulted to help solve a problem, or a ticket is opened with the third-party vendor that administers the Moodle courses hosted by HC.

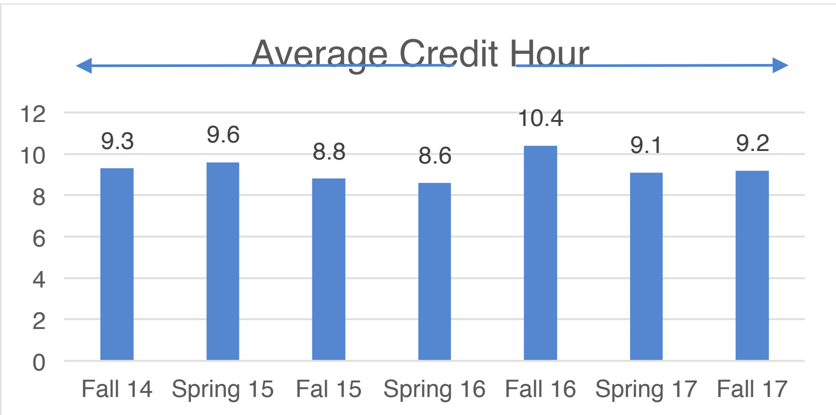
Students can contact the Computer Center Help Desk for personal support and assistance troubleshooting problems. Rarely, if the Help Desk student assistants or staff cannot answer student questions specific to Moodle, the request is escalated to the ID.

Summary of Implementation: Year 1

Impact on Enrollment

The overall goal of this initiative was to increase enrollment with new starts and to better accommodate the scheduling needs of current students. While the data on current students is anecdotal, enrollment tracking over three semesters provides more concrete data. In PGS, the primary enrollment metric is average semester credit hours. Head counts are important, but one student could take three credit hours and another could take 16. It is different from the TC where all students pay for a base of 18 credit hours. Thus, an increase in average semester credit hours year over year in each of the three semesters of the 2016-17 academic year is an early indication of the success of this new calendar. Table 1 shows early gains in semester credit hours in the new delivery format; numbers for Fall 2017 are also included, but are likely to increase by the start of that semester.

Table 1
Average Credit Hour Enrollment of PGS Students Fall 2014 – Fall 2017



Impact on Student Satisfaction

Now that we have completed one academic year of this model, we have a better understanding of the operational and pedagogical challenges. It would have been premature to ask students to respond to the new format during the initial rollout. We are still in a phase where the blended format may be new to some instructors or some courses may still be in their first blended offering, but we have enough anecdotal evidence from course evaluation feedback, student and instructor feedback to craft a satisfaction survey to be administered in the 2017-18 academic year. Main topics of this survey will include satisfaction with delivery mode, satisfaction with time to degree completion, feedback on overall course scheduling, and technology support.

Informal Faculty Feedback
Faculty attending the PGS Faculty Development Day in March 2017 were asked to respond anonymously to printed table discussion prompts with others sitting at the same table during lunch, and then to document their responses in writing "so that we may collect and share."

Balancing face-to-face and online time. The first prompt commented on "the balance between face-to-face time and online time in the blended environment" and asked participants to "share with those at your table how you approach the decision about what to do in the classroom and what to do online." Responses suggested that face-to-face time was perceived as very valuable, and therefore faculty put significant thought into implementing a schedule that could optimize use of this time. In other words, rather than approaching blended teaching as an opportunity for learners to access and interact with course materials 24/7, as frequently as needed, they seem to perceive time outside of the course as “second best,” and best utilized for activities for which face-to-face time is not required. Several themes emerged from the prompt, in particular, faculty preferences for enhancing interaction. To comment upon these preferences, we utilize the framework of Moore (1989, p.1), who distinguishes among three types of interaction in distance education: learner-content, learner-learner, and learner-instructor.

Learner-content Interaction. With respect to *learner-content* interaction, faculty indicated a preference in the face-to-face weeks for what one faculty member described as “what must be done in person,” namely, "harder material," "tangible in-class activities that emphasize application of assessments," and labs. In contrast, learner-content interaction in the “online” weeks focused on what the same faculty member described as “what can be done online": access to course resources like videos, case studies, and other instructional materials; and individual work, including writing, submitting drafts and papers, and taking quizzes and tests. As another respondent commented, “Why waste valuable face-to-face time?" The difference in phrasing between “what must be done” and “what can be done” highlights an apparent difference in how faculty value face-to-face and online delivery.

Learner-learner Interaction. Faculty similarly distinguished between face-to-face and online environments for *learner-learner* interaction. They specified utilizing face-to-face time for interactive activities such as debates, group work, peer workshopping of each other’s individual papers, and presentations. One faculty member commented that the greater the number of learners that were involved in an activity, the more likely it would take face-to-face. Another summarized the idea that learner-learner interaction was more successful in the face-to-face environment by suggesting "Take maximum advantage of relationship development in person." With respect to learner-learner interaction in the online environment, one faculty member expressed concern on how to facilitate discussions online, while another noted two technology tools introduced during the morning session that could help increase interaction.

Learner-Instructor Interaction. Somewhat surprisingly, faculty commented less upon differences in learner-instructor interaction in the two environments, although comments that touched on face-to-face learner-content interaction probably assumed a high degree of learner-instructor interaction as well. One mentioned the strategy of "Initiating activities in the classroom that learners can complete online." Another announced providing more reminders in the online environment: "[I] have started adding a 'You should be working on' and 'You should be reading' notes in addition to the due dates. It's a small thing, but I think it helps students to remember the online week in not an 'off' week." Finally, a faculty member reflected on future technology use to enhance learner-instructor communication: "I am hoping to Skype individually with students for perhaps an hour in order to explain concepts in greater depth. This would be optional of course."

Successful technology and delivery implementation. A final theme that emerged was reflection on ways to ensure that learners could be successful in the blended environment. One faculty member suggested ensuring learner readiness by testing for "technology familiarity and access." Another indicated a preference for changing the first-week-face-to-face schedule used by all PGS blended courses so that the last week could be face-to-face instead: "Maybe make first week an off week, online, prepare."

Strategies to engage students. The second prompt focused on strategies to engage students regardless of delivery mode, asking in particular that respondents "share successful examples of how you have been able to engage students in your classes or talk through challenges where colleagues may be able to help." Again, several themes clearly emerged.

Engaging students through instructional materials. Faculty commented upon resources they had been introduced to that morning, including utilizing subscription services for educational multimedia that HC had acquired as well as utilizing free services for educational multimedia. In addition, one faculty member supported utilizing original case studies, which "make students more involved."

Engaging students through collaborative activities. Faculty distinguished between face-to-face and online environments in suggesting collaborative activities that could help engage students.

For the face-to-face environment, they promoted activities such as:

- Forming groups for initial in-class work on an assignment, which could then be completed individually or in groups outside of class.
- Requiring student presentations to class.
- Deliberately finding ways to "to engage different parts of their brain" by including hands-on activities like taking cut-up sentences of a well-written essay and forming them into a coherent paragraph.

For the online environment, there were fewer suggestions. We infer from this that faculty are still adjusting to teaching in a blended environment and still in need of support. One faculty member promoted using discussion forums that include specific assignments with specific deadlines for posting. Another commented “I'm finding it difficult to kept them engaged online. It's hard to keep a conversation going or lead them to new ideas.”

A few suggestions could be directed to both face-to-face and online discussions, e.g., “Clarify what constitutes meaningful feedback and civil discussion,” and requiring discussions that go “Beyond ‘I agree’” so that learners “contribute meaningful/representative example.”

Engaging students through deliberate teaching and delivery strategies and software tools. Several faculty members commented upon utilizing pedagogical strategies and technologies to engage students, involving both faculty and student technology use. Suggestions included: “Find their learning style and use teaching and delivery strategies that suit them”; “Use of apps for real-time games to reinforce course content attainment”; and use of apps for faculty or student creation of multimedia.

Engaging students by reinforcing the goals of a liberal arts education and creating a culture of accountability. Finally, faculty took the open-ended question as an opportunity to comment, sometimes with frustration, upon lack of student awareness of the goals of a liberal arts education and the need to make students accountable. This seemed to be less focused on the delivery format, but perhaps the blended environment made faculty more aware of student challenges in taking responsibility for their education. Several suggested that students be reminded of the goals of liberal arts education, and the goals of Hiram College in particular, with one noting that community college students "do not necessarily embrace the goals.” Another stressed that faculty should “create a culture of accountability” and that students should take “responsibility for their education”; this might be enhanced by asking them "What would you like from this class?” Another commented about the difficulty of “getting students to read,” and even the need to “Teach them how to read.” One offered a strategy that might help in the blended environment: “Get students to work throughout the weeks, e.g., by scheduling an assignment due soon after an in-person class.” And another commented that it is “Harder to lead the horse to water" in this format, in comparison to the traditional Hiram environment where profs may often have more access/power to cajole students to give great efforts. What is the key to inspiring?”

Next Steps and New Innovations

As the first year of implementation draws to a close, we can take this time to reflect on the successes and challenges of this new delivery mode. In terms of successes, average semester credit hours are increasing in the new format. We are still enrolling for fall 2017 so we expect that total to increase. Overall, anecdotal feedback from faculty and students has been positive. Students appreciate continuing the alternate weekend format and are beginning to see how this schedule will help them speed their path to degree completion. Faculty continue to embrace the functions of the learning management system and work to improve their courses. Some very specific items are surfacing as areas where faculty need assistance. These concerns, such as ensuring copyright compliance for multimedia formerly delivered face-to-face, and addressing accessibility in course documents made available online, will help to set the professional development agenda for the next year. Another success includes the emergence of a "community" of faculty users who can share experiences in technology integration. In the coming year, we will complete a formal survey to collect data on student satisfaction to add to the semester credit hour data as another evaluation metric.

Hiram College is continuing its spirit of innovation by introducing Tech and Trek, a 1:1 iPad initiative in the traditional college for the 2017-18 academic year. In the first phase of this project, students, TC faculty, and staff are given iPad Pro devices along with significant professional development to use the devices in the classroom and across campus to improve student learning and engagement as well as improve operations in various facets of the college. PGS is slated to be included in the second phase of this program. We are looking forward to utilizing iPads to enhance the blended delivery model, giving all users a common device and platform, common apps, and reliable mobile-friendly access to the learning management system. We also look forward to documenting the success of this approach. According to the 2017 Horizon report, "Online, mobile, and blended learning are foregone conclusions. If institutions do not already have robust strategies for integrating these now pervasive approaches, then they simply will not survive. An important step is tracking how these models are actively enriching learning outcomes." (Adams Becker, et al., 2017, p. 2). As Hiram College moves forward as an increasingly digital campus combining the blended format in PGS with mobile technology keeps the College viable now and into the future.

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STATE OF THE ART TECHNOLOGY? MAPPING STUDENTS´ TALK ABOUT INFORMATION AND COMMUNICATION TECHNOLOGY IN UPPER SECONDARY SCHOOLS

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Abstract

This paper explores upper secondary school students' talk about how information and communication technology (ICT) can structure and support their everyday activities and time in school. The data consists of 11 group interviews with a total of 46 students. The results show that ICT plays a central role in the students' schooling, not in terms of "state-of-the-art" but rather as "state-of-the-actual," for instance in supporting the writing process and for peer-support, digital documentation and storage.

Introduction

Information and communication technology (ICT) is said to play a central role in several K-12 school-related activities, from school leader management and administration to teaching and learning in the classroom (Selwyn, 2011). In the ongoing digitalisation of schools, students can bring their own digital devices (BYOD) (Song, 2014) to be used in learning activities they engage in during their time at school. Research reports that students use ICT devices such as laptops and tablets on a daily basis in many schools (cf. Lindberg, Olofsson, & Fransson, 2017; Selwyn & Facer, 2014) and that the digitalisation of education has imposed great expectations for ICT in teaching and learning situations (Wastiau et al., 2013). It has also resulted in a number of challenges (Olofsson, Lindberg, & Fransson, 2017; Tondeur, van Braak, Ertmer, & Ottenbreit-Leftwich, 2016), for instance in relation to students' in-school use of smartphones (Philip & Garcia, 2015).

According to the literature, many schools still seem to struggle with their digitalisation. Questions that have arisen include: How should schools respond to a situation in which students have instant access to their own ICT devices at school (Selwyn & Bulfin, 2015)? How should schools deal with students using ICT for academic and non-academic purposes whilst at school (Charles, 2012)? This paper aims to answer such questions from a student perspective. More specifically, the focus is on students' talk about how ICT contributes to structuring and supporting their everyday activities and time in school.

Some Additional Notes About Related Research
In their study on the various ways in which Australian secondary school students use ICT, Bulfin, Johnson, Nemorin, and Selwyn (2016) emphasise that even if schools respond optimistically to the ongoing digitalisation, they "continue to regulate student behaviour, not least in terms of what students are expected to do, and when and where they are expected to do it" (p. 240).

By encouraging research to focus more on "state-of-the-actual" rather than "state-of-the-art" technology, Selwyn (2010) asks, "What is the use of technology in educational settings actually like?" (p. 70). Bulfin et al. (2016) further distinguish between the notions of "school as a location/ setting for digital technology use" (p. 2) and "school as a purpose for digital use" (p. 2). The former refers to how technology use is facilitated by institutional infrastructures and school rules and regulations, whilst the latter refers to how ICT is used for "the logistics of managing one´s studies or using technology to engage in learning" (p. 2). Bulfin and colleagues report that the students in their study stressed the importance of their teachers' consistent use of ICT, the need for teachers to improve their digital competence and schools' provision of adequate ICT support for students. Due to the various infrastructures and regulations, it was found that only certain types of ICT were used in the investigated schools and that information retrieval (e.g., Google) and content creation (e.g., Word) were the most common in-school ICT activities. This last finding is in line with Mangen (2016), who argues that writing is now mainly performed using digital technology rather than a pen and paper. García-Peñalvo and Svanaes (2012) report that an increased use of digital writing in school can contribute to greater student motivation and that, "For those who struggle with their handwriting, which can be a problem across different disabilities, typing notes and messages is often easier and less time consuming than writing by hand" (p. 60).

Another growing body of research relating to the study at hand concerns students' in-school use of smartphones. Some results indicate that smartphones have a positive impact on students' learning (Philip & Garcia, 2015; Thomas, O'Bannon, & Bolton, 2013), whereas others point in the opposite direction. For example, Beland and Murphy (2016) show how the banning of smartphones in schools in four English cities affected students' examination results at the end of nine years of compulsory schooling. Schools that have banned smartphones experience much better academic results after the ban than before it, with the lowest-achieving students making the greatest headway. Results like these are interesting, but can also potentially create an in-school dilemma. For example, schools banning smartphones could be viewed as being against digitalisation. At the same time, they may not want their students' achievements to decrease due to a potentially non-school related use of ICT.

An ICT tool that is used in the schools reported on in this study and also more generally in western European schools is the Learning Management System (LMS). Ros et al. (2014) describe the development of LMS in terms of three generations and show how the third generation of LMS allows students to personalise their use of it. Further, LMS makes other communications and collaborations possible, for example between teacher and parent, or student and student. Yildram, Reigeluth, Kwon, Kageto, and Shao (2014) explore the use of several LMS in relation to their capacity to support what is described as a learner-centred paradigm of education. They conclude that LMS should support collaboration both inside and outside school, be able to be customised by users and be used via smartphone apps. In their study, García-Peñalvo and Alier Forment (2014) argue that it is important for institutional LMS to co-exist, interact and enrich other digital tools that students use in the learning context.

Purpose

The purpose of this paper is to explore how students at upper secondary schools talk about ICT for structuring and supporting their everyday activities and time in school. Two research questions are posed: (a) What do the students regard as the main areas and activities of ICT use? (b) How might schools improve the use of ICT to structure and support students' time in school?

Methodology

This study is part of a four-year research project on how ICT is used in upper secondary schools in Sweden. Three schools are included in the study that, in different ways, have been recognised for their advanced use of ICT. Two of the schools are campus-based (schools A and B), whereas the third (school C) has a mixture of campus and distance teaching. When the data was collected (in November 2015), a new LMS system had just been introduced at two of the schools (A and B). The data consists of semi-structured focus group interviews. A total of 11 group interviews with 46 students were carried out. In six of the groups the students followed theoretical programmes, and in five of the groups the students followed vocational programmes. The students were either in their first or third years. The number of respondents in each group varied from three to six students, and the interviews lasted between 30 and 60 minutes. The interviews were transcribed verbatim before being analysed.

The analysis was conducted using content analysis, including meaning condensation (Kvale, 2008). The data was analysed in several steps. Using NVivo (Pro 11), the first step of meaning condensation resulted in 22 broad categories of the complete set of data. In the next step, the data was transferred to a Word document consisting of 242 pages. The document was read several times in order to: (a) identify whether some of the categories were too broad or outside the scope of the study and could therefore be removed and (b) determine whether some categories were similar in focus and content and could instead be grouped together in one category. This process resulted in 17 categories in a 64-page Word document. In the fourth step, the document was repeatedly read in order to further condense the meaning of the data. This resulted in 12 categories in a 15-page Word document. Six themes were constructed from these 12 categories and are presented below.

Results

In this section the results are presented in a thematic and qualitative manner.

Theme 1. How and When Should ICT Be Used in School?
There were some variations in the students' descriptions of the frequency of use of ICT. For example one group of students, attending a theoretical programme at school C, talked about ICT as being used intensively on a daily basis: "[I]*f you don´t bring the laptop you won't be able to do anything because you won´t get tasks on paper*" (student, year 1, school C). In contrast, a group of students in a vocational programme (student, year 3, school B) estimated the time of ICT use to between three and four hours per week. However, the majority of the students in the 11 groups said that they used ICT in school at least four out of five days a week. Students talked about the use of ICT both as something that the subject teacher decided and as their own choice. Some students stressed that it must be their teachers' decision when ICT should be used "*…you actually have to trust the teacher´s judgement. I mean they were also students once*" (student, year 1, school B). Several students expressed confusion about when ICT could or could not be used at school and that they experienced the way their teachers talked about ICT as paradoxical: "... *`well I* [the teacher] *am rather old-fashioned so I want you to take notes using pen and paper'…but they* [the teachers] *anyway always tell us to bring the laptop as often as possible*" (student, year 1, school B).

Theme 2. ICT – Making Storage and Text Production Easier
ICT was often talked about as supporting the ongoing documentation of students' schoolwork "*…you have all your stuff in one place, you can search for things. Everything is so easy. I especially appreciate the easiness*" (student, year 3, school B) or "[I] *can create folders* [in Google Drive]*, and know for sure where they are*" (student, year 1, school C). Some students also wanted to use their school laptop for private means by having school and non-school related aspects on one digital device "[A] *lot of people do that. Using it* [the laptop] *both as a private and work computer is common in many workplaces*" (student, year 1, school A).

The students claimed that the laptop helped them to take structured notes during lectures "[Y]*our notes aren't a mess if you are stressed. If you're stressed and take notes using pen and paper you can´t always read what you've written*" (student, year 1, school B). The laptop also enabled the students to move easily around text sections or to reformulate sentences in their documents. Moreover, the students maintained that digital written texts could be better structured, were of higher quality, and could be completed in less time than they would be with pen and paper "[I] *mean, we can write so much faster on the computer. Basically our fingers fly over the keyboard*" (student, year 1, school A) and "[I] *often change a lot in the* [text] *structure. You can´t* [using pen and paper] *move a section in the same way, which means that you need to think in a different way than you're used to. That takes a lot of time*" (student, year 3, school A). Another aspect of how ICT supported students' communicative work was "*...when giving oral presentations it's much easier to have your notes in your smartphone*" (student, year 3, school B). Some students thought that teachers should only use digital assignments, both with regard to digital editing and for physical comfort: "*...writing 27 pages makes your hand ache a lot*" (student, year 1, school C).

Theme 3. Institutional Regulations and Support
Students at all three schools had to sign a laptop user-contract. School leaders, teachers and IT technicians had the right to control students' laptops if there was any suspicion of irresponsibility. Several students talked about the contracts as reasonable "[I] *can´t say that this is wrong. It's a school laptop and should be used for that purpose and not for a lot of other things*" (student, year 1, school A). However, many students also expressed uncertainty about the regulations, if they were used in practice or were simply a rhetorical trick: "[I] *think they are pretty cool about this* [downloading], *but yes it might prevent students from doing it if the school first issues a warning and if it happens again take the laptop away*" (student, year 1, school A). Despite this, several students stressed that they did not at all want their laptops to be impounded because it was an important tool for their schoolwork and that if it was taken away their studies would suffer.

In all the groups, the student talk included aspects of the ICT support provided by their school. Overall, the students seemed to be relatively pleased with the support they received. However, one frequently mentioned improvement concerned the limited opening times of the ICT support centres, which potentially conflicted with students' lesson times. Further, the turnaround time for a laptop handed into the local ICT support centre could range from one day to two or three weeks. At school C, the students were concerned that "*only having one IT technician at the school is vulnerable*" (student, year 1, school C). Other students at school C said that the Internet connection was not always stable and that they had experienced problems with lessons not running smoothly as a result: "*…it was on a Monday. All the students are in school that day, sitting with their laptops. It* [the connection] *didn´t work, we were too many* [connected to the Internet at the same time]" (student, year 3, school C). Students at this school were also grateful that the maths teacher made sure that the ICT infrastructure worked well for the distance-based lessons:"*…even if he has his own class* [of students] *he always pops in to make sure that everything's OK*" (student, year 3, school C).

It can also be noted that, with one or two exceptions, students at all the three schools seldom talked about more structured introductions of digital software, such as Microsoft® Office or the local LMS. However, there were a few examples. At school C, students said that in first grade they were introduced to Class Live [a synchronous ICT tool] and taught how to use Fronter [the local LMS] and LMS for online communicative purposes when studying at a distance.

Theme 4. In-School Use of Smartphones
In many of the groups the students talked about not being allowed to use their smartphones during class: "[T]*he teachers think that you use it* [the smartphone] *for checking out social media…you should show* [the teacher] *what you are searching for*" (student, year 3, school A). Teachers were also thought to have difficulties judging whether smartphones were used for learning purposes or not: "[I]*t is easier for them* [the teachers] *to check whether the laptop is being used than the smartphone*" (student, year 3, school B). Several of the students talked about the use of smartphones in the

classroom as a potential distraction and a disturbing element. In some of the groups the students talked about responsibility "[I] *feel that if you pick up the smartphone you'll risk missing the lecture, but that's your own fault. It's your problem. You have to take more responsibility*" (student, year 1, school B). One group posted the rhetorical question: "*...perhaps they* [the smartphones] *could be part of the teaching, so you can focus on the right things*?" (Student, year 1, school C).

Despite the talk about smartphones as a distraction and students seldom being asked by their teachers to actively use their smartphones for learning purposes, there were some exceptions: "[Name of the teacher] *lets us use it* [the smartphone] *as a dictionary, for listening to music, for checking out things we want to know more about or understanding in order to make learning easier*" (student, year 1, school A). Some students also described the advantages of using smartphones in class: "[M]*aybe you have a test that day or something needs to be handed in. If you have taken a photo and by accident display it* [the photo] *on the smartphone, you just think `now I remember`* [we have a test today]" (student, year 1, school B). Other advantages were that smartphones could be used as calculators and for speed googling to avoid starting up the laptop. Students also said how much easier a smartphone was to carry than a laptop. Another argument for in-school use of the smartphone was: "[I]*f I want to check something here and now it's very convenient. It's great for retrieving information*" (student, year 3, school C).

When talking about the usability of technologies like the laptop, tablet and smartphone, students seemed to prefer laptops to tablets and smartphones: "[P]*ersonally I think that the laptop is far better than the smartphone. It has a much more powerful hardware which makes things so much faster and it's also easier to write on it* [the laptop]. *The space for writing is very small on a smartphone*" (student, year 1, school A).

Theme 5. LMS

The talk about LMS concerned the teachers' and the students' own use of the system. Many students said that most of their teachers used the local LMS to some extent. It also become apparent that a mobile app for the LMS would probably result in more active use on the part of the teachers. The teachers' use of LMS was described as being for activities such as distributing and collecting assignments, posting student grades and disseminating information and learning materials.

Students described many teachers as dissatisfied with the design and functionality of LMS: "[I] *haven´t met a single teacher who actually likes it* [the local LMS]" (student, year 1, school B). The limited use of LMS by the teachers was related to the age of the individual, their own interest in using LMS or their low levels of digital competence: "[T]*oo often you hear phrases like `I´m not confident in using ICT, I can´t use it`. They* [the teachers] *have to learn; that´s the reason why it's like it is when it comes to the present use of XXX* [LMS at school B]. *There are lots of possible functions in the system, but we only use one of them because that's the only specific function they* [the teachers] *know how to use*" (student, year 3, school B).

Students in many of the groups also talked about being dependent on the teachers for using LMS in a consistent way. If they did not do this they could miss school assignments and as a result fall behind in their schoolwork. This seemed to be the case for students at school C: "*...if we're out on a training camp we're not physically able to go and see the teacher*" (student, year 1, school C). Teachers' consistency of use also seemed to reflect how frequently the students logged into LMS: "*...if you know that work is to be done or has been uploaded* [to the LMS] *you log in. You don´t log in just to check for new information*" (student, year 1, school A). Many of the students talked about inconsistent use as being related to the implementation of a new LMS system: "[I]*t* [XXX, the former LMS] *was easier to use than YYY* [the current LMS] *and above all our teachers knew that system really well. Now the teachers hardly know how to use YYY, it has become more difficult to access the things you need. In my experience, since we switched learning platform things have got worse*" (student, year 3, school B).

Students at all the three schools mostly used LMS for submitting assignments and downloading new tasks. However, many also talked about LMS as an important hub for supporting and structuring their time in school: "*...we have a room in XXX* [the local LMS]*, you just enter that room and the log out if you don't have anything to submit to the teacher*" (student, year 3, school B), or "[I]*t´s so much easier. You don´t need to keep track of a lot of paper...you can access* [to the LMS] *at home. For example, if you are ill you can still do your* [school] *work*" (student, year 1, school A).

A new LMS system had recently been introduced at two of the schools. Some of the students talked positively about the change of LMS system, although the majority seem to be of a different opinion. On the positive side, the students regarded some of the teachers as supportive and able to demonstrate the basics of the new system, such as how to report sick leave and absence from school. However, several students talked about texting a classmate as the easiest way of reporting this and asking him or her to tell the teacher. On the less positive side, many of the students regarded the new LMS as user-unfriendly and that it contained unnecessary levels: "*...just to submit work to the teacher you have like click ten times. It would've been so much easier to choose from a dropdown list or search* [in the LMS]*...it takes like ten minutes* [to send a message in the LMS]" (student, year 1, school B) or was outdated: "[T] *he LMS is not up-to-date enough. It* [the LMS] *expects that we log into the system using our laptops. It would've been much smarter to use an app*" (student, year 1, school A).

Theme 6. Peer Support Through ICT

Several groups talked about ICT as a functional tool for peer support in school-related activities and in particular mentioned Dropbox, Facetime, Google Drive, Snapchat and Facebook – but not the local LMS. Peer support ranged from sharing information about subject-related assignments to providing each other with peer-review comments on writing assignments. The tools used were mostly said to be other than those provided by their schools. It can be noted that when talking about parallel ICT tools, the students also referred to power, in the sense that they, not the teachers, could decide who should have access and which information should be posted "[I]*f we invite the teachers so they can see and read, it often only includes the presentation. First you write down everything* [in Google Drive] *so that your classmates can take part in a discussion, and after that we do the presentation*" (student, year 3, school A).

In one of the groups the students talked about a page on Facebook that was reserved for members of the class. This page was used to share information to support their school work "*…when you are ill and at home there is always the possibility to post a question* [on Facebook] *about for example whether we have received any homework or whether I've forgotten something to do with school. That's really great!*" (Student, year 1, school B). Examples of other peer support activities were students sending text messages to support a classmate who was ill at home or in the same classroom but did not know how to solve an assignment. Another example of smartphone support use was mentioned by a student at school C, who received support from her father geographically located elsewhere in Sweden "[I] *text a mathematical problem for him to solve. He then texts the solution to me together and calls me to explain what he did* [how he solved the problem] *and how he got that answer*" (student, year 1, school C).

Discussion

The students' talk about how and when to use ICT in school includes many of the aspects referred to in former research (cf. Lindberg et al., 2017; Selwyn & Facer, 2014; Song, 2014). Although there are minor differences, according to the students ICT is used more or less on a daily basis. Students in all the schools are expected to bring their laptops to class, even though some of the teachers never actually make use of them in their teaching. Ambivalent signals like these could help to generate opportunities for a more structured and efficient use of ICT in school. It could also be argued that if students always brought their laptops to class teachers would have with richer opportunities to use them to re-plan, improvise or capture teachable moments. This aspect would, of course, need to be researched empirically.

ICT is said to be used for ongoing digital documentation. Students describe how they see both Google Drive and the laptop hard drive as easily accessible containers for both storage and rapid searches for material to solve a school assignment (cf. Bulfin et al., 2016). Furthermore, ICT is talked about as a tool that supports oral presentations and the taking of structured notes during lectures. Another advantage in relation to digital text production is that text processing programs such as Word do in fact provide students with rich possibilities to edit, structure and re-structure their texts. This is said to result in written assignments of a higher quality that are completed in less time than they would be using pen and paper (cf. Clarke & Svanaes, 2012; Mangen, 2016).

Many of the students seem to have a rather relaxed attitude towards (cf. Bulfin et al., 2016) the signing of a laptop user-contract. The contract seems to reflect a kind of silent agreement that school leaders and teachers trust students to use their laptops in a responsible way and that in practice the contracts play a very minor role. A related issue that students talk about concerns the possibility of receiving ICT support when their laptops crash. Overall, the students in the three schools seem to be satisfied with the turnaround time. However, given the important role the laptop appears to play in the students' everyday lives in school, a turnaround time of up to three weeks, indicated by some students, is likely to create problems when it comes to managing school work. LMS is often described as being of inferior standard and under used by teachers. Notably, at two of the schools the LMS system had recently been replaced, which could explain why students regarded it as under used by many of the teachers. However, at the same time LMS is referred to as a highly important hub for supporting and structuring students' schooling (cf. Yildram et al., 2014). Students download and upload their assignments and collect information via LMS (e.g., to find out whether a lesson has been cancelled for some reason). In many of the groups the students talk about the importance of teachers using LMS consistently. For example, students want to be sure that the information they need for an assignment is always accessible in LMS. For instance, if students are unable to attend school, they can still access their assignments and thereby reduce the risk of falling behind in their schoolwork (cf. García-Peñalvo & Alier Forment, 2014).

Another issue that is talked about in the interviews is the in-school use of smartphones. In several of the groups, students say that they are not allowed to use smartphones in class, sometimes for obscure reasons The teachers are also described as being unsure about whether or not smartphones should be used for learning purposes, and that the easiest solution is to ban their use in class. Students talk about the smartphone as a potential source of distraction, but also that if it is used responsibly it could be a good learning tool. Students also talk about the smartphone as a digital tool that is always available, as a support to remember assignment deadlines, or as a calculator. Furthermore, they think that smartphones are functional tools for peer support, both inside school during class and outside for school-related issues. In research, the question of students' use of smartphones has been reported as both negative (Beland & Murphy, 2016) and positive (Philip & Garcia, 2015; Thomas et al., 2013). The findings in this study also indicate positive and negative aspects.

In many of the groups, different tools for peer support and the sharing of information are regarded as central, such as Dropbox, Google Drive and Facebook (Bulfin et al., 2016). Interestingly, ICT tools and resources are not always provided by the schools, but are instead selected and used by the students. Of importance here is that it is the students and not their teachers who decide how the tools are used and who has access to the peer support communities that are established.

Methodological limitations

Three schools were included in the study. Two of the schools were campus-based (schools A and B), while the third (school C) had a mix of campus and distance teaching. Additional schools, as well as more groups of students interviewed, could have provided both richer and more nuanced results. The results could also have gained from being complemented with ethnographically inspired observations by means of the researchers documenting the students' everyday ICT supported activities in school.

Conclusions and Future Research

The main conclusion is that schools can increase the use of ICT to structure and support students' everyday activities and time at upper secondary school, such as using ICT for writing, documentation, storage and peer support. Further, consistency in the use of ICT by the teachers is important, especially concerning LMS and clarity about when the laptop can be used in class. Other conclusions are students' appreciation of prompt ICT support and that there are different opinions about the in-school use of smartphones. Finally, it can be concluded that the overall result from the study in this paper seems to show a somewhat different picture compared to a significant body of research in K-12 school that focus on the use of advanced technology in teaching and learning. Following the students, in order to learn more about "school as a purpose for digital use" (Bulfin et al., 2016), research on the use of ICT in K-12 school would instead benefit from an increased focus on "state-of-the-actual" rather than "state-of-the-art" technology (Selwyn, 2010). Considering that, future research could for example continue to investigate several issues. For instance, (a) how, and with what purposes, students' use of ICT provided by the schools can be in comparison to ICT use chosen by themselves. Another issue is (b) how different kind of school regulations have impact on students' use of ICT such as smartphones. Further, (c) teachers' understanding of the role of ICT for students' everyday activities in school. Finally, (d) teachers' understanding of students' perspective on the use of ICT for everyday activities in school.

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INDONESIAN TEACHERS' USE OF THE INTERNET FOR LEARNING

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Abstract

The increasing permeation of the Internet into daily lives gives cause to study the role of the Internet in classrooms. The beliefs of teachers about the Internet are a twenty-first century phenomenon that impacts the teaching and learning process of Indonesian students in the classroom. Consequently, it is necessary to know the views of teachers about, and practices with, the Internet. Though Indonesian teachers view the Internet as useful for both personal and professional uses, pedagogical awareness for uses by and with students in the classroom appear limited. There is evidence that an increased understanding of the potential of the Internet for students to construct knowledge and benefit from the capabilities of the Web 2.0 environment is needed.

Introduction

An increased diversity of students in primary classrooms has resulted from widened access to and use of the Internet (Thrupp, 2008). Digitisation has changed the nature of time and space, resulting in deterriorialisation and disintermediation of learning (Brabazon, 2016). Learning is no longer limited to the territory that is the school, and teachers are no longer the sole source that mediates learning. Students come to school knowing that information is readily accessible if they have access to the Internet and the World Wide Web (WWW) and that they can control the process of accessing information and self regulate their learning. This process has seen teaching described as a chaotic and messy business (Mishra & Koehler, 2008). Contemporary teachers work with this chaos and mess to support students in making sense of that which needs to be learned. One way to support students is to use digital practices including the Internet, meeting students in a learning space with which they are familiar and they see as modern (Mojica-Casey, 2014). However, where there are gaps between student and teacher use of and knowledge of the Internet, pedagogical conflict may arise.

Much use is made of the Internet socially in Indonesia (Asosiasi Penyelenggara Jasa Internet Indonesia [APJII], 2015). Predominantly, Internet use by children occurs away from the school. Indonesian students reported that their teachers use a range of information communication technologies (ICT) at school, but student use at school is limited, particularly in elementary and junior secondary schooling (Palekahelu, Hunt, & Thrupp, 2016). In this context, this study examines the knowledge of and views of Indonesian elementary teachers about the Internet and the uses made of the Internet in the classroom, enabling answers to these questions to be formed:

1. How do Indonesian elementary teachers view the Internet?
2. What use do Indonesian elementary teachers make of the Internet?

Conclusions from this study can inform school managers, education systems and teacher educators about ways to implement and manage the Internet for learning and directions for professional development for teachers, Indonesian education system policy and programs, preservice teacher programs and teacher practices.

Literature Review

Diversity in contemporary classrooms originates in differences between students and differences between students and teachers. Digitisation of our lives as one source of this diversity has its roots in beliefs about, access to and use of the Internet. There are differences between students based on access and more importantly, use of and the nature of Internet use. The diverse nature of students in our classrooms is partially determined by the size of the gap between students of the amount of use of the Internet at school and at home (Thrupp, 2008). The complexity of this diversity is deepened by the difference between knowledge of and use of the Internet between teachers and students. Misalignment between teacher and teacher knowledge of the Internet can create pedagogical conflict, resulting in the needs of students not being met. This study is interested in the extent of and nature of alignment between student and teacher knowledge of and use of the Internet as demonstrated by teacher use in the classroom with students in Indonesia.

Important to research related to education in Indonesia is acknowledgement that Indonesia is a highly populated country (in excess of 250 million people) with highly diverse communities across 17,500 islands. Given this, research on education is generally limited in its potential to describe Indonesia as a whole. For example, there is a considerable gap between education and Internet access between Java and the provinces of eastern Indonesia. With respect to the research, it is necessary to have this in mind when viewing the connectivity of Indonesian schools, Indonesian teachers and Indonesian students. This provides the context for investigating the degree of transition to ICT and the Internet by teachers in learning and teaching in Indonesia. Further, there are two aspects to teachers and the learning and teaching process: teacher knowledge and teacher pedagogical practices.

Internet Access in Indonesia

Indonesia is a connected country with the nature of connection being mobile and social in nature. This is evident in a report by APJII (2015), stating that the vast majority of Internet users (85%) conducted online activities using their mobile phones. Fewer than one in three respondents went online using a laptop computer, desktop or tablet. Use of these devices with the Internet is synonymous with social media use.

Children of elementary and secondary age access the Internet to connect with others and to access a wide range of information. Internet usage in Indonesia represents the third highest number of Facebook users in the world (Marketer, 2015): 50-80% of users in 2011 were between the ages of 15 years and 30 years (Waizly, 2012); 88.1 % of users access Facebook using mobile phones. School use of the Internet is less than home use, suggesting the home environment to be a richer ICT environment than the school. A study by Palekahelu, Hunt and Thrupp (2016) in Central Java indicated that 50% of students in elementary, secondary and vocational schools have Internet access at home. However, use at school is considerably less with 50.1% of students using computers at school either one or more times a day or two to three times a week, and only 37.3% of students in primary school using the Internet either one or more times a day or two to three times a week. Despite less use of the Internet at school, students exhibit a positive attitude to the use of ICT in learning. High mobile phone access and hence Internet access provides an alternate lens with which to view this usage data. Connectivity is a socio-cultural artifact of students currently attending school in Indonesia. As such, contemporary students view use of the Internet as modern (Mojica-Casey, 2014) and therefore, an appropriate element of their learning, even though this may not occur at school. This assumption goes some way to supporting Brabazon's (2016) claims that learning for Indonesian students is deterritorialized and disintermediated in that they learn independently of school in a mobile environment.

The differences between student and teacher beliefs is the focus of this study, investigating teachers and Internet use in the classroom. The other partner in the classroom environment, the teacher, experiences a different connectivity: 25% of Indonesian teachers in a study by Son, Robb, and Charismiadji (2011) claimed to have a computer connected to the Internet at home. In viewing the competencies of Indonesian teachers with ICT, the list includes use of word processing, email, and Web and multimedia programs (Palekahelu et al., 2016; Son et al., 2011). While some use is evident, the World Wide Web was rarely or never used by 52% of teachers. This lack of usage increased for other uses of the Internet.

ICT and Teachers in Learning

The use made of the Internet and its capacity is at the heart of understanding teachers and their use of the Internet for learning in the classroom. The benefits of incorporating technologies into teaching and learning in Indonesian schools has been recognised for some time. In 2002, Yuhetty argued for the integration of technologies into school education in order to build the international competitiveness of the nation. However, it is the pedagogical framework around the use of ICT that creates the advantage for learners (Harendita, 2013; Mishra & Koehler, 2008).

The SEAMEO Regional Open Learning Centre (SEAMOLEC) report of 2010 suggested Indonesian schools are in the emerging or applying stage of access to ICT infrastructure, and resources in schools are at a low level. Supporting this, Oncu, Delialioglue, and Brown (2008) observed that ICT were not integrated in the learning process. This continued to be the case in the work by Cahyono and Mutiaraningrum in 2016 where they suggested that the use of ICT in teaching is not evident in many places in Indonesia. However, Baubeng-Andoh (2012) stated that there are factors at many levels that discourage Indonesian teachers from the use of ICT in schools while Maknun (2013) highlighted that skills for using the Internet for learning are different from those for social purposes. Disparity in some reports is in the definition of use for learning and teaching. In 2011, data showed that while 80% of Indonesian schools had access to the Internet, only 39% of teachers used ICT during the teaching and learning process (Harendita, 2013). On the other hand, 49% of teachers claimed to use a computer for teaching purposes, and 38 % claimed to use Web sites to supplement learning/teaching (Son et al., 2011). Students in Salatiga reported a wide use of ICT by their teachers (Pakehalu et al., 2016). What remained unclear about teacher use of the Internet is the nature of use; the Internet as a resource for teachers in preparing for learning in the classroom as compared with an interactive use between teacher and students during the learning process.

Further reasons have been suggested for the limited use of ICT by Indonesian teachers with students. These include teacher resistance (Harendita, 2013) and lack of skills (Son et al., 2011). In their research, Son et al. found that teachers indicated factors such as limited access to facilities (77%), limited time (49%), limited access to the Internet (45%) and lack of computer skills by teachers (37%). The Education Sector Analytical and Capacity Development Program (ACDP) (2015) study of ICT in Papua reported lack of access to computers and the Internet as a major barrier to ICT integration and use. Maknun (2013) suggested that the preparation of teachers was another issue.

Pedagogical Issues

Effective use of the Internet has been demonstrated to provide new approaches to the teaching and learning process. Given recent research, the pedagogical issues of teachers and the Internet are twofold. Harendita (2013) suggested that the complexities around teacher resistance relate to pedagogical issues, specifically pedagogical conflict. This conflict can be subdivided into two issues. Firstly, there is teacher identity, as it is required to transform into new cultural contexts such as the digital environment. Secondly, alternative pedagogies related to the use of ICT in the classroom conflict with past classroom approaches (Harendita). Teachers cling to approaches that they assume have always worked for them. The implication here is that the pedagogical shift enabled by the Internet is too extensive for some teachers. Organising the learning processes that use the Internet requires teachers to think differently and manage unlimited content (Maknun, 2013). This requires a pedagogical shift, the heart of disjuncture of teachers and disadvantage for students.

In summary, the use of connectivity evident generally in the community is not reflected in classrooms. Further, the use of the Internet in Indonesian classrooms is highly inconsistent in extent and nature. This study investigates the context of this inconsistency in use for learning and emphasizes differences between social uses of the Internet and educational. The study of possible pedagogical conflict for Indonesian teachers has a worthwhile role to play in informing the way forward.

Research Approach

The Internet is a social and technological phenomenon, and the use thereof for learning is an educational phenomenon. Consequently, studies that investigate teacher use of the Internet and, in particular, teacher use in the classroom, serve to reveal aspects of that phenomenon. This study developed from earlier research with Indonesian elementary students on their beliefs about the Internet (Relmasira, Hunt & Thrupp, 2016); a keen interest in the alignment of student and teacher beliefs developed. From this, an interest in the views of and uses of the Internet by teachers developed into this study, examining the phenomenon of Internet in the classroom. Harendita (2013) suggested that teacher's voices are often not heard and that the issue of Indonesian teachers and ICT, in this case the Internet, are often seen from the perspectives of policy makers or administrators. Subsequently, the design of this study aimed to hear 50 elementary teachers from one district in Central Java set in urban and peri-urban settings around Kota Salatiga talking about their use of the Internet. An element of the survey used a Y chart graphic organizer, previously used with Year 6 students. The Y chart format (Hunt, 2015; Relmasira et al., 2016) enabled participants to reflect upon the look, feel and sound of the Internet. The accompanying survey questions elaborated upon the use of the Internet in a range of settings and a range of purposes and finally, the use made of the Internet in the teaching and learning process. The survey was presented in the national language, and teachers responded using their national language. Data had both quantitative and qualitative elements.

Results

The quantity of data collected from each question varied greatly as participants answered only questions of relevance to them.

Demographic Data

Participants were teachers with varying years of teaching experience from local schools in Salatiga, Central Java. They have a range of experiences with the Internet with an average of less than eight years experience.

Beliefs About the Internet

Data providing views on the Internet were drawn from the Y chart and cross-referenced with items from the survey. There were 34 responses to the Y chart that asked, what does the Internet look like, sound like, and feel like. Dominant beliefs were grouped as follows: knowledge and information, use in problem-solving, and balancing negative and positive aspects of the Internet. The first of these three beliefs, relating the Internet to knowledge and information, was the strongest. Twenty responses focused on the Internet being information or *full of data*. The words information and knowledge were used interchangeably throughout. Comparisons with books were frequent, being able *to dig up information*. An emphasis of the capacity of the Internet was expressed, *Internet helps us to know everything.* Further responses posited the richness of the Internet and its providing a *window to the world. Because of various knowledge we can easily read the world. Very wide; very complete; like a window to the world* but a wind*ow that defeats books.* The second concept of the Internet as being of use in problem-solving was evident in some responses. This was elaborated by, *where there is the Internet, there is a solution.* Further elaboration of jobs being easier related to the ability to access the Internet *wherever and whenever.* The third belief related to the negative/positive aspects of the Internet. Awe and astoundment were balanced by negativity. This was evident elsewhere in the survey where responses expressed fears related to *pornography*, *children seeing pictures they shouldn't* and the need to *use the Internet wisely*. The benefits were well enunciated in expressing *usability* and *making life complete*. See Table 1.

Table 1

Beliefs About the Internet: Y Chart Data

The Internet Is	Of Use in Problem-Solving	Negative/Positive Aspects
access new information, broaden our knowledge, find information, variety of information, negative information, helps us know everything, can get answers, Internet feels like knowledge, the abbreviation for Internet, sounds like knowledge Internet = knowledge	making jobs easier, feels easier the Internet is able to facilitate/expedite jobs	sweet, spicy, Nano-nano candy that has a variety of taste, fun, goosebump, awesome, scar, sometimes bitter

Beliefs expressed also integrated some misconceptions in defining the Internet. Some responses suggested it to be a box or an object rather than a network of networks. No responses showed an understanding of this concept of the Internet. Despite this, there was strong agreement about the usability and usefulness of the Internet.

Usefulness

A Likert scale was used with participants to elaborate upon the usefulness of the Internet for learning. Participants used a 5 point scale from *Not very useful* to *Very useful* with regard to their view of the Internet at home and at school. This corroborated their beliefs of the Internet *being of use in problem-solving* and *making jobs easier* as shown by the Y chart.

While specific responses regarding usefulness for learning were rare in the Y chart, the data from the second item demonstrated a strong positive response in contexts, both home and school: 38 out of 39 responses stated the Internet is useful to very useful for learning at home with a similar figure for usefulness for learning at school. This was strongly supported by open-ended responses in a later item where 11 out of 24 participants used words like *useful,* *necessity, helpful, learn* to add information about the Internet. Despite this, data related to use for preparing learning for classes showed a clear balance between rare use and regular use and was not consistent for all teachers.

Further questioning about the use of the Internet provided useful insights. Use at home or school dominates, with little use evident in other locations. Even those teachers who identified the Internet at home to be very useful made limited use of it for their role as teachers. Personal use dominated the time spent on the Internet. Use at school appeared less than that at home, but maximum use in this context was directed at preparing for the teaching and learning role.

Barriers to Use of the Internet for Teaching and Learning

One question specifically asked about the extent to which professional development, access to the Internet, cost of the Internet, Internet safety, access to computer/tablet or mobile phone and teacher ability/competencies would be a problem for using the Internet for teaching and learning. Generally, it was evident that all of these ideas would be *a slight problem sometimes* or *sometimes a problem*. Very few participants identified any of these issues as a *large problem*. The responses about access to computers were consistent with data from other questions. Of 50 participants, 41 indicated that computer equipment in the classroom was useful to very useful for access to the Internet. A similar number indicated that computer equipment in the classroom was useful to very useful for children accessing the Internet for learning. However, responses related to Internet safety are not consistent with open-ended responses about the Internet that clearly identify concern about the extent of dangers the Internet posed for children. These responses are demonstrated in specific concerns with *pornography* and *violence* and the need to *guide children* and *block negative sites*.

Among participants, 38 indicated that their ability/competencies could be problematic on a continuum from slight to large. Participants identified themselves as users of the Internet, but only one response outlined lack of competency. This data, however, has to be compared with other data that suggest a limited knowledge of the capability of the Internet, its scope of facility, and its potential for learning. Thus, a holistic view of the data posits concern. Participants appear not to know what they do not know about the Internet, especially its more recent developments. Consequently, ability/competencies is revealed as a barrier to the use of the Internet in the teaching and learning process. Further, this suggests that Indonesian teachers are unable to identify the professional development programs they need.

Further Issues with the Internet

Open-ended responses asked participants to *add other information you want us to know about you and the Internet*. Responses to this item strongly reiterated the negative aspects of the Internet and the need for care when children are using the Internet. This was strongly balanced by the usefulness of the Internet in relation to information, knowledge and learning resources. Two new themes became evident in this data: communication and building/broadening networks. Participants indicated that the Internet presented the ability to *communicate faster* and *easily*. Related to this is the ability to *make friends/build a network* and *as a bridge to broaden my netw*ork.

Discussion

Misconceptions about the Internet, its structure and purpose, result in ineffectual engagement with the Internet, especially so, when discussing and implementing the teaching and learning process. The key outcome of this study shows little evidence of Technological Knowledge (TK) (Mishra & Koehler, 2008), this being knowledge of technologies and how they work and work together. Further, but to a lesser extent, there is little evidence of Technological Pedagogical Knowledge (TPK) and Technological Content Knowledge (TCK). The first, TPK, is the use of technology to implement different teaching strategies. The second, TCK, is knowledge of subject matter and how technology is used to engage with information. The use of TPACK (Mishra & Koehler), that is the integration of TK, PK and CK is a succinct means of summarizing the findings of this study. While this study did not begin with the intent of investigating Technological Pedagogical Content Knowledge (TPACK), the findings suggest the lack of TPACK at the heart of the use of the Internet by Indonesian teachers. Teachers in the study demonstrate little evidence of current technological knowledge about the Internet, and little knowledge of how to use the Internet for learning.

This study identified strongly held teacher beliefs that the Internet is useful, predominantly providing information readily. There was reasonable evidence that use of the information from the Internet is thought to provide a global perspective, well beyond that provided by books. This has strong correlation with the study by Maknun (2013). Searching for and locating information is the main purpose of the Internet at home and at school. There was evidence that the teachers generally valued the Internet for their personal learning and the contribution to information for lessons and materials for use in the classroom as in the study by Son et al. (2011). Alternate uses of the Internet and the WWW were not identified; once again, this was consistent with the work of Son, Robb and Charismiadji.

The focus of participants in this study with the Internet as a source of information appears aligned to the ideas embedded in Web 1.0. This would be considered a limited capability with the Internet and WWW. The Internet since Web 2.0 has provided considerable opportunities for creating and constructing knowledge with information (Johnson, Adams, Becker, Estrada, & Freeman, 2015), visual and graphical interfacing, apps and free programs for CAD work and differentiated means of communication. In many spheres of education, this has been recognized as having great potential to connect students with people, places and processes for learning (Hunt, 2015). Web 2.0 has provided the facility to use multiple Web resources to locate, manipulate and create products, providing teachers and students with a process for thinking with information to create knowledge as opposed to searching for information. These aspects of the Internet were not evident as themes in the data from this study.

Pedagogical practices were not evident even though the teachers identified sufficient equipment was available. It could be assumed that, if use with children were to occur, it would focus upon searching for and locating information, this being the dominant use made by teachers and their acknowledged belief of the purpose of the Internet. This study supports the finding by Cahyono and Mutiaraningrum (2016) that the use of ICT in teaching is not evident in many places in Indonesia. This requires further investigation, and it can be concluded that there is some misalignment between student and teacher capability with the Internet and the WWW.

Indonesian teachers suggest that classroom ICT facilities provide little barrier to the use of the Internet for learning; this needs further investigation. While teacher judgment of adequacy of ICT facilities aligns with their beliefs about the Internet and pedagogical approaches to connectivity in the classroom, this may need to be reviewed as Indonesian teachers build knowledge and capacity of how Web 2.0 and Web 3.0 technologies can impact on learning and use by students in classrooms. Once this learning is established, teachers may change their judgment as to future requirements for ICT in the classroom.

Conclusions

In answering the research questions, it can be concluded that Indonesian teachers view the Internet as a highly useful source of information and that use of the Internet is to locate information for personal use and for presentation by the teacher in the classroom.

This study raises concerns for the professional competencies and capabilities of Indonesian teachers with the Internet. Teachers identified minimal problems with this as a barrier to use of the Internet for teaching and learning purposes. In contrast, however, responses across the survey indicated limited knowledge of the capacity of the Internet generally. This knowledge of the Internet combined with limited pedagogical knowledge in relation to use of the Internet by students for learning in the classroom was evident in this study.

Further investigation is required to evaluate the capability and competency of Indonesian teachers and the Internet. This study indicates a Web 1.0 mindset, limiting the effectiveness of connectivity in the learning and teaching process. The evident weakness in Technological Knowledge (Mishra & Koehler, 2008) as shown in this study results in issues with Technological Content Knowledge and Technological Pedagogical Knowledge. Consequently, it provides direction for professional programs for teachers and the content of programs for future teachers in contesting currently held beliefs about the Internet and its contribution to the learning and teaching process. Beliefs and values guide the professional practices of teachers.

Shaping beliefs and values for currency in a new cultural context is essential to national development (Harendita, 2013; Yuhetty, 2002). Teachers have clarified their role as presenters of information and the font of knowledge for students. When this is compared with a TPACK view of the teacher's role with the Internet, there is a strong possibility of pedagogical conflict. This could well be the challenge for school and system leaders as they move toward ICT strategies in education for the nation.

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THE RE/CONSTRUCTION OF ENGLISH TEACHERS' PROFESSIONAL IDENTITY: A CASE STUDY OF A BRAZILIAN TECHNOLOGICAL UNIVERSITY

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Abstract

This study aims to understand how the English teachers deal with the demands raised from the transformation of information and communication technologies (ICT), and from the educational system of a Brazilian public technological university, and how they re/construct their professional identity. A qualitative approach with a case study format was used, and the participants were English teachers from the institution. Documentary research and a semi-structured interview were used to gather the data. The results reveal that the teachers struggle to reach the demands. It is verified that identity re/constructions are being performed by their own actions, choices and decisions.

Keywords: professional identity, foreign language teachers, technological university, digital technologies

Introduction

The end of the last century was responsible for technological advances that promoted deep changes in the political, economical, cultural and social fields. These changes have become even more radical in the 21st century and have contributed to the broadening of educational demands once Communication and Information Technologies (ICT) became part of our everyday life.

While the way of teaching before was centered on the teacher, learning environments today focus on the learners and have to be relevant and connected with their needs. This knowledge society values human skills, relationships and organizational knowledge. It also requires flexibility, creativity, innovation and initiative. Thus, teachers need to be articulated with the principles of developing multiliteracies, which forsee the process of teaching and learning within a context that involves the use of ICT and globalized knowledge. This is the context in which teachers need to construct their professional identity.

Xavier (2008) and Kalantzis and Kope (2010, 2012) affirm that collaborative learning is the most promising direction for education. The teacher's main role is not just to transmit knowledge, but also to encourage learners to seek for knowledge, to develop multiliteracies and critical thinking. The teacher's goals should be to exchange knowledge besides monitoring, managing and conducting the learning processes. In this scenario, teachers often feel that their professional identity is being threatened, because they perceive that they do not dominate digital literacy or dominate it very little.

The National Curricular Parameters (Brasil, 2002) advocate in favor of learning as a process produced by interactions, which is in accordance with sociocultural theory (Lantolf & Thorne, 2007). The documents also prescribe the use of the computer as an instrument that can be used to research, select, compare, organize, register, review, correct and socialize information, as well as perform most of the everyday social practices. Thus, the focus of learning lies in the interaction between learners and technology, the teacher and the learners, among the learners themselves, and between the learners and the world.

This research was carried out at Centro Federal de Educação Tecnológica de Minas Gerais (CEFET-MG). Earlier, the institution was a technical high school, and the staff had started working there as high school teachers. After the implementation of the undergraduate and graduate courses CEFET-MG became a technological university. This issue has created a great impact on the teachers' careers. In order to deal with the governmental rules that regulate these changes, the institution has undergone a series of transformations. Among them came the necessity of qualifying its academic staff to increase the numbers of master's and PhDs, as required in its Institutional Development Plan (Brasil, 2012).

This study aims to understand how the English teachers from CEFET-MG are dealing with the demands that emerged: (a) from the educational system of a Brazilian public technological university and (b) from the spread of ICT.

A Brief Review of the Concept of Identity

In order to understand how those English teachers are constructing their professional identity, a brief review on the concept of identity anchored in the poststructuralist perspective of cultural studies was undertaken.

Previously, identities were determined by birth and social class, which defined the roles individuals should perform in society. Today identities have lost their stability. They are displaced, contradictory and difficult to understand (Bauman, 2005). The decline of the old identities, which for so long stabilized the social world, fragmented the individuals' references. Identity ceases to be fixed and stable to become unfixed, fragmented, displaced (Hall, 2006).

The so-called identity crisis is seen as part of a larger process of change that is shifting the central structures of contemporary societies. Thus, identities are crossed by differences, divisions and antagonisms. Identities can be articulated depending on the circumstances and the moment. Thus, identities remain open to new articulations and to the creation of new identities. Identity is therefore a process which is always under construction, never completed (Hall, 2006).

Identity is submitted to social and material conditions. Both are part of a symbolic marking needed for the construction and maintenance of identities. They give meanings to social relationships and define who is socially included and who is excluded. In this sense, the existence of at least two groups which are in opposition to each other can be seen: 'we' and 'they'. The construction of identity happens in opposition to other(s) identity(ies) in a dualism in which one is always more valued than the other, establishing the difference between them (Woodward, 2009).

The professional identity of teachers is embedded in those arguments. It is also connected with their curriculum and with the representations and meanings which are built through constant peer-to-peer negotiations. For Celani and Magalhães (2002) and Celani (2010), representations about knowledge, competence, skills, attitudes and values are always changing according to the historical and social context. Therefore, the continuing formation is becoming increasingly necessary for teachers. This tends to lead them to re-evaluate their pedagogical actions and to offer important theoretical subsidies for their professional updating.

The English Language Teacher in the Current Brazilian Context

Education has been strongly impacted by technological advances. Mobile phones, for example, already allow users to perform various actions besides just making and receiving calls such as: listen to music, watch videos, record, take photos, read books or articles, search and share information, etc. Finally, the access to mobile phones favors instant connection with the world and as a consequence it has changed the learners' profiles (Tavares, 2010).

By surfing on the Internet, learners can either entertain themeselves, have social interaction or seek information. But, the circulation of information requires criterion and care. Snyder (2009) warns that teachers should encourage learners to use the Internet to acquire knowledge and to be engaged in authentic research. This can favor the understanding of the real world, develop autonomy and critical thinking, and stimulate curiosity. Critical thinking will lead learners to evaluate what is best for them and to participate in the construction of knowledge.

The use of technologies is seen as natural and fundamental for pedagogical actions and much more appropriated to the current reality of the learners. However, they tend to master technology much better than their teachers. Coracini (2006) claims that this aspect creates conflict and insecurity once teachers know that knowledge empowers the individuals. Because of this, while many teachers perceive the use of technologies as a solution to the problems of methodology and motivation, others resist.

More than ever, teachers need critical reading of the current society and deep understanding of the ways students learn. At the same time, they need to develop their digital literacy and understand its possibilities, potentialities and limits. Teachers need creativity as well to rethink the educational methodologies in a continuing process of learning. Therefore, education in the knowledge society consists of a constant challenge.

Analyzing the Re/Construction of the English Teachers' Professional Identity

The participants of this research are the English teachers from the Department of Language and Technology (DELTEC) from CEFET-MG. This department embraces the areas of Portuguese and English Language. It was structured with the purpose of giving support to the implementation of the undergraduate, master's and doctorate courses in Language and Technology. It also gives support to some extension courses such as Center for Languages and Cultures - CLIC. It is worth mentioning that the interviewed teachers were hired through public contests to teach in a technological high school. However, due to the institution's expansion, the English teachers have to give support to the other courses. Thus, teaching qualification has become even more necessary.

In order to reach the goal of this study, a semi-structured interview was conducted with all the eighteen English teachers from DELTEC. In this universe four of them are PhDs, six are doing their doctorates, four are master's, two are doing their master's, and two could not achieve the master's degree. The interview sought to delineate their academic qualification and their professional performance possibilities, the fulfillment of the institutional demands, and the use of new technologies in teaching. The Brazilian official documents (2002) as well as the documents that regulate the institution (Brasil, 2012) were also reviewed. For this paper, the data from all the interviews were taken into consideration, but only the voice of two participants were closely analyzed. They are known here as P1 and P2 and are both referred to as 'he.' They were chosen because they represent the profile of the other professionals interviewed; they have worked in the institution for more than twenty years and have experienced the most significant changes that outlined the transformation of a technical high school into a technological university. This is a qualitative research and it has the format of a case study (Nunan, 1992).

Complying with the institutional demands

As a university, CEFET-MG demands much more from its academic staff. Before CEFET-MG became a technological university, English teachers were required to teach in the technical high school and at CLIC. Besides the mentioned activities, the staff is now expected to work in undergraduate and post-graduate courses. Thus, they need to be involved with researches, mentor master's and doctoral students and participate in administrative activities, etc.

When questioned about his intentions to invest in his academic career P1 states: "I had no way to escape and now I am doing my master's. I am studying hard and I am investing in my academic career. I am reading a lot and I am trying to publish a paper. This is now necessary."

P2 had started his master's in order to deal with the institution's demands but failed to complete it. "Unfortunately, I could not defend my dissertation. It was very painful for me. (...) Here at CEFET, there is no more space for those who do not have at least the master's degree. If you do not specialize you are no longer respected here."

The participants tried to find ways to achieve professional success and comply with the institutional demands. P1 realizes that knowledge evolves over time and is always under construction. Therefore, post-graduation studies became a necessity for him, “Updating needed to be inserted into my professional life and I decided to study again.” It seems that his identity is being reconstructed since qualification empowers his curriculum and gives him support to feel safe and deal with his co-workers. On the other hand, P2 failed to achieve his purpose, probably because his target was not the master’s itself. It is apparent that P2‘s professional ambition did not include the academic life but only being a high school teacher: "I did not really want to study anymore.”

In order to comply with the institutional demands, some questions about their participation in research groups, congresses, mentoring, publications, administrative activities and extension courses were asked to the participants.

P1states: "I have been taking part of a research group and working with Portuguese as a foreign language since I started my master’s. Now, I can say I like it.” It is possible to verify his attempt to adapt to the new parameters required by the institution he works for. According to Silva & Aragão (2013), the ways to be pursued by foreign languages teachers today consist of the continuing formation and the practice of researching. These aspects enable teachers to reflect on their professional praxis and reconstruct their professional identity.

As P1 is in the first year of his master’s, he is also trying to participate in some conference. “I am submitting two papers to some conferences. I hope they are accepted. It is a requirement of my master’s." P1 is committed to his post-graduation course, and, for this reason, he feels included in the department he belongs to. He reports: "At first I did everything only to comply with the requirements of the master’s, but I feel enthusiastic and interested now. I think my co-workers are also looking at me with other eyes.”

Besides studying his master’s, P1 has got some administrative positions. He notes: "Besides doing my master’s and being a teacher, I am the deputy chief of DELTEC and of CLIC. It is a lot of work." Probably because P1does not have the master’s degree yet, accumulating tasks makes him feel important to his department. In addition, having a position of leadership may confer him some status and power. "Administrative activity is something I do with pleasure and I think I do it well. I like being a chief." P1’s narrative is strongly associated to his pleasure and pride of the tasks performed. His experiences also make him develop a sense of belonging to the academic staff.

Unlike P1, P2 does not participate in any research group or conference, and neither has publications. P2 just teaches English at the technical high school and at CLIC. Therefore P2 does not feel respected and as part of the academic staff. As a form of resistance, we find in his narrative a strong marking of his position of high school teacher, since he was hired after a competitive public contest. He complains: "I was hired to be a technical high school teacher. I was not hired to teach at undergraduate or post-graduate courses or even to be a researcher. I don't think it is fair to be discriminated by some co-workers for this reason."

It is clear that P2 feels excluded and wants to ensure his identity as a good high school teacher. "I really like to teach students from high school. What is important for me is that I am a good English teacher. I do my best and I know my students like me. I understand research is important but not for me."

As a consequence of just being a high school teacher, P2 faces difficulties regarding to belonging. "With all those changes our team is no longer united. There is a lot of competition. There is no solidarity. Everyone has to fight for his or her own survival. I do not feel comfortable here anymore."

Bauman (2005) states that solidarity has gradually been replaced by individualism and by fragile, artificial and fluid bonds. Competition, a framework that opposes solidarity, has led the individual to fear, insecurity, inadequacy and exclusion, as it could be seen in P2's narrative.

According to all teachers' narratives, it is possible to verify that there are two groups in opposition. On one hand the PhDs', professors, and on the other the ones who have not obtained such title yet. As Woodward (2009) argues, the construction of identity happens in a dualism in which one is always more valued than the other. The author (2009) also claims that identities are constructed in opposition to other identities. For thus, difference can be constructed negatively when it excludes or marginalizes those people who are defined as 'others,' but it can be seen as a source of diversity and heterogeneity, and for this reason it can also be enriching.

Having to deal with the difference between the two teams of the department, P1 chooses to face it and find ways of shortening it. He envisions new possibilities assuming administrative positions, doing his masters, participating in a research group and probably in future conferences. This curriculum seems to empower him and, as a consequence, makes him feel included in the group. However, P2 feels excluded, marginalized and different, since he has failed to comply with the institutional demands. He states "I feel that most of my co-workers do not see me with the same eyes anymore. It is embarrassing and as soon as I have the right to retire I will do it quickly."

Complying with the educational demands

The Brazilian official documents (Brasil, 2002) suggest that foreign languages should be taught from topics that are relevant to the students. Besides, these topics must favor a critical reflection of the society and enable critical and digital literacy. For this purpose, the communicative approach via textual genres was embraced by DELTEC, and it has been used to teach English for the technical high school since 2012. This approach deals with linguistic functions and conventions and allows students to lead with authentic texts circulating in different spheres (Bambirra, 2007).

In relation to the adequacy to this new methodology, P1 and P2 report that they are in the process of adapting themselves to this approach. Thus, they are still not comfortable with it. P1 clarifies: "I prefer the methodology we used before. I am not very fond of this new approach." P2 narrates: "I think that working with the textual genre is difficult and you have to believe and understand this approach well. In fact, I come from another background, from the communicative approach. I liked the other way better."

Besides having to adapt themselves to the new approach used to teach English in the technical high school, the participants also need to use the digital technologies in their classes as it is advocated by the Brazilian official documents (Brasil, 2002). The students are inserted in a digital world, and therefore they make use of technologies in their everyday activities. ICT are not only a source of information; they are also a means of communication and can contribute favorably to the process of learning English (Murphy, 2000).

In this sense, according to Snyder (2009) and Paiva (2015), teachers must know why and how to use technologies for pedagogical purposes. Both authors believe that when teachers make use of technologies they become able to make choices, use and sometimes even refuse them. Therefore, teachers need to be ICT users in order to choose tools that can contribute to the students' learning process.

When the participants told how they insert technology into their pedagogical practices, it was identified that its use is still associated to old teaching practices and is basically confined to the presentation of schoolwork. P1 declares: "In my classes, technologies are used by the students to present the works they do in groups, usually PowerPoint or Prezi. I see that some colleagues are using cell phones, but I have not tried them yet." P1 expresses the difficulties he has and says: "I have never prepared anything special using technologies. It is very difficult for me to think about something useful to give to my students using technologies, and so I avoid them."

In relation to P2, most of the time his students also use PowerPoint to present schoolwork. "Students use PowerPoint, but I seek to encourage them to use technologies to improve their English. They use online dictionary and we communicate via email or WhatsApp. The students use technologies better than we do."

P2 reports that his students created a blog to share their schoolwork like videos and podcasts with other students. He states: "Inserting technological resources in my classes is a way to be up-to-date to their reality. I think that when we use technologies students can learn in a more autonomous way."

The data reveal P2's effort to adapt himself to the use of new technologies in his classroom, in spite of all his insecurity and limitation. "I have a lot of difficulties with technologies, and sometimes I feel insecure, but the students use them all the time, and I try to use them as well. Students help me and I improve." In this sense, he does not only cease to be the focus of teaching but also becomes a learner, once he does not master technology as his students do. Despite of all his difficulties to deal with technologies, we can see that he is proud of himself. P2 sees himself like a modern teacher, a good teacher, a teacher who adds technological resources to the learning process. It seems that P2 wants to reinforce his identity as a teacher who is beloved by his students as he says: "Students like me and they like my classes.”

Both P1 and P2 complained about the lack of assistance from the PhDs’, professors or even from those who are already better adapted to the new approach and to the use of new technologies in the classroom. P1 states: “I do what I already know. We do not work as a team. Nobody helps you to improve your pedagogical skills.” P2 says: “We work in isolation. There is no solidarity here anymore. They want us to change, but they do nothing to help us. They want us to learn by ourselves, and this is impossible.” Their narratives show the lack of solidarity and pedagogical discussions in order to improve everyone’s skills.

It becomes evident that the teachers are trying to use technology in some of their routine activities, although they still find it difficult to associate its use to add value to learning. It is clear that P1 only uses technology when his students are presenting schoolwork. Despite his insecurity, P2 is trying to insert technology with pedagical purpose although, it was not clear whether his actions lead to effective linguistic acquisition.

In fact, as Snyder (2009) states, it is useless to bring technology to the classroom and continue with old teaching practices. The question, therefore, focuses on how to change and how to teach and learn. Because of the depth of the impasse between when and under which circumstances should new technologies be used as learning support, our participants face some issues as it seems they have low digital literacy: (a) difficulties in using technologies, (b) difficulties in inserting technologies to bring relevant pedagogical benefits, and (c) work in isolation, without sharing theoretical and practical discussions.

It is understood that our participants want to feel part of the modernity of the 21st century. Adding technologies to teaching makes them feel modern, although they still find difficulties and do not know how to use them properly for pedagogical purposes. This is not an exclusive dilemma of the English teachers from CEFET-MG, but one of Brazilian English teachers in general.

Conclusion

In this study we have examined how the English teachers of a Brazilian technological university are constructing their professional identities. We have explored the problems they face in adapting themselves to the institution’s new context, while it was transformed from a technical high school into a technological university. We have sought to emphasize the important role of technology in education, as well as the use of the genre approach to teach

English in high schools as it is recommended by the Brazilian legal documents (2002).

As we have demonstrated, getting a post-graduate diploma is one way in which teachers reinforce their professional identity, but using the genre approach and technological artifacts in education are also important components of constructing professional identity of the participants.

One of the challenges of constructing the teachers' identity is directly related to the use of ICT. As it has been pointed out in this study, most of the participants still use technologies to do what they have always done. Posting exercises, communicating with students via email, Facebook, WhatsApp, wikis or blogs, presenting schoolwork or searching the dictionary does not mean a technological revolution in education yet as argued Snyder (2009) and Kalantzis and Cope (2010, 2012). In this view, there is much more to be done to modernize our education and make it more effective for the learners. Thus, their greatest challenge lies with how to change, teach and encourage their students to become autonomous learners, capable of learning to learn.

One of the most pronounced tensions taken from the narratives is working in isolation rather than as a team. This shows that careful discussions and studies need to be done to help teachers solve the problem of adapting themselves to the new methodology and adjusting their pedagogical practices to insert new technologies to teaching.

In relation to the new educational needs, some of the participants feel unprepared and with low self-esteem. It is possible to see that in the struggle to negotiate their professional identities, P1 has chosen to continue studying and has started his master's, while P2, unable to adapt to the new contexts, has felt excluded and is eager to retire.

It is possible to conclude that the participants' own choices, actions and decisions are shaped by the power relations and the centrality of their curricula. Thus, their professional identity is being re/constructed with elements that are individual and collective, subjective and objective, involving dynamic processes and multiple contexts that are marked by uncertainty and insecurity, conflicts and dilemmas, and successive personal and professional transformations. The elements that have emerged from their narratives underlie their emotions, experiences, competence and motivation. All these elements have formed a correlation between their personal projects and the multiple demands contributing to the re/construction of their professional identities.

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HOW WILL THEY REACT IF WE MAKE THEM TALK? STUDENTS' EXPERIENCES FROM LEARNER-CREATED VIDEO TASKS IN ONLINE UNIVERSITY EDUCATION IN SWEDEN

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Abstract

In focus in this paper are students' views on their experiences of an educational design with oral assessment tasks supported by video technology in online university education in Sweden. Questions targeted how the students perceived the impact of oral tasks on their learning. The data were gathered through questionnaires, qualitative interviews and students' self-reflection documents. Results indicate most students appreciated the oral assessments, and their descriptions of this learning experience indicate that the studied video-based task-design may enhance online students' learning experiences.

Keywords: online teaching, oral assignment, design for learning, case study, pedagogical digital competence (PDC)

Introduction

In this paper students' views on their experiences of an educational design with oral assessment tasks aided by video technology in online university education in Sweden are in focus. The idea behind the implementation was to develop strategies to support the students' oral communication skills and to explore if oral tasks using video technology could support the students' sense of social, cognitive and teaching presence. One important reason for the start of the project was related to expectations from national policy documents that the students also should develop oral communication and presentation skills (Swedish Code of Statutes, 1993:100). Previous studies (Dunbar, Brooks, & Kubicka-Miller, 2006; Ice, Curtis, Phillips, & Wells, 2007; Mathieson, 2012) have also revealed the importance of oral tasks in higher education for students' learning process. The study is a contribution to the growing understanding of what learning designs using video technology in online education could add to the overall learning process. The questions targeted in this paper are: (a) How do students perceive the impact of oral tasks for learning in online education? And (b) What could the results indicate regarding the quality of this design for learning?

The Case-Setting and the Participants

Courses and programs delivered by Information Communication Technologies (ICT) have become an integral part of most of the higher education institutions' overall strategy worldwide. Many countries have experienced a rapid growth in this area to the extent that the growth in online enrolments is now overtaking the growth of traditional enrolments (Allen & Seaman, 2011). During the last ten years, the proportion of students in higher education online in Sweden has increased from one-tenth to nearly one third. In similarity to online students worldwide, a great number of online students in higher education in Sweden state that one important reason for their decision to study online is the flexibility, which enables them to fit studies into their general life situation (Statistics Sweden, 2012). However, conducting studies online may come at a price as: "…high frustration levels, lower levels of satisfaction, technical and logistical problems, lack of teacher interaction, difficulty developing student friendships…" (Hirschheim, 2005, p. 97). This could indicate that the designs of online courses do not always match students' expectations and the quality of their overall learning experience.

The strategy plan for e-learning at Umeå University explicitly specifies that all decisions related to e-learning should be guided by simplicity, flexibility, and cost effectiveness, with customized systems, learning environments and support for users' different needs (Umeå University, 2016). The Higher Education Ordinance stipulates that university education should enhance the students' skills to demonstrate the ability to present and discuss information, problems and solutions in speech and writing and in dialogue with different audiences (Swedish Code of Statutes, 1993:100). The need to assess speech performance was consequently an important reason for the experiment to design and implement oral tasks in the online courses. Along with this followed a curiosity regarding if oral tasks could enhance students' learning experience and if so, what aspects were involved. These institutional frames highlight the challenge to design for learning that ensures that the students develop expected skills through flexible attendance, which meets their expectations regarding the learning experience - whilst using inexpensive, accessible and easy-to-use technology that does not exclude individuals due to location or personal disposition.

The complex challenge to create good learning conditions within the above described frames, has been addressed at the Department of Education at Umeå University in various ways. As one of the largest departments of Education in Sweden, the department has become a major actor in online university education in the country, both in terms of research related to distance education and the number of students enrolled in online and distance courses (Holmgren & Johansson, 2012). The department has a long history of distance teaching and already used video conferencing tools for this purpose in the early 1990s (Dahlgren & Karp, 1998). In those days, the university did not provide a central online education environment that met the requirements for high quality online education. Therefore, the Department of Education invested in technology, to be able to control and adjust ICT solutions in relation to pedagogical needs.

As pointed out by Laurillard et al. (2013), many teachers in higher education lack teacher training and have little time and/or support to learn how to teach online. Fortunately, most teachers engaged in online courses at the Department of Education have teacher training and experience from research in online education, which are two good conditions for developing Pedagogical Digital Competence (PDC) – the “ability to develop/improve pedagogical work by means of digital technology in a professional context, primarily in web course/online teaching” (From, 2017, p. 7). Most teachers have a constructivist or sociocultural outlook on learning, in line with the teaching strategies found in research in online learning. For example, instructional scaffolding (Belland, 2017; Garrison, Anderson, & Archer, 1999; Jumaat & Tasir, 2014; Ruey, 2010) is practised through templates, guides, instructional videos, practise questions and teacher feedback to groups and individuals, with an aim to provide beneficial conditions supporting the development of cognitive, social, and teaching presence (Shea, Sau Li, & Picket, 2006). Further, successful experiments such as peer-review elements (Liljeström, Hult, & Stödberg, 2008; Liljeström, 2010) and tutoring in virtual seminars (Holmgren & Johansson, 2012) have become integrated, although sparsely, together with, study guides, feedback templates and a mixture of text-based and video instructions.

The video-task design in focus in this paper was tested in the Bachelor and Candidate degree programs in Educational Science during 2015 and 2016. These courses are provided entirely online, with 100-120 active students per semester. They form a very heterogeneous group; some of them are new university students whilst others have studied at university level for several years. Some students have never studied online before and others have completed many online courses in the past. Most students live in Sweden, where the technological infrastructure is rather advanced in aspects such as fast broadband connection, up-to-date technology and a population with generally good computing skills. However, some learners participate whilst abroad, sometimes staying in countries with poor Internet connections and out-of-date technology at hand. A handful of learners have some sort of a disability, and some speak Swedish as a second language.

The Design of the Learner-Created Video Tasks

The studied case is a 30-credit course (European Credit Transfer System) composed of four modules, each with their own expected learning outcomes. The learning management system (LMS) used for online education at the Department of Education is Moodle, a result of investments in ICT-tools at the department based on the possibility to adjust it to educational strategies, and the versatility with built-in tools suitable for online education. The standard design for coursework and assessments was entirely text-based and asynchronous until the implementation of learner-generated video tasks and real-time video conferences in 2015. This includes a mixture of mandatory and optional seminars, in which the students are expected to interact through asynchronous text-based discussions based on the course content. Scaffolding is provided in the form of schedules, study guides, written instructions, video lectures, library resources and Q&A-forums. The standard final assessment is a written paper based on the course content, and the completion of a self-reflection document, in which they are to reflect on their own learning process during the course work, and in what ways their experiences from various course activities have supported their learning. In three modules, one of the assessment tasks was modified to be a video task. The tools were chosen because they seemed easy to use, even for students with limited experience of digital technologies, and could be managed despite older technologies or slow Internet connection. Further, there were no additional costs for the students since either freeware or programs provided by the university were used. Technical support in forms of various instruction videos was provided, alongside with the option to contact an ICT- educationalist.

The synchronous video conference - Video task 1. The synchronous Adobe Seminar was implemented in the first module, to create an opportunity for interaction during "life-like" circumstances. The idea was to explore if this could raise the students' awareness of their peers and stimulate the students' motivation to engage with peers in future group activities. This could increase the awareness of the presence of knowledgeable and supportive group members, which could be crucial to learning satisfaction in online study environments (Grieve, Padgett, & Moffitt, 2016). The task was designed to engage the students in discussions about their previous study experiences, their view on the course content and tasks, their individual learning goals and how their personal resources could be used to support the group members during the learning process. The idea was to help the students identify the dimension of teaching presence that can emerge through inquiry in collaboration with peers (Garrison et al., 1999). Teachers did not participate in the Adobe Connect seminars. However, inexperienced students could find guidance from more experienced peers.

The asynchronous learner-generated presentation - Video task 2 and 3. Both learner-generated video tasks were designed foremost to enhance the students' oral presentation skills, but a second motive was to stimulate in-depth interpretation of the course materials. Both tasks were designed to stimulate the students in understanding the content in relation to their own experiences and engage the students in the role of teaching others. The idea was that the expectation of taking on the teacher role could endorse cognitive presence (Garrison & Cleveland-Innes, 2005). In Video task 2, the students were asked to choose a part of the course content, e.g., a theory, some concepts or an interesting article and create a video presentation directed to (and with relevance to) an audience of their own choice (e.g., a workplace, school, sports club). The study object was identity, mirrored through theory of gender, normality, social reproduction and ethnicity

Video task 3 was tested in a module in which the study object was theory and research in ICT and learning. Four fictive cases were presented to the students through video clips in which teachers played the role of a potential manager with a request for a proposal for a study plan to educate employees, parents at a school or the general public. The students were to choose a case and, based on course content and research in ICT, design a study plan (aided by ICT) that addressed the requests presented in the case. This task was assessed through the video presentation of their proposal, which had to be performed in such a manner that the persons in the case could understand the relevance of the proposed learning activities and the justification of their choice of ICT aids for these activities.in relation to the circumstances and learning goals presented in the case. In parallel the students also submitted a written paper in which they applied the course content in discussions about strengths and weaknesses in their proposed study plan. Both Video task 2 and 3 required that the students used PowerPoint for their video presentation (maximum 15 minutes) as a base for recording a presentation in Screencast-O-Matic, which was uploaded to Office 365. The original design included a mandatory peer review element to further stimulate social, teaching and cognitive presence. However, as one of the students had a hearing impairment, the opportunity to share their videos for feedback from peers was made optional.

Method

A qualitative case study approach forms the methodological framework of this study. Accordingly, a detailed description of the rationale behind the design of the course elements supported by audio-visual tools tested is provided. Stake (1994) argues that case materials, to some extent, can be compared to actual experience in the fundamental processes of awareness and understanding of a case study. The detailed description of the circumstances in which the video tasks were implemented has been an attempt to help readers relate the results of this study to their own experiences as well as to provide a holistic foundation for the study, as a phenomenon anchored in a real-life situation (Merriam, 1998).

Data Samples

Samples from Video task 1 were collected through evaluation questionnaires at the end of the module from the implementation in 2015. In 2016, the second time the Video task was used, there were a total of 87 answers, including free text comments (N=43). Data samples from Video task 2 were collected at the end of the module from the implementation in 2015 (N=45) and in self-reflection documents from all 172 students. Here, spontaneous remarks in the self-reflection documents about the video task were found in 78 of the 172 self-reflection documents (N=78). Data samples from Video task 3 were collected from (N=45) and supplemented with spontaneous remarks in the students' self-reflection documents and interview data (N=10) from the implementation in 2015.

Table 1. Data Collection

Module 1	Module 2	Module 3
***Video-task 1*: Purpose:** Develop peer-supportive relationships and familiarity with technology. Performed at beginning of course. **Data collection methods**: Course evaluation, self-reflection documents.	***Video-task 2*: Purpose:** Develop content knowledge and oral abilities and ability to discuss theory and research. Performed at mid-time in module. **Data collection methods**: Course evaluation, self-reflection documents.	***Video-task 3*:** **Purpose:** Develop content knowledge and oral tasks to present, motivate and problematize an educational plan based on theory and research. Final assessment in module. **Data collection methods:** Course evaluation, self-reflection documents, interviews.

Analysis

The data from Video-task 1 were analysed with a focus on how the students rated the impact of the task on their learning and the quality of interaction with peers, and also regarding their general experience of the video technology. In the first stage, the data from Video task 2 and 3 were analysed separately. The data were thoroughly analysed to identify general themes, which were used to create categories. The data from both tasks were triangulated in the next step, due to the similar task design and equal patterns, in search for how the students in general perceived the task of performing and recording an oral presentation and what impact they found that tasks like this had on their overall learning experience. However, rare or deviating comments were also identified to nuance the general patterns. All members of the research group were actively involved in the analysis and categorisation of the data.

Results

Almost all students' remarks about the three oral tasks were expressed in positive terms like *fun*, *challenging* and *good variation*. Some students chose to give more detailed information about their opinion, and what impact they thought that the video tasks had on their learning, as reported in the themes presented below.

Students' Perceptions of Video Tasks as Support for Learning

The students' remarks on the two video presentation tasks show that the students experienced that these tasks had a positive impact on their oral skills. For instance, 34 of 54 students commented on this in their self-reflection documents after completing Video task 2, and similar results emerged in the self-reflection documents and free text comments from Video task 1. The students described how they felt the need to refine their presentation repeatedly, after listening to their own recording. Listening to their own presentation made them identify the need to organise their speech more systematically and to carefully choose their words to add clarity. They also described how they realised that they had to consider how to adapt their speech to create a convincing tone, which was needed to capture the audience's interest and assurance of their expertise. Some students reflected over how the task to record an oral presentation was useful to help overcome previous issues about oral performance. Beyond the findings that most students seem to perceive that the oral tasks enhanced their oral skills, other interesting results emerged regarding other aspects of learning. The students' comments about what impact the oral tasks had on their learning revolve around two distinct themes such as the impact they perceived that the tasks had on their understanding of the course content, and how they developed their Pedagogical Digital Competence (PDC).

Understanding of the course content. The central theme in the students' remarks about Video task 1 revolves around beneficial aspects on learning through interaction with peers. The students' general portrayal of how they experienced Video task 1, is that it was beneficial to engage in a synchronous discussion with peers about the course content and upcoming tasks, and that this stimulated their approach to coursework and assessments. Their reasons given for this opinion, for example, that they (18 out of 43 free-text evaluation comments) found that their discussion had a positive effect on their own ability and understanding of course content and tasks, indicate that interacting in this format can stimulate the evolvement of an interpersonal dimension in the interaction with peers. Many students noted that participating in this conference had made them aware of the presence of peers and that they could contribute to each other's learning. One student stated: "Since I have studied before, I could contribute with my experiences from previous seminars and exams" (Self-reflection document, Video task 1). Others mentioned how their participation in the seminar had resulted in the creation of a Facebook group to use for further interaction. When answering the evaluation questionnaire, a majority agreed that they would like to participate in synchronous video seminars in future course modules.

The students' descriptions of their approach to and experiences from completing Video task 2 and 3 are very enlightening. Several students report how they to a higher extent felt the need to reflect upon the accurateness of the content covered in their video manuscripts, compared to what they usually do when creating traditional papers for assessment. For example, one student stated that "to make the recording good, I had to make it several times, which meant extra reflection on my own text" (Self-reflection document). Thus, it seems that working with Video task 2 and 3 stimulated in-depth learning approaches, and thereby their understanding of the course content. The assumption that the video tasks stimulated deep-learning approaches to the course content is supported by other data derived from all three modules. For example, 18 out of 43 free-text evaluation comments contain explicit comments about how working with the video presentation tasks had a strong impact on their understanding of course content. Some 20 of 54 remarks about Video task 2 in the self-reflection documents contained descriptions of how the students felt the need to interpret the course content in depth to clarify their own understanding of concepts and theories and gain enough understanding to be able to create their presentation. The results from the students' evaluation of how they perceive that the oral assessment task contributed to their learning in comparison to the written part of this assessment show that 39 out of 45 students perceived that the oral elements contributed to their learning as much as the supplementary written element. However, learning about the course content from the experience of creating this type of oral task is not the only learning outcome that the students identified. A few students perceived that these tasks truly challenged their previous learning strategies. One student expressed that "I'm not used to studies at the university level being so concrete and practical. This task forced me to go outside my comfort zone" (Interview with student after task 3). Others noted that this experience made them aware of the importance of increased reading and reflection to achieve a deeper understanding of the course content.

Pedagogical Digital Competence (PDC). The second theme that emerged was the students' perceptions of how the task contributed to their PDC, through the understanding of how content and digital competence relate to each other when creating a video presentation. For example, one student wrote about gaining "increased reflection and understanding between technologies, content and pedagogy" and another stated "I have understood that different digital technologies can be used for various educational purposes, which may be based on different theories of learning" (Self-reflection documents). The overall results indicate that the general experience of these tasks was that it enhanced this type of competence. A handful of students described that technological issues restrained their learning during Video task 1, but testified that these issues were resolved during their work with Video task 2, when they already were familiar with the technology.

The opinion that working with the video tasks supported a deeper understanding of the course content also emerges in the students' remarks on what they learned from the use of the ICT-tools and what this meant for learning from the task itself, i.e., the content as well as the purpose, oral communication, for which it was used. For example, when the students describe the process of using ICT-tools to create both the presentation and recording and draw the conclusion is that it stimulated and enhanced their ability to reflect on the content and on how they presented this content. In addition, several students reported that they reflected to a higher extent on the content of their video presentation than what they usually do in written examinations. Thus, there seems to be an added value when students hand in an oral presentation for assessment in which the digital technologies used seem to support the development of processes enhancing deeper understanding of the content. Finally, the results regarding PDC show that the students (19 out of 20 remarks in self-reflection documents) perceive that they have enhanced their general technology skills. This is put forward in remarks about how performing the video tasks have inspired them to plan how to use this type of task in their work life. For example, one student claims "I am convinced that I, in my future career, will have the benefit of having designed and presented a plan for an education activity" (Self-reflection document).

Indications Regarding the Quality of this Design for Learning
During the implementation and monitoring of the video tasks, the teacher team, as well as the students, have identified some quality aspects on the design. These aspects are presented below.

Achievement of educational objectives. The implementation of the technology-supported oral tasks implies that the guidelines given by the Higher Education Ordinance (Swedish Council for Higher Education, 2014) have been met in a more expedient way than before. In accordance with the guidelines, the students have been given many opportunities to demonstrate their abilities to, orally and in writing, present and discuss educational content, problems and solutions in dialogue with different groups. Given the previous design of courses, the implementation of these tasks has also created further opportunities for students to achieve the course objectives, such as presenting, discussing and problematizing the course content. This is also supported by the students' statements concerning their increased understanding of content, oral ability and PDC, which indicate that their learning has been strengthened by the work with these tasks. Furthermore, the overall analysis of the task design also demonstrates that the different tasks have contributed to higher degrees of social, teaching and cognitive presence. For example, the video conference provided an opportunity for the exchanging of students' experiences and peer-support. The video presentation tasks resulted in students increasing their reflections on the course content, their manuscripts and oral presentations.

Progression. The overall analysis of the implementation of the tasks indicates that the progression between the three tasks, concerning the design and requirements, has been important for the students' learning. The group-based video conference meant that the students were given the opportunity to familiarize themselves with the technologies and develop supportive peer relationships, which made them more comfortable in the forthcoming courses. A further progression is seen between Video task 1 and 2. While the first task stipulated that they should present and discuss a self-chosen course content, in the second task the students were also asked to motivate and argue for their choices of technology and learning activities for an external actor. This increased degree of complexity meant that they could benefit from their previous experiences and gradually enhance their learning in the abovementioned areas.

Generic competences. The design of the video tasks should also be highlighted in relation to the development of generic skills. As the results show, the students perceived that their improved oral ability and PDC-skills could be used in other circumstances than studies.

Discussion

As the overall result indicates, the design of the video tasks was appreciated by the students and seems to have had a positive effect on their learning experience. The descriptions of how they experienced the synchronous video conference indicates that oral seminars could enhance the students' awareness of peers and provide a platform for the development of social presence and to some extent provide the feeling of teaching presence through helpful peers. The students' descriptions of how they approached Video task 1 and 2 and how they perceived the outcome of this experience indicate that this design for learning can have a stimulating effect on cognitive presence, in that the students testified how these tasks triggered in depth-learning strategies and repetition. Nevertheless, the design could be improved in the future. In this design, the students only performed asynchronous video presentations, focusing on their own delivery. In the future, it could be of interest to carry out presentations synchronously in for example a video conference. This would involve a different type of presentation, opportunities to ask questions in real-time and perhaps promote presenter skills, which could also be relevant for working life. Further development could be to implement a mandatory review process of oral presentations to enhance their oral ability further. Finally, future designs need to be considered regarding accessibility according to students' needs as students are composed of a heterogeneous group, which includes individuals with various disabilities, such as being hearing-impaired, and students in places in the world with poor Internet connection. Future design needs to continuously keep these aspects in mind.

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USING RICH MEDIA TO FACILITATE DIALOGICAL FEEDBACK PROCESSES

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Abstract

This paper explores how rich forms of digital media can be used to enhance assessment and feedback design in an online or blended delivery subject. This innovative design facilitates dialogical feedback processes by leveraging digital recordings created by educators and students. The aim of this design is for educators to explicate their evaluative thinking using sustainable methods, and for students to reflect and respond to the educators with regard to their assessments. The results indicate that rich media can effectively be used to engage students in asynchronous feedback discussions regarding assessment tasks, which may lead to improvements in future work.

Introduction

In order to enrich their learning, higher education students need to develop evaluative judgment; that is, the ability to make educated decisions about the quality of their performance on assessment tasks (Boud & Molloy, 2013). Furthermore, students can more easily improve their performance on future tasks when they are able to ask questions of the educator who provided feedback on their work (Nicol, 2010). One way to help students achieve these objectives is by providing them with clear opportunities to engage in dialogue with educators.

Research suggests that feedback should be more than just an educator providing one-way commentary on student performance, but rather an ongoing conversation in which educator and student work to co-create meaning (Nicol, 2010; Yang & Carless, 2013). By doing so, students can calibrate their expectations against the opinions of someone known to have a deeper level of experience in the relevant area, and clarify misconceptions about their work (Boud, Lawson, & Thompson, 2013). These notions support conversation theory (Pask, 1976); that is, the idea that learning is enhanced when individuals are able to externally represent their knowledge about a topic by engaging in conversation with another participant (i.e., a teacher, peer, or the learner themselves). Indeed, Laurillard (1999) argues that for learning to truly occur, individuals must justify and communicate a "theoretical representation of [a] particular action" (p. 114) with a teacher and through their own internal dialogues.

Dialogical feedback typically conjures images of students partaking in individual face-to-face discussions with their lecturers. The reality is, however, that very few universities have adequate academic staff levels to provide this option to all enrolled students. As such, one-on-one consultations are generally only offered as an optional extra, and are restricted to designated consultation times. While this approach is understandable due to teacher labour, it can be problematic for students who lack knowledge of educator expectations and are unable to construct meaningful interactions (Bloxham & Campbell, 2010). This approach also raises equity issues (Sadler, 1989), as only certain students may be able to take advantage of consultation times (e.g., those who have sufficient amounts of free time available on campus). Moreover, it is simply not viable for educators to offer individual face-to-face consultations with students in massified courses and subjects that are delivered online. Thus, students completing these sorts of subjects are given little or no opportunity to participate in personalised communication about their learning.

While these challenges are significant, they are certainly not insurmountable. It is possible that rich forms of media, such as digital audiovisual recordings, could be used to facilitate sustainable and equitable discussions between educators and students. Digital recordings (e.g., videos and screencasts) are already recognised as a useful means of providing assessment feedback, as they allow for the provision of detailed comments in a concise format (Denton, 2014; Orlando, 2016; Ryan, Henderson, & Phillips, 2016). In studies that have examined the advantages of using digital recordings to deliver unidirectional feedback comments (i.e., educator to student), the process has been found to be as efficient, or even more efficient, than marking up electronic documents or writing handwritten comments on assessment tasks (Borup, West, & Thomas, 2015; Knauf, 2016; Morris & Chikwa, 2016).

Students also tend to appreciate receiving digitally recorded feedback comments; in comparison to text, they are perceived to be easier to understand (Bourgault, Mundy, & Joshua, 2013; Turner & West, 2013), more supportive (Borup et al., 2015; Gould & Day, 2013), and more personal (Knauf, 2016; West & Turner, 2016). This may be because audio and visual recordings allow educators to convey rich cues like tone and expression (Cavanaugh & Song, 2014; Henderson & Phillips, 2015). Also, students tend to believe that digital feedback recordings reflect a greater investment of time and effort by the educator than text comments (Anson, 2015; Chew, 2014), even though the opposite is generally true (Knauf, 2016).

Despite the growing body of research advocating the affordances of digital recordings as feedback, few studies have investigated their utility to support dialogical feedback processes. This pilot study explored this possibility by measuring students' engagement and perceptions toward digital recordings as a modality to deliver dialogical feedback. To achieve this aim, video and screencast recordings were used to facilitate dialogue between lecturers and students in a mixed delivery postgraduate Education class.

Method

This section outlines the feedback design and research method used in this study. Ethics approval was received from the University's Human Research Ethics Committee before data collection took place.

Participants

The participants involved in this study were 39 Master of Education and Master of Teaching students enrolled in a subject focused on the instructional design of online learning environments. This subject was offered by the Education Faculty of a large Australian university.

All 39 students were given the choice to take part in a dialogic feedback activity with their lecturer, but only 11 (28%) did so. All students, regardless of whether they completed the feedback activity, were then invited to complete an online survey. Of these, 51.3% (n = 20) elected to take part. Data from one respondent was removed, as this student did not provide usable answers to the open response questions. Of the final sample of survey respondents (n = 19), the majority were female (77.8%) and considered English to be their first language (83.3%). Forty two percent received feedback from Lecturer 1, 32% received feedback from Lecturer 2, and 26% received feedback from Lecturer 3.

Materials

A short online survey was used to collect data relating to the dialogical feedback exercise. The survey comprised a total of nine items, of which three were closed-ended demographic questions (gender, whether their first language was English, and which of the three lecturers had created their feedback recording for Assignment 1). Also included was one 5-point Likert-type item that asked students to rate their level of agreement that the feedback they had received for Assignment 1 had an impact on what they did for Assignment 2 (strongly agree – strongly disagree). This was followed by one open response question asking students to explain their chosen level of agreement. The survey also included one binary closed-ended question (yes/no) asking whether students had been involved in the dialogical feedback activity. This question was followed by one of two filtered open response questions: the first asked students who had engaged whether they found it helpful, and the second asked students who failed to engage why this was the case.

Procedure

The subject was taught by three lecturers, of which two (Lecturer 1 and 2) had numerous years' experience creating digital feedback recordings, and one was attempting it for the first time (Lecturer 3). Lecturer 3 was also an early career educator who was teaching this subject for the first time, while Lecturers 1 and 2 had been teaching this subject for several years.

Students enrolled in this subject were asked to complete two formal assessment tasks: the first was an annotated bibliography that was due in Week 5 of the semester, while the second was an essay or negotiated project that was at the end of Week 11. The feedback design used in this study was based on the idea that digital recordings could be used to enable and enrich multiple feedback loops amongst educators and students between submission of the first and second assessment tasks.

The first step in the design was the creation of digital recordings (either video or screencast recordings) by the three lecturers after students had submitted Assessment Task 1. These recordings were sent to students in Week 8, and provided information relating to each student's performance in the task. The recordings followed a structure that had been utilised by the researchers in previous years (Henderson & Phillips, 2014), which specifically focuses on providing students with substantive comments relating to areas that they can strengthen in their future work.

Within the Assessment Task 1 feedback recordings, the lecturers offered each student a personalised provocation. Essentially, this entailed inviting students to record a short video or audio file responding to a nominated area of improvement that the lecturer had raised within the recording. Lecturers specifically encouraged students to outline how the feedback they had just received would change the way they would undertake work for Assessment Task 2. Students were also invited to discuss their ideas for Assessment 2, which allowed the lecturers to provide a follow-up video either honing or validating these ideas. In this way, the feedback loop was enhanced through continued dialogue.

In the week immediately following the end of semester (Week 13), students were invited to complete an online survey that was hosted on Qualtrics. Participation in the survey was voluntary, and no incentive was offered.

Results and Discussion

Of the 39 students enrolled in the subject, 11 (28.2%) provided a response to the provocation provided by their lecturer. In 9 out of the 11 (81.8%) cases, students' responses formed the basis of ongoing dialogue with lecturers about the impact of the Assessment Task 1 feedback on Assessment Task 2. Students' response artefacts were generally multimodal, incorporating a combination of either video and text, or audio and text. However, two students elected not to include a digitally recorded component, choosing instead to post text based responses in a general discussion forum on the web-based learning management system associated with the subject.

The majority of the 19 survey respondents (73.6%, n = 14) either agreed or strongly agreed that the feedback they received about Assignment 1 had an impact on what they did for Assignment 2. When asked to explain why they had agreed, 9 out of 14 students mentioned that the lecturer provided specific examples of where they could have strengthened their work. As a result, it was easy for these students to understand how to action the feedback and improve their second assignments. For example, one student wrote "In [Lecturer 1's] Assignment 1 video feedback he clearly outlined where I could improve for Assignment 2. I used his feedback to then inform several of my Assignment 2 choices." Another remarked, "[Lecturer 1] gave really useful feedback regarding the content, structure and writing style of my work. He also commented on referencing points. These were useful in structuring my work for Task 2."

The results outlined above are in part influenced by the fact that lecturers were specifically focusing on providing students with usable feedback for Assessment 2. However, these results also highlight the affordances of digital recordings. For example, by speaking rather than writing, educators have the ability to effectively convey a large amount of detail in their feedback to students. Moreover, students' understanding of the information can be improved through the inclusion of non-verbal cues, such as tone, pace, and expression (Ryan et al., 2016). Screencasts are particularly beneficial in this regard, as educators can adopt a split screen approach whereby students can simultaneously view their own work and the educator's face, while also hearing their voice. This can further aid student understanding, as educators are able to highlight exactly which part of the work they are referring to, at the exact moment that they are speaking about it (Henderson & Phillips, 2015).

The survey results also revealed that the effectiveness of the feedback activity was due to more than just the modality of the feedback. For example, one respondent mentioned that it wasn't the initial feedback *per se* that had had an impact on Assessment 2, but the subsequent dialogue with their lecturer which provided them with a clearer sense of how to improve. This is illustrated in the following comment, "The feedback I received for Assignment 1 encouraged me to share my thinking about Assignment 2 with [Lecturer 2]. I did this and got subsequent feedback which I incorporated. So, the process of the feedback impacted assignment 2 -- probably more so than specific advice given in the Assignment 1 feedback." This quote supports conversation theory (Laurillard, 1999; Pask, 1976), and strengthens the argument that dialogical feedback can help students beyond what they experience when feedback is unilateral.

With regard to engagement in the dialogical feedback process, 57.9% (n = 11) of respondents indicated that they had discussed the feedback they received on Assignment 1 with one of their lecturers (e.g., by recording a response video). Of these, seven provided follow up survey responses stating that they had considered this process to be helpful or useful. Unfortunately, there were only a few cases where respondents elaborated on their open-ended responses to explain why they felt this way. Three students noted that the act of verbalising their responses had deepened their reflections on their own work, while two others remarked that dialogue with the lecturer had helped them shape their next assignment. These results highlight how the process of engaging in dialogical feedback allows students to verbally articulate their ideas, which can consequently help them shape and strengthen their arguments. Indeed, it may be the case that this process enables students to externalise their inner dialogue of knowledge construction, thus supporting deeper learning (Laurillard, 1999).

Scholars recommend that students should participate in dialogue with educators both before and after submission of assessment tasks (Bloxham & Campbell, 2010). However, in reality, most student experiences of communication with their lecturers or assessors are limited to text-based comments received after submission of assessment tasks (e.g., handwritten comments, digital annotations, comment banks, or generic rubrics). Nicol (2010) refers to these types of feedback as "impoverished and fractured dialogue" (p. 503), and argues that educators should instead be aiming to have direct, personalised interactions with students. Likewise, Ajjawi and Boud (2017) argue that feedback should be viewed "not as a set of unilateral comments, but as a social act, a dialogue" (p. 253). As the results provided here illustrate, engaging students in a dialogue can be extremely useful for students, even when that dialogue is asynchronous in nature.

The act of engaging in dialogue can also increase the level of rapport between educators and students. This is advantageous for students, as it can increase motivation to achieve in the subject (Sass, 1989). There was evidence of this effect in the survey responses; for example, one student noted that the dialogical feedback activity had heightened the personal connection between themselves and their lecturer. This outcome may also reflect the nature of rich media, as previous research has observed that digitally recorded feedback can strengthen relationships between educators and students. Educators can convey empathy and warmth more easily using audiovisual media than they can through written comments (Henderson & Phillips, 2015), and students feel that recordings reflect a greater deal of effort than text comments (Anson, 2015). This makes digitally recorded feedback particularly appealing in situations where the affective relationship between students and educators may be lacking, such as massified or online courses (Borup et al., 2015).

It should be noted that not all of the respondents provided positive comments about the dialogical feedback activity. Students who disagreed (15.8%), or felt neutrally (10.5%), that the feedback had an impact on their subsequent work provided several different reasons why this was the case. For example, two students mentioned that they already had a clear sense of what they were doing for Assignment 2, while another mentioned that external pressures had interfered with their ability to impact on Assignment 2, stating, "I had so many constraints on my project that realistically I did what I could." Three other students were somewhat critical of the feedback comments they received on Assignment 1; noting that they were "hard to decipher," that they were not "completely relevant to the second assessment," and that there was "too much focus on marginal errors." While these comments may be a symptom of the students' degree of proficiency in evaluative judgment, it also may be because each of these students received feedback from Lecturer 3, who was both new to teaching the subject and providing feedback in a digital recording.

The perceived effectiveness of digital recordings can potentially differ according to various contextual factors, such as those related to the educator providing the feedback (Phillips, Henderson, & Ryan, 2016). As Lecturer 3 was just beginning to have higher education teaching experiences, the lecturer may have lacked confidence regarding the content of the feedback and the medium being used to record it. Such findings highlight two potential considerations for future research. First, researchers should explore whether digital feedback recordings are more likely to increase student engagement and understanding when the feedback is provided by educators who are experienced and confident in their delivery of information. Second, scholars should not only focus on the impact of modality when attempting to understand students' perceptions of recorded feedback (Ryan et al., 2016), but also the influence of external factors, including the experience level of educators and their familiarity with digital recording processes.

The timing of the dialogical feedback activity was also a negative aspect noted by some students. For example, respondents who failed to discuss the feedback with a lecturer generally indicated that this was due to a lack of time. For example, one student wrote "[I] get distracted with other [subjects] that I'm trying to divide my focus on," while another stated, "I ran out of time trying to fit everything it, especially with something that was going to take time to figure out how to do it a video or voice recording and then uploading it." Yet another noted, "…at the time the video was sent, there was a lot going on and I was already in preparation mode for the second assignment." Based on these observations, it may be worthwhile planning the dialogical feedback occasion to occur several weeks before a subsequent assessment task is due. This would also aid students in their thinking processes before they have committed significant amounts of time to the task, and avoid issues associated with time restrictions and competing demands.

Conclusions

This study evaluated the use of rich forms of media, such as video and screencast recordings, to support dialogical feedback processes in a mixed delivery higher education subject. The results clearly highlight that audiovisual recordings allow educators to convey rich and detailed information using multiple simultaneous cues. This can help students to understand and use the feedback, due to the increased specificity of comments and higher perceptions of rapport.

Furthermore, dialogical feedback processes can aid students in honing their ideas and arguments for future assessment tasks. The very act of verbalising and justifying ideas to a more knowledgeable other (e.g., a lecturer) can help to strengthen learning and evaluative judgment. However, the articulation and reframing of ideas by the educator is also similarly important. Arguably then, this process is most effective when educators and students participate in multiple occasions of dialogue.

Although the results of this study were generally positive, educators should continue to be cautious when using rich media to provide feedback. At this stage, more work is needed to explore the implications of teaching experience in this process, and how level of training in the recording method and structure can mediate the effect and outcomes. Further thought also needs to be extended to the timing of feedback occasions. In this study, the initial feedback recordings were provided three weeks after submission of the first assessment task and three weeks before submission of the second. However, this timing was not suitable for all students; some had already commenced working on the subsequent assessment task and were confident with their progress, while others were preoccupied with competing demands. It therefore appears essential to provide the initial feedback early enough that students are still in the process of shaping ideas for a subsequent piece of assessment and have the capacity to deal with other impending deadlines.

Overall, this study indicates that rich media can be used to support asynchronous dialogical feedback processes, and that such exercises can be useful and engaging for students. While there are various factors that may account for these outcomes, the richness of the media is of particular importance.

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USING THE MUSICBRAINZ DATABASE IN THE CLASSROOM

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Abstract

Musicbrainz is a crowd-sourced database of music metadata. The level 6 class of Data Science teaches students about *big data*, using a large database, interacting with a database from a programming language, exporting data as XML, JSON or CSV, applying data mining algorithms and visualising data. This paper reports on using Musicbrainz in this class as well as the Orange educational tool. After a description of the class, this paper will give an evaluation based on students' questionnaires and a discussion on the experience and how to improve the class.

Introduction

Teaching and attending a class involving databases can be dull. Databases, data analysis and data science are important fields of computer science and often suffer from misconceptions as people feel they are boring, hard and not interesting when they are exciting, fun and essential. In the scope of the computing curriculum at Southampton Solent University is a level 6 class of Enterprise Data Modeling in which I chose to teach about data science and to use the Musicbrainz database to engage students better with the topic. Data science is a revolutionary field, which purpose is to make scientific discoveries out of data, and in which applications in business lead to improve existing businesses or find new strands to exploit. Through the class, students get to use the Orange educational data-mining tool, Postgres Musicbrainz database, migrate data to a MongoDB database (Docs.mongodb.com, 2017) and the Python programming language. The class is inspired by the work of Mesnage and Jazayeri (2008) in the context of the project based learning curriculum set in Jazayeri, (2004). This paper is structured as follows, a presentation of the Musicbrainz database, the Data Science class, a reflection on engagement with the class, challenges and technical settings.

Musicbrainz

The Musicbrainz database is an open source music metadata database available at Musicbrainz.org. It is crowd sourced and is used by major digital music companies such as the BBC, iTunes and Amazon to identify artists, albums and tracks. Originally people submitted metadata when purchasing a new CD or other formats, and, playing it on their computers, they would enter metadata about the album, the artist, the list of tracks, the label and who published it. This data would be sent

Figure 1. MusicBrainz logo.

to the Musicbrainz server and related to previously entered data about the same elements. The database now stores and makes available metadata about more than a million artists and 16 million tracks from all other the world. It also contains links to music services and some information about genres as tags or concert and events. Musicbrainz is run by the Metabrainz foundation and supported by remote developers.

I have contacted the developers through their IRC chat and apart from the fact that they are very pleased for us to use their database, they also mentioned it has not been done before in a classroom.

Data Science Class

In the scope of the level 6 of the computing curriculum at Southampton Solent University, students can take the Data Science class as an option if they study the Web Development, Networking or Software Engineering course or have it as a core course if they follow the computing curriculum.

The class goal is to study data science, i.e., how to make scientific discoveries out of data. For this purpose the class starts with the current context, the world of big data. In fact it is predicted that by the year 2020 we will generate 40 Zettabytes of data per year, which converted in high definition video is equivalent to 4.5 billion years of video, the age of Earth to watch each year seems unfeasible. We study the history of database management systems going from mainframes to the more recent non-relational databases through the relational model as shown in Figure 2.

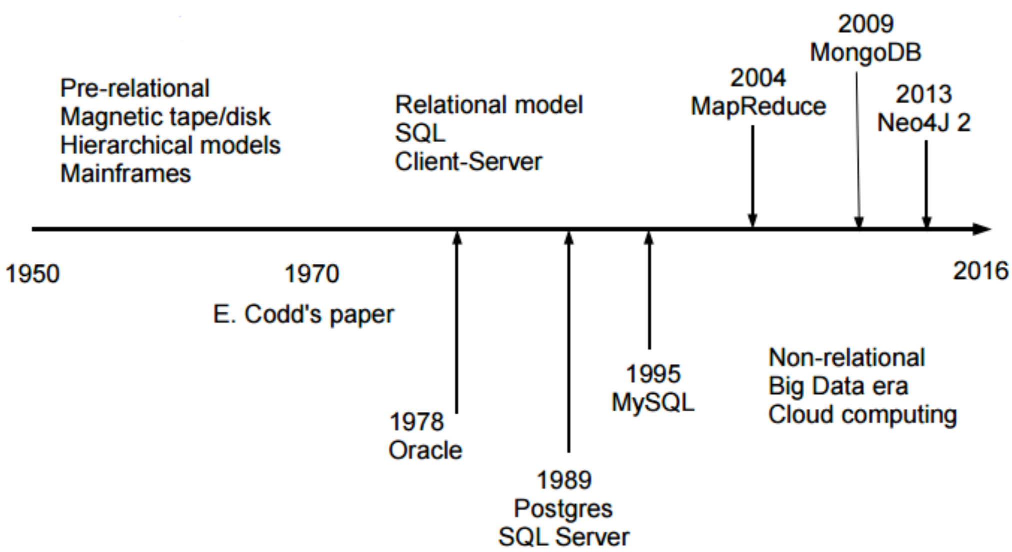

Figure 2. Evolution of database management systems.

As an example of a large database we use Musicbrainz; students get in touch with the database by first interacting with the website and searching for their favourite artist and albums. We then move on to actually connecting to the Postgres database (Postgresql.org, 2017) and students are set to write SQL queries about what they are interested in by looking at the schema in Figure 3.

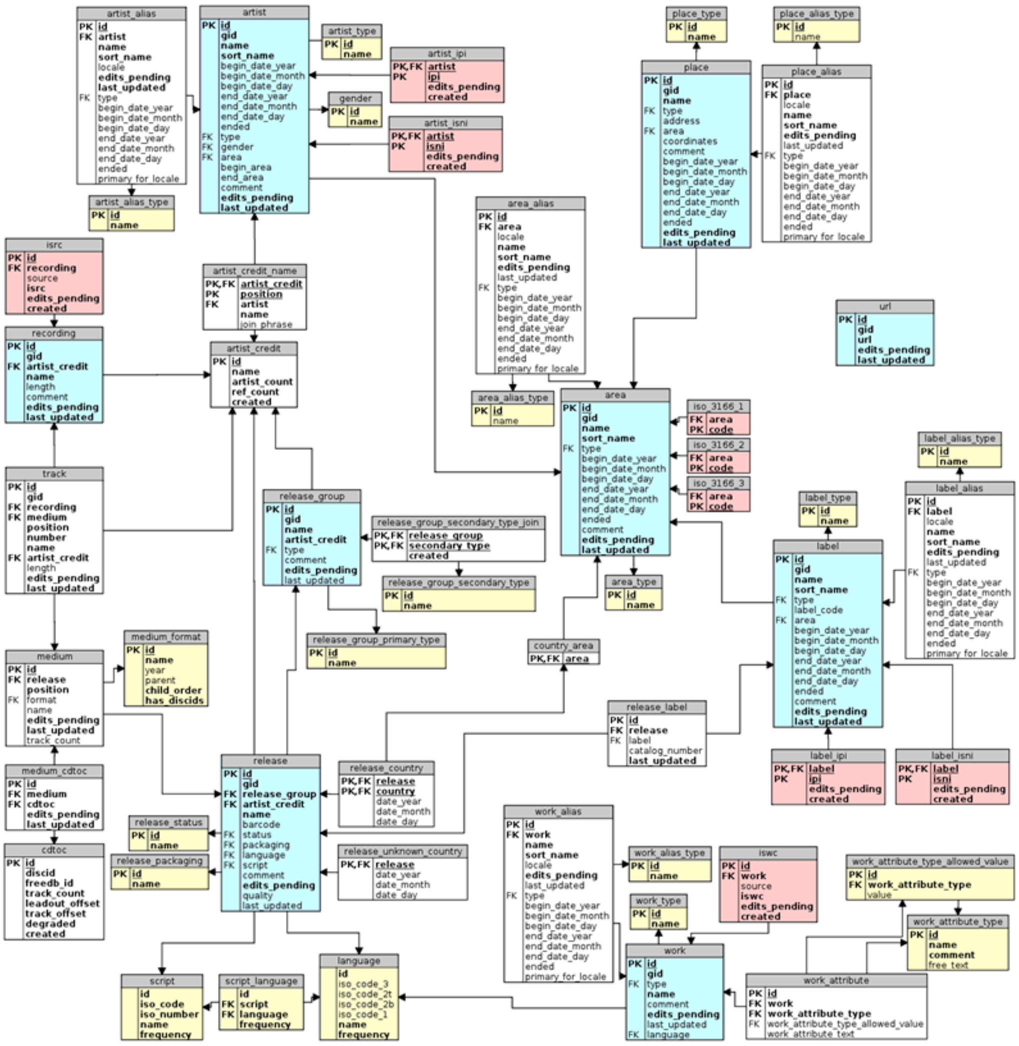

Figure 3. The MusicBrainz database schema.

The first assignment is to migrate parts of MusicBrainz to a MongoDB database. This is a case study of modernising a system as MongoDB is a recent database management system that enables easy distribution over multiple servers and facilitates retrieving data in now conventional formats such as JSON (JavaScript Object Notation). To perform the migration, students write Python programs.

The second part of the class focuses on the data science process as shown if Figure 4. Collecting data, pre-processing it, applying data mining algorithms and visualisations and interpreting them. The process is simplified, as it does not include hypothesis formulation nor hypothesis testing, verification or falsification. We study multiple data mining algorithms for clustering, prediction, classification, association rules, time series and basic statistics such as variables distributions. Since it is not the purpose of the paper we will not go into many details of this part of the class.

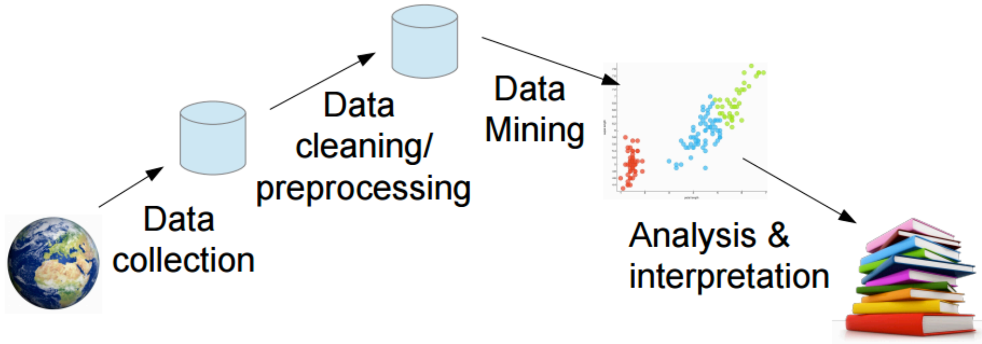

Figure 4. The data science process.

The second assignment of the class takes the students in extracting data from the Musicbrainz database, processing it and analysing it using the Orange open source data mining tool built by the bio lab of the University of Ljubljana (Bioinformatics Laboratory, 2017). It is an educational tool programmed in Python and on top of the Scipy, Numpy and Scikit learn scientific libraries. Figure 5 shows a scatterplot produced in Orange, which was part of the assignment.

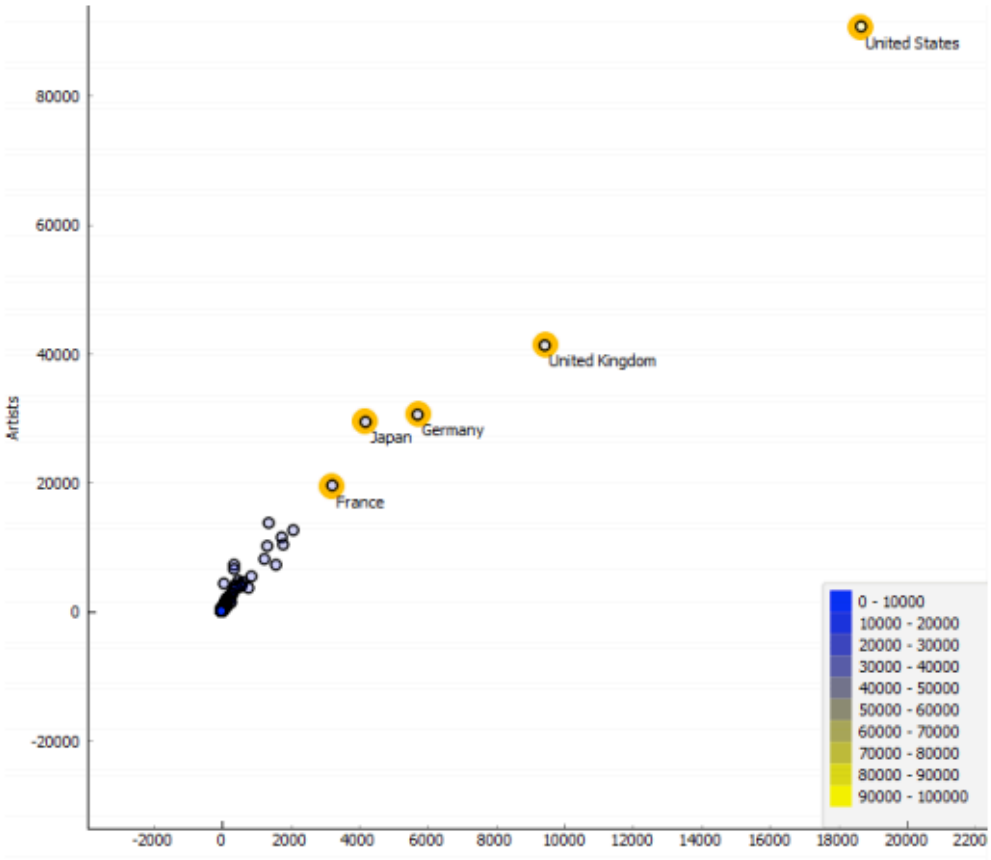

Figure 5. Example of a scatterplot produced by a student of the number of artists and music labels per country.

Engagement

I have not measured the student engagement with the class nor can I compare with previous instances since this was the first time I taught the class. I can transcribe my observations. Students engage better with Musicbrainz as the domain is music and most students are interested in music and have knowledge about it. Top students are engaged by the fact that this is a real database in use by popular services as shows the following student feedback.

Example of student feedback related to Musicbrainz:

> Going through the MusicBrainz and learning about that, as it was a real database used for professional applications so it was very interesting to look into. To sum it up, everything is recent and industry focused and that doesn't feel the same with the other units sometimes.

Students of a lower level are engaged as well, as they want to find data about their favourite artist, and I have observed a stronger interest from them in the class once we started using MusicBrainz.

I ran two surveys to get student feedback, one midway and one at the end of term. The only question from the survey that relates to engagement was “is the class interesting?” as shown in Figure 9. Out of the students who answered, 57% found the class interesting, and 89% did not find it not interesting. I believe this shows students engaged well with the class. The exit survey is not significant as only 4 students answered it.

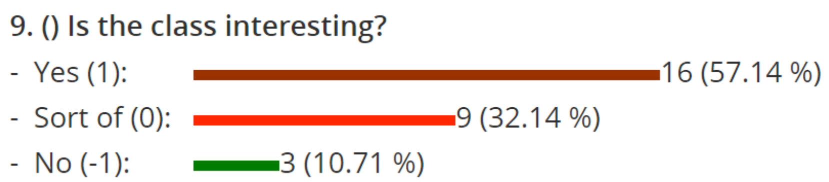

Figure 6. Result about engagement from the midway survey.

Challenges

It is challenging for students to work on such a large database schema as shown in Figure 3, grasping the semantics of more than 50 tables. The size of the data is a challenge as well; the database is 30GB, which forces the SQL queries to be not only correct but also efficient.

Another challenge in the class was to let students write queries about anything they want to look for, requiring them to be creative, which seems to be difficult for many of them who are used to having examples and more straightforward exercises to perform.

Most students passed the class, out of 37, 35 passed, and 2 are currently working on their retake. This is another measure of engagement, as to carry out the work of the assignment was challenging.

Technical settings

The Musicbrainz database is installed on an Ubuntu Linux virtual machine called Alexandria, which runs on the university servers. Students have a personal account on the machine and since using SSH (Secure Shell, which enables user to connect to a remote machine and run commands and programs on it) is new to most of them, this became part of the class as well.

One issue is that Alexandria is not accessible from outside the university for security reasons. The data-mining tool Orange is installed on the machines in the classroom where the class is held but not in the work areas of the university, which is a problem when students want to work outside of class.

Conclusion

In this paper we have seen the importance of using a database that engages students better with such a critical topic as data science. The Musicbrainz database is a large open database, which can be installed in any university on a Linux virtual machine, and students can connect to it with PostgreSQL and programming languages. Students found the class interesting in a feedback survey conducted within the class. Musicbrainz has gaps: it lacks data about events and venues, the genre information is very sparse, and the schema overly complex. We are developing a music database in house and might use it in the classroom as a replacement or together with Musicbrainz. The fact is music engaged students with a difficult topic, it would be interesting to experiment with other topics such as films (IMDB), video games (STEAM) or ultimately on anything they like.

Acknowledgements

I would like to thank the students who attended the class of Enterprise Data Modelling at Southampton Solent University the year of 2017, the previous unit leader for this class, Dr Jing Lu, for her input, the Musicbrainz developers, the Orange team and the Computing group of Southampton Solent University for giving me the opportunity to develop this class.

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EPHP – A VISUALISATION TOOL FOR LEARNING SERVER-SIDE WEB DEVELOPMENT: INITIAL WORK AND PILOT STUDY

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Abstract

Over the course of more than 10 years teaching PHP, we have come to recognise that many students find the architecture of web applications confusing and in particular often confuse the programming constructs to read user data from the front-end with those used to obtain data from the back-end database.

Our *EPHP* software aims to address these problems via a visual simulation of the operations of a PHP-based web application. A prototype has been used already by students on our second-year unit "Developing for the Internet," and feedback via a survey obtained. We discuss points for enhancement identified from the survey and our own observations of the students using the software.

Keywords: visualisation, learning tool, web development, learning programming

Background

The Challenges of Teaching and Learning Web Development

For many years, teaching and learning programming has been recognised as a significant challenge. A number of reasons have been put forward for this. Two major international, multi-institutional studies were done in the early years of the 21st century by McCracken et al. (2001) and Lister et al. (2004). The former found that many students lacked the ability to solve problems, while the latter found (via a series of code-based multiple-choice questions) that many students had an inability to comprehend the semantics of small sections of code. Other studies (Radošević, Orehovački, & Lovrenčić, 2009) suggest basic syntax is a problem for many students.

This has been backed up by our own experiences at university on a range of programming units: students frequently struggle with a range of aspects of programming, ranging from basic syntax errors, confusion with object-oriented concepts, and problem-solving skills.

Web development, as pointed out by Zhang and Dang (2015), raises a number of unique problems not seen in other types of programming, due to the multitude of different technologies (e.g., HTML, CSS, JavaScript and a server-side language) and due also to the distributed, client-server nature of web applications. A typical web application consists of three components: the web browser; the web server, such as Apache (The Apache Software Foundation, 2016), which executes server-side scripts written in a language such as PHP; and the back-end database system, such as MySQL or Oracle.

The role of PHP, the focus of this study, in such applications is to receive user input from the browser, look up data in a database, and format that data for presentation to the end user, which is sent back to the browser as a response. This system is more complex than a simple desktop application, increasing the scope for confusion on the part of the students (see Figure 1).

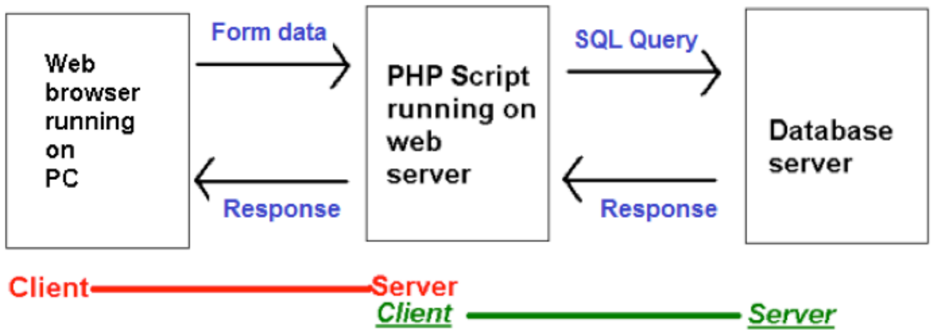

Figure 1. The components of a typical PHP web application.

The principal author has been running and teaching a second-year undergraduate unit entitled "Developing for the Internet" for 14 years. This unit focuses largely on server-side web development using PHP. During this time, we observed several common problems encountered by students. Frequent issues come from students appearing not to understand that PHP runs on a server (a common problem is opening the PHP directly from the hard drive of their machine in their browser, rather than requesting it from a server by typing in a valid URL), and confusion between the three components of the system described above (students frequently confuse data being sent to a PHP script from a web form and data being received by a PHP script from the database).

Previous studies back up our own observations that web development is a particular challenge. Park and Wiedenbeck (2011) made a "study of help-seeking activity in an introductory Web development course" (p. 125). The problems included the code itself but also other, ancillary issues such as how to transfer files to a server.

Alston, Walsh, D., & Westhead (2015) interviewed five lecturers as part of their study, who gave feedback on what they believed to be the main issues causing problems for their students. One participant identified that problems in web development come from the details being behind the scenes; giving the quote "a lot of it is hidden from the students" (p. 2). This is certainly the case: for example, a beginning student may not realise that when entering a URL in a web browser, a request is sent to a web server via a request which delivers the requested page as a response. Another example is the fact that a PHP-based web application requires a web server, such as Apache, to run, as described above – which is a likely source for the misunderstanding we have observed where students attempt to run PHP scripts directly.

Park and Wiedenbeck (2011) also raise the issue of “decomposition” (p.131) in which they propose that students have difficulty breaking down what they see as a single whole (a web page) into its components (HTML and CSS); Alston et al. (2015) raise similar points. By inference the same principle could lead to students being unable to break down a PHP application into its three components (HTML, running in a browser; PHP, running on Apache; and a back-end database).

A further study on the difficulties encountered by students in web development was done by Zhang and Dang (2015). These authors researched (by means of a survey) factors affecting students’ issues when learning web development with C# and ASP.NET. Findings from this research are also enlightening: for example, “code behind” (p. 3), a specific feature of .NET development (Microsoft, 2009) was seen as difficult and other comments made by students included difficulties understanding “why things go where they do” (p. 3) and “knowing what file structure does what, how to program the code behind file” (p. 3). These observations appear to support those of Alston et al. (2015), who, as described above, obtained the comment from one of their interviewees that “a lot of it is hidden from the students” (p. 2) – and (with the caveat that .NET web development is different in style to PHP) also support our own.

In summary, then, learning web development is a significant challenge when the problems with learning any type of programming are added to the difficulties in comprehending the relatively complex, multi-language client-server system that is a database-driven PHP server-side web application.

Existing Interactive Learning Tools for Web Development

A number of online environments exist to help students learn web development involving interactive exercises, including Codecademy (Codecademy, 2017) and CodeAvengers (Online Education Ltd, 2016). Codecademy consists of a series of interactive exercises for learning various web development technologies, including PHP. Exercises involve writing code in the browser or filling in blanks in existing code. Codecademy includes a split view in which the output from the code is shown on the right hand side of the screen (including syntax errors). Detailed feedback is given for errors, and badges given for completing exercises.

Codecademy covers language features such as loops, arrays, conditionals, and variables. However it does not cover the client-server aspect of PHP, such as receiving form data, understanding HTTP requests and responses, and database interaction.

In addition, some IDEs, such as PHPStorm (JetBrains, 2017) include full debugging tools such as breakpoints and watches. Nonetheless, none of these tools really address the problem of effectively presenting the distributed, multi-component, multi-language nature of a server-side web application and allowing students to understand how it works as a whole.

Visualisation

A good deal of work has been done in using visualisation tools to help students learn general programming, using languages such as Java or C++. Tools include EVizor (Moons & Backer, 2013), JEliot (Ben-Ari et al., 2011; Ben-Bassat Levy, Ben-Ari, & Uronen, 2003; Moreno & Joy, 2007) ViLLE (Kaila, Rajala, Laakso, & Salakoski, 2009), and Verificator (Radošević et al., 2009). However, little or no work appears to have been done on using such tools for learning web development.

A common approach made by these tools is to present an animation, involving stepping through the code, highlighting the current line of code, and showing users what is going on graphically. This is done by means of depicting code constructs such as variables and their contents, objects and their contents, loops, or function or method calls and their parameters. These graphical depictions are typically in different colours for emphasis.

Success in improving student learning with these tools has varied somewhat but trends towards positive. For instance, with EVizor (Moons & Backer, 2013), students were asked questions on the operation of a recursive program. Results indicated significantly more understanding after using the tool, and furthermore, answers given were at higher levels of the SOLO taxonomy (Biggs & Collis, 1982, as cited by Moons & Backer, 2013). The design of EVizor was informed by learning theories including constructivism and cognitive load theory – in the case of the latter, not overloading someone with too much information to "reduce load on working memory" (p. 370). Guidelines from cognitive load theory incorporated in the tool included placing "related concepts (of similar or different media, such as pictures and explanatory text) closely together" (p. 373) and that "information should be kept concise, and irrelevant information should be hidden" (p.374).

ViLLE (Kaila et al., 2009) is another such tool. It steps through code and includes separate windows for program output, current values of variables and visualisation of techniques such as recursion. It includes play, fast forward and rewind buttons and controls for speed. A study using ViLLE revealed that it was of particular benefit to "novice programmers" (p. 25).

JEliot, which has had several, progressively enhanced versions, has been the subject of the most studies amongst this group of tools, with mixed results. Moreno and Joy (2007) used JEliot 3 as the subject of their study, with mixed results: on the one hand, students gave positive feedback in that they believed it helped them understand concepts such as "object creation" (p. 55), but on the other hand it did not appear to help them actually write the code which uses such concepts.

Ben-Bassat Levy et al. (2003) performed a study with the earlier version, JEliot 2000, amongst a group of Israeli "10th-grade" (p. 2) school students. Concrete results were more encouraging than the later study here; students were able to articulate programming concepts more clearly. It was found to helped medium-range students to a greater extent than either strong or weak students; the investigators believed that stronger students "did not really need it" (p. 11) and that the "weakest students are overwhelmed" (p. 11).

Naps et al. (2002) derived a taxonomy for student engagement with visualisation tools based on a survey of educators plus analysis of the existing literature. This taxonomy involves 6 levels of interaction with a visualisation tool: "no viewing," "viewing," "responding" (answering questions using the tool), "changing" (making the visualisation work differently), "constructing" (changing the visualisation itself) and "presenting" (to an audience) (p. 142). With the Naps taxonomy it is proposed that visualisations need to be at levels three or higher to have benefit, i.e., students should not just watch a visualisation but should at the very least be able to interact with it, at the "responding" level (answering questions presented by the tool). The ViLLE (Kaila et al., 2009) study confirmed that the tool was only of use when students interacted with it at level 3 or higher.

A number of findings can be summarised from this analysis of the literature:

- The visualisation tools examined present programming constructs graphically, typically by stepping through the code and at the same time visualising the constructs (such as simple variables, or objects, and their values) in adjacent windows.
- Visualisation tools generally have reasonable success, but only when students interact with them (Naps level 3) as opposed to passively watching them (Kaila et al., 2009).
- There is a need to place related information together (such as graphics and their explanation) and hide unnecessary information (Moons & Backer, 2013) to avoid information overload and thus confusion (Ben-Ari et al., 2011; Ben-Bassat Levy et al., 2003)
- Tools appear to benefit beginner or intermediate programmers more than experts (Ben Bassat-Levy et al., 2003; Kaila et al., 2009), presumably because experts are happy learning programming without the aid of a visualisation tool.

EPHP – The Learning Tool

We now present the initial prototype of our visualisation tool for learning web development, *EPHP* (the "E" standing for "easy"; the hope being that it will ease the process of learning PHP web applications).

EPHP is a web-based application with the server-side component itself written in PHP; the client-side is written in JavaScript with an HTML5 and CSS-based interface. In order to visualise the client-server nature of a web application, the screen is split into three windows. The left-hand window represents the client (the browser) while the right-hand window represents the server. In between is the "Network" window, which represents the communication between client and server.
The client window consists of two tabs, *Develop* mode and *Simulation* mode. In Simulation mode, the client window contains a "browser within a browser"

in which the user can enter a URL and visualise the HTTP request being sent to the server. This is shown in Figure 2:

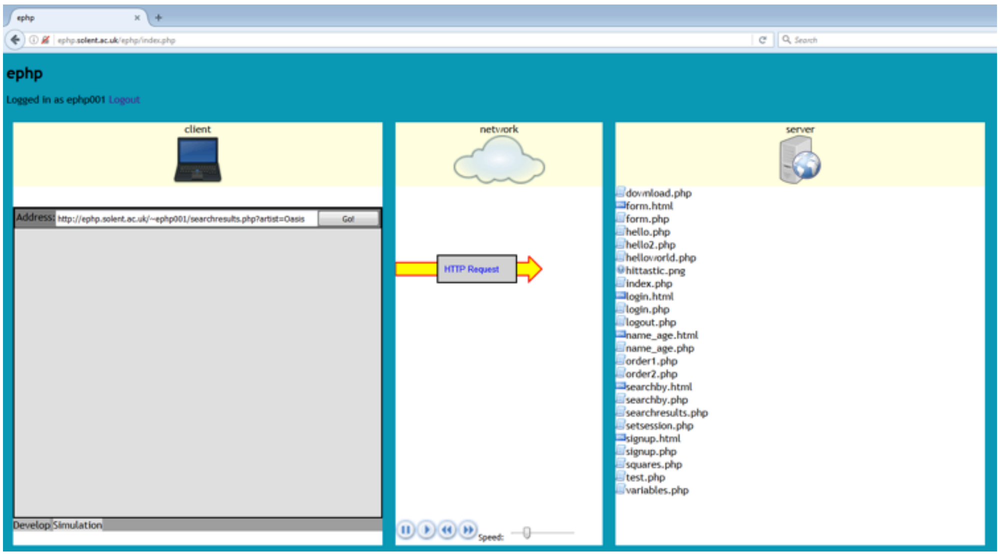

Figure 2. The EPHP user interface.

Furthermore, the user can roll the mouse over the "HTTP request" box and view – and edit – the HTTP request being sent to the server. In this way, EPHP aims to help students visualise the client-server communication that takes place behind the scenes when a user enters a URL in a web browser.

When a request is received, the requested file is highlighted server-side, and sent back to the client as an HTTP response that can, like the HTTP request, be viewed and edited by the browser. Finally the requested page is loaded into the "browser within a browser" in the client window.

Develop mode allows users to enter HTML or PHP code using an embedded Ace editor (Cloud9, 2017) and upload to the server using FTP, allowing users to make use of EPHP as a single tool to develop, upload and test their code.

As well as visualisation of client-server communication, EPHP aims to help students understand the relationship of PHP code to data from web forms, and to results from a database query. A user can enter a search term in a web form (which sends its data to a PHP script) in the "browser within a browser," visualise the HTTP request, and see the PHP code stepped through on the server window. PHP variables are highlighted, and a user can roll over them to see their value. When they are highlighted, the corresponding form field is also highlighted. Thus, EPHP shows the relationship between the PHP code and the form fields. This is shown in Figure 3.

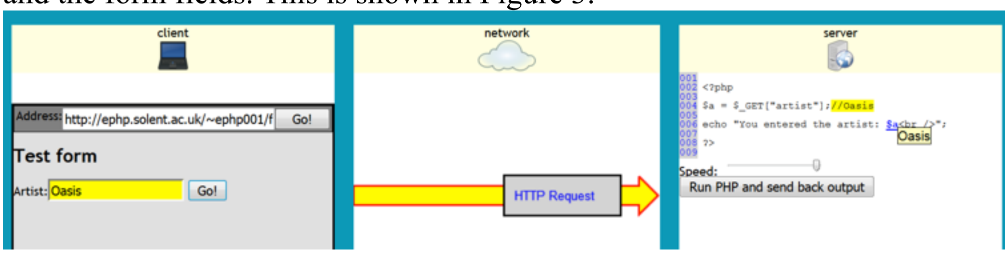

Figure 3. Reading form data in EPHP.

This example shows a simple PHP script to read in the artist the user entered in the form into a variable, **$a**, and then display a message confirming to the user which artist they entered. Note how the form field is highlighted in yellow, and a comment, also in yellow, has been added to the line of code which reads in that form field (i.e., `$a = $_GET["artist"]`). If there are multiple form fields, each will be highlighted in a different colour, and the corresponding line of PHP will have a comment of matching colour added to it, explicitly linking the PHP variables to the corresponding form data. Note also how rolling over the variable **$a** shows its value, i.e., Oasis.

This approach is informed by findings from the research above, which suggests that visualisations should be annotated with accompanying text and that unnecessary information should be hidden until needed (Moons & Backer, 2013), for example the variable $a is accompanied by its value (the user's chosen artist) but only when you roll over the variable.

EPHP also helps students understand the workings of a typical "while" loop to iterate through database results, which in our experience is a common source of difficulty. Figure 4 illustrates this:

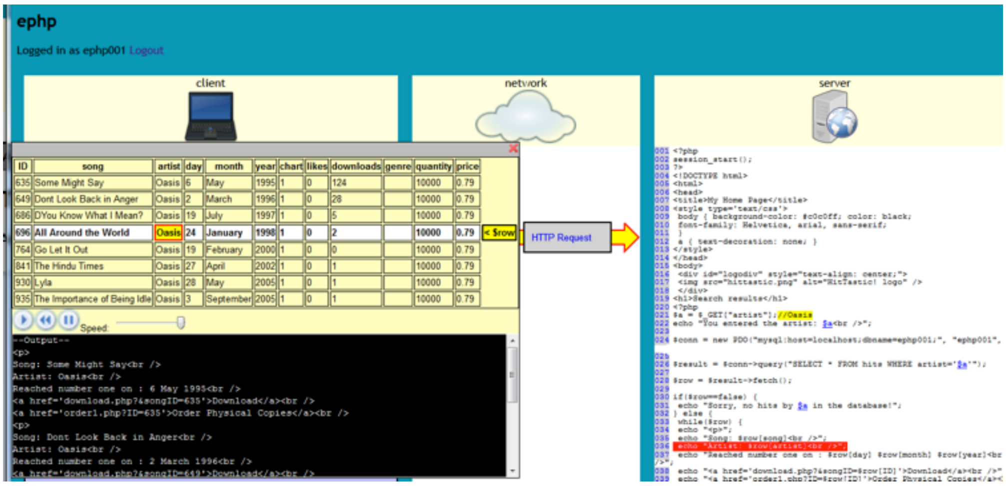

Figure 4. Looping through database results.

The simulation shows the "while" loop being executed multiple times (one for each row from the database results); each line is stepped over and highlighted. At the same time, the window on the left shows the entire set of database results, highlighting the current row being processed. Thus students can see the relationship between the code and the actual results. Note also how the artist (Oasis) is emphasised within the current row, indicating that the current line of PHP being processed (the one highlighted in red) is specifically the line that displays the artist from the current row. Finally, note the black output window below the database results, indicating the HTML being generated from the PHP code within the loop, providing further insight to students. EPHP allows students to have a degree of control; for instance "video player" style controls (Play, Pause, Fast-forward, Rewind) have been added so that students can pause, resume and repeat animations, which Moons & Backer

(2013) suggested leads to “a better understanding of the causal relations between the code and the actions caused by the code” (p. 373).

Deployment of EPHP to Students

During the academic year 2016/17, EPHP was deployed as a learning tool within our second year unit “Developing for the Internet.” Students used EPHP for six of the first seven lab activities, covering HTTP requests and responses, basic PHP, PHP and databases, and passing information between pages in multi-page PHP applications. These topics were done over the course of four weeks, with typically two topics per week. Later topics (session variables, AJAX and prepared statements) did not use EPHP, as the tool cannot handle those technologies at present.

During the course of the laboratory sessions, we qualitatively observed students’ interaction with the tool, and immediately following the four-week period obtained feedback from students via an online survey with 14 questions (11 multiple-choice and three freeform text).

Results

A total of 126 students registered for a login to the EPHP server, but nine students had no code uploaded, and furthermore the timestamp of their web directory suggested that it had not been modified since creation. This suggests that 117 students actually used it.

Of these 117, 36 responded to the survey, a 31% response rate. Most of the students in the sample rated themselves as beginner or intermediate programmers: only 10% rated themselves as “strong” or “advanced.” Thus, the sample is representative of EPHP’s target group, as it is expected from our own experience that stronger programmers should be able to understand web development without the need for a visualisation tool.

The results suggest that, amongst the group that responded, EPHP has generally been perceived as useful. In particular:

- 83% of students rated EPHP’s HTTP request and response animation “useful” or “very useful” to visualise how information is sent between client and server, with 42% rating it “very useful.”
- 78% rated EPHP “useful” or “very useful” in helping them understand the relationship between user input in HTML form fields and PHP variables containing that input, with 33% rating it “very useful.”
- 77% rated EPHP’s database loop animation “useful” or “very useful” to understand the PHP code to display the database results, though only 17% rated it “very useful,” with one student not answering.
- 85% of students answered “totally agree” or “agree” to the statement “the visualisation feature of EPHP helps me understand the communication between client and server in a PHP application.”

- 71% of students answered "totally agree" or "agree" to the statement "EPHP has helped me learn the basics of PHP," with one student not answering.
- 81% of students answered "totally agree" or "agree" to the statement "Overall, do you agree that EPHP has been beneficial to your learning in this unit?"

Two of the questions elicited slightly less favourable responses:

- 58% of students found EPHP's animation of the database results "useful" or "very useful" in helping them understand how to pass database data through to another script, though another 31% answered "no strong opinion" to this question.
- 60% of students answered "totally agree" or "agree" to the statement "EPHP has made learning the basics of PHP more enjoyable," though a further 23% answered "neither agree nor disagree" to this question.

The responses to the questions above appear to indicate that the visualisation of communication between client and server, in which the HTTP request and response are illustrated by arrows moving from the client window to the server window and back, were particularly beneficial, with 80% positive responses in both questions relating to this topic.

Also seen as useful was EPHP's ability to visualise the relationship between form fields and the PHP variables used to read their contents, with a 78% positive response to this question. Furthermore, when asked "what features of EPHP are most useful to you?" (with students able to select more than one feature), this feature was rated most favourably at 72%, with the HTTP communication animation coming second at 61%.

Visualisation of the database results, arguably EPHP's most advanced feature, was rated somewhat less favourably. While 77% of students rated EPHP's database loop animation useful or very useful to understand the corresponding PHP code, only 42% selected it in the "what features of EPHP are most useful to you?" question – suggesting that it was often seen as secondary to the two features above.

The two features seen as least useful, according to this question, were the integrated code editor and FTP upload features, with just 36% of students selecting each – features not critical to EPHP's role as a visualisation tool but included in order to make EPHP an "all-in-one" beginner development environment.
Three questions (11-13) invited students to contribute more specific, written-answer feedback, with Question 11 asking students to report bugs, Question 12 inviting comments on usability or user-friendliness, and Question 13 asking for suggestions for additional features or improvements. Some interesting responses come from these questions, which partly align with the multiple-choice answers given above. The following themes commonly occurred.

Make EPHP support other browsers. Due to some of the advanced JavaScript techniques used (HTML5 drag-and-drop being a particular issue), EPHP only works fully on the Firefox browser, with many respondents requesting Chrome support in particular. Four respondents mentioned this in Question 11, one in Question 12 and one in Question 13 – six independent respondents in all.

Apply the CSS to the rendering of the web pages in the "browser within a browser" in the client window. At present, only the HTML of requested web resources is rendered, with the CSS not applied. One student mentioned this in Question 11, one in Question 12 and two in Question 13 – four independent respondents in all.

Include functionality to delete files on the server. Six students mentioned this in Question 13.

Give an option to turn off the animation. One student mentioned this in both Question 11 and Question 12, and a further two students in Question 12 only – three students in all.

Allow the size of the coding window to be adjusted. Two students mentioned this in Question 13.

EPHP needs to be more flexible in how it interprets the code. Two students reported issues with EPHP when it was processing PHP code written differently to the style introduced in the lectures.

Discussion

The generally positive feedback obtained from the pilot study presented above gives encouragement that the early prototype of the tool presented so far shows promise, and validates its use in the unit as an aid to learning web development.

A number of issues have been raised, both by the students' responses and from our own observations. Firstly, the functionality to visualise the database results is perhaps not seen as quite as useful as EPHP's other features. This is in one way surprising as, from our own observations, students have previously struggled with the meaning of the PHP code to show database results, and EPHP aims to make this clearer through visualisation. On the other hand, this is the least mature and least tested feature in EPHP and had some inherent problems. It was desired to show the database results on the "server" side of EPHP – as database results are obtained on the server – but it was difficult to place the window here without obstructing the PHP code. Midway through the four-week period, we repositioned this window to the client side (as shown on Figure 4), which is conceptually incorrect but does allow students to see the code and the results concurrently. Thus it is quite conceivable that students experienced usability problems with this feature. We propose to seek more detailed feedback from students, via a focus group.

One observation we made ourselves was that students struggled to enter code in the "Develop" tab within the "Client" window of EPHP due to lack of space. The integrated editor was too narrow to clearly see their code; the "Network" and "Server" windows occupied too much space. Furthermore, many students utilised a mode of working in which they had two browser windows open simultaneously side-by-side, one containing EPHP, and the other containing the lecture notes or the worksheet. This further reduced the amount of space available for students to enter code in the editor. In the end, most students resorted to writing the code in a separate editor (such as Notepad++), and copied and pasted it into the EPHP develop window before uploading. This observation is supported by the feedback for Question 13, with two students mentioning this issue. Thus it is proposed to allow a resizable "client" window, to allow it to occupy most of the screen while code is being developed.

A common theme of the feedback was that EPHP did not apply CSS to the web pages rendered in the "browser within a browser" in the client window; thus, this is on the priority list for new features. However, there is a potential conceptual problem here. EPHP aims to show users what is actually happening when a browser requests a resource from a server. CSS files are typically linked to HTML pages in this way:

```
<link rel="stylesheet" type="text/css" href="style.css" />
```

When the browser encounters the above tag, it sends another HTTP request to the server to receive the specified CSS file (style.css here). If EPHP is to apply all external stylesheets, to be consistent with its stated aim of showing users what actually goes on, it really needs to show another HTTP request animation to retrieve the stylesheet. This could potentially make the animation sequence too long and frustrate the user; is it worth doing this simply to apply the CSS? This is an interesting question and a potential further subject for a focus group.

A possible solution to this problem is to give the user more control to turn animations on and off. Three students requested the ability to turn off the animation, three students requesting this feature; with one student specifically volunteering the information that she/he found it frustrating once the concepts had been mastered.

It is of note that a few students have attempted to use EPHP during later topics within the unit, such as session handling and AJAX, when not specifically instructed to - indeed, when advised not to. EPHP is at present unable to handle these technologies so cannot be used in this context, but the fact that students have attempted to use it appears to indicate that these students are happy with it. In addition, a significant number of students have continued to use it as an upload tool (in preference to a dedicated FTP client recommended by ourselves), again suggesting they are comfortable with this aspect of it. This does contradict the fact that only 36% rated the FTP upload facility as a "most useful" feature – though this may have been due to being perceived as secondary to the visualisation.

There are some lingering concerns, however, with how much some students have learned and whether they have gained a clearer and deeper understanding of server-side web application development. After several weeks using EPHP, we have observed that some students remain confused between form data and data obtained with a database, and make mistakes with referencing form fields and database columns correctly within their PHP code. This perhaps aligns with Moreno and Joy (2007) who observed that while students using JEliot appeared to give good feedback on the tool, they did not do appreciably better in actual coding problems. Care needs to be taken that EPHP is not merely "wowing" the students, but actually enabling them to achieve deeper learning. Indeed, Ben-Ari et al (2011) suggest that "teachers need to prepare lessons that use JEliot in order to obtain the maximal pedagogical advantages" (p. 382) – suggesting that benefits could be achieved by carefully planning the curriculum to make the most of EPHP, something that did not happen to a great extent this year; EPHP was introduced in a somewhat ad-hoc manner. For instance, adding features such as questions or quizzes, as suggested by Moons and Backer (2013) and Moreno and Joy (2007), is a possible additional step.

So what of the future? Obvious steps to take include incorporating the requests for additional features made by the students. In addition, we plan to overhaul the code "step-through" feature, which is currently coded in an inflexible way, and can only handle code written in a particular style. The principal author presented EPHP at the Hampshire PHP User Group in November 2016 and received useful suggestions from PHP professionals on improving this aspect of the software. At present the PHP Tokenizer API (The PHP Group, 2017) is used to interpret students' PHP code; more flexible and powerful alternatives include PHP-Parser (Popov, 2017) and possibly integration with the xdebug system (Rethans, 2017), which opens up the possibility of adding full debugging functionality.

At present, EPHP works with PHP only; however, its architecture, with distinct client and server components, potentially allows use with other server-side languages (by substituting the server component), thus widening its user base.

Thus, we plan to fully integrate an enhanced and improved version of EPHP into the "Developing for the Internet" unit in early 2018. The tool also has potential for the follow-on third-year unit "Web Application Development" which focuses on web services and their clients, a frequent source of confusion for students. Assuming appropriate work has been done, it is possible EPHP could be introduced for this unit this coming autumn. We also plan to conduct follow-on analyses of EPHP and its effects on learning in the coming academic year.

Conclusion

We have presented EPHP, our prototype PHP learning tool, and conducted a pilot survey that has produced generally positive feedback and indicated that the tool has promise. A number of concerns and issues have been identified through student feedback and our own observations, and we aim to address these with the next version of the software.

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TEACHING TRAINING EFFECTIVENESS IN UNDERPRIVILEGED AREA ON TEACHERS' PERCEPTIONS OF TEACHING METHODOLOGIES IN TERMS OF INTEGRATING COMPUTER TECHNOLOGY (ICT) IN THE LESSONS TAUGHT

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Abstract

This paper is based on the findings of a teaching training project the authors conducted in a semi-subsidized school in an underprivileged area in the Beqaa, where most of its population is of a low economic status, and they are in dire need for financial and economic improvement. Study participants were nine teachers who met weekly three hours for three consecutive months. The study investigated the impact of teacher training programs on teachers' knowledge of new teaching methodologies adapted from the American context. The findings show that the teaching program was beneficial since it introduced the teachers to different new teaching methodologies and allowed them to shift from classical classroom methodologies to non-classical ones. Moreover, the program influenced all of the participants' teaching skills in terms of introducing them to different theorists, which helped while developing lesson plans and taking into consideration students with special needs. This was reflected through their teaching during the training program. This initial study adds to the literature in terms of encouraging teaching training in the public and semi-subsidized sector, which in return affects positively the students' motivation, engagement in the classrooms, and academic performance.

Keywords: ICT, teaching methodologies, student centeredness, constructivist teaching approaches, professional development

Introduction

New teaching methodologies being embedded in our education system day after day have had a strong influence on teaching-learning processes where schools, teachers, and students have found themselves facing this challenge; this fact has made schools and teachers in Lebanon, as well as other countries, get prepared to survive this phenomenon. In other words, with the changing nature of these new services required, there is a need to improve the skills of the Lebanese teachers especially with the current economic crisis and the importance of education more than ever. Yet despite recent improvements in pedagogy, schools located in underprivileged area in Lebanon still lack the basic teaching requirements, and improvement should be obtained.

Personal Information Led To Initiating this Study

During the researchers' stay at a selected mid-sized and mid-eastern State University in the United States of America in summer 2015 as members of the Fulbright program for Junior Development, more research about teaching methodologies and their effect on students' learning was developed; especially after conducting observations and interviews in public schools in Lebanon for a Ph.D. dissertation in which findings showed that public school teachers do not fully comprehend new methodologies such as constructivism, which are now occupying American classrooms. Thus, the researchers decided to meet American professional researchers and professors to learn from their experiences and transfer the knowledge to the Lebanese schools; especially as the American culture is integrated into the curriculum in the Lebanese private schools but not the public ones.

Thus, the researchers met many specialized experimenters in the constructivist learning approaches in the field of education. After observing that the higher education program in the mid-eastern State University stressed and aimed at switching from the traditional school to the non-traditional one, the researchers determined to benefit from every single data or detail they could attain from their stay in a university stressing the high importance on research and adopting constructivist methodologies. The researchers wanted to learn more on how educational pedagogy could be improved and how teachers could be motivated to integrate more learning approaches into their teaching routine in order to transmit this knowledge to the Lebanese schools. The university aim was to integrate the students in the learning system where they were given the responsibility to search for information based on the student-centered approach, project-based learning, and problem-based learning.

A brief summary of one of the meetings the researchers conducted with a higher administrator responsible for restructuring the curriculum indicated that it was expected for the students to build on their knowledge based on their needs (Hajal Chibani, 2017). In other words, the teachers showed the students the right way. For example, the teachers in such learning approaches gave the students the freedom to construct as if they had received a sand box and were given the freedom to play with it within a specific perimeter, which was the students' learning outcome. In fact, educators need to change education from the inside out. The teacher is a mentor or a facilitator, and the students are given the responsibility to build on their knowledge throughout their education experiences, following the students' learning outcomes. The teacher's job is to ask questions and to lead the students to figure out the answers based on their own needs and knowledge. Some of the students get back the work with good answers based on good critical thinking and others miss them; in this case, the teacher's job is to redirect these students to be able to come up with answers or solutions, in contrast to the old teaching methods when the teacher was the provider of information (Hajal Chibani, 2017). Effective educators change this gradually and shift the old school of education to a new interesting and active one where students never forget the knowledge they construct on their own. The teachers' comment on the student's work is very important. Hajal Chibani reported that the teacher gives the students projects to work on based on project or problem-based learning approaches. The teacher in this case is a facilitator trying to let students apply what they learned to their community. Creating the conditions rather than the syllabus for the students to fill in the steps, the teacher teaches the students how to think of a conflict and find ways to solve it and how to tap into ideas they have not thought of. The teacher provides the students with more innovative ways to take roles in the education process The easy way to do this is to design the aim, go back to it, and determine what kind of learning to do. Hajal Chibani cites that in such cases, each time the teacher teaches the course, the syllabus will be different The teachers must have clear student learning outcomes and help the students achieve these outcomes in different ways by providing them with some readings considered as tools. If the students are engaged with the learning and are motivated, they might be learning more. Sometimes, students feel at ease if they receive the information instead of searching for it, but when they grow and start to contribute and pull knowledge to the world, they will definitely perform better. This is why group thinking and project examinations are required.

From here, the researchers' interest in conducting professional teaching training programs began. They have started researching more about the topic and decided to help as much as they could the underprivileged population in their country and share with them what they have learned from the American context. This research examines teachers' perceptions of the impact of their professional development experience on teaching practice and examines the impact of the training program on the teachers' skills perception on new teaching approaches and on the teachers' teaching skills performance.

Description of the Professional Teaching Training

The professional development program was supported by a grant the United States of America Embassy in Beirut awarded to the researchers. The project was a teacher training program that aimed to enhance the teachers' teaching skills and introduced them to new methodologies adapted from the American context the recipients observed and worked on during the Fulbright for Junior Faculty Development Program they attended and participated in during summer 2015 in the United States of America. The school in which the program was conducted was a semi-subsidized one where its population was of a low economic status and was in dire need for financial and economic improvement. As for the teachers, six had high school degrees, and six had BA degrees. As with all the public schools, the school was funded by the government since it was a semi-subsidized school. The students paid $200, a quarter of the fees, and the government paid the other 75% once a year, which was usually paid to the school after four years. For example, in 2015, the government paid the school the fees of 2011. It's also worth mentioning that some of the parents couldn't even pay 25% of the fees. Since the school bore a financial crisis and couldn't enhance the teacher's teaching skills and keep them up-to-date with all the educational enhancements other private institutions offered to their teachers, a professional development teaching program was beneficial for the students and for the teachers, especially as the school was not able to fund such programs to improve the teaching qualifications. If the teachers learned new skills and new learning approaches, this would allow and prepare the students to develop higher order thinking and become ready for other upper educational cycles.

Thus, the trainers conducted a professional development teaching training workshop series for the nine preschool teachers employed in a semi-subsidized school in the Bekaa valley of Lebanon to enhance their teaching skills and introduced them to different English teaching methodologies. After discussing the school needs with the director of the school, it became clear that the school was in need of training the teachers on how to adopt the constructivist learning approach and other new learning approaches to facilitate and guide the learning process. According to the school's director, the teachers came from a traditional school system where they taught the students the way they had been taught in a very traditional way. The continuous training program was for 12 weeks. The trainers met the teachers as a group, listened to them, and discussed with them the different strategies they could implement in their classrooms with the limited facilities the school could afford due to the lack of financial benefits. In other words, the trainers (the researchers in this case) met the teachers once weekly for 3 months, which was an equivalence of 12 sessions (3 hours each).

The objectives behind the training program were multifold. The program aimed to: introduce the teachers to different theories of learning approaches, promote the teachers' awareness and comprehension of effective teaching and learning skills in relation to the constructivist learning approaches and integrate different learning approaches in the English daily lesson plan, encouraging critical thinking skill development, and apply different constructivist learning approaches in the English classroom. Other objectives were to introduce the American culture (use American stories and books) into the preschool curriculum in underprivileged schools and integrate it in the curriculum, utilize technology to engage with classrooms as part of the constructivist learning approach, provide teachers with facilities to be able to change/tweak the curriculum to fit disabled students and students with special needs, study the impact of the training program on the teachers' skills perception, and study the impact of the training program on the teachers' skills performance.

Capacity Building

Every Saturday from March 5th till May 28th, 2016, a capacity building workshop was conducted. The workshops were divided into three main parts.

1. Part One: The trainer introduced participants to the project and indicated the importance of participation in such professional growth programs. The trainer then discussed with the teachers their needs in order to enhance their teaching skills. Finally, by the end of the first part of the project, the trainer was invited to attend several classes in order to build on the teachers' needs for more efficient training.
2. Part Two: The trainer conducted capacity building workshop sessions to introduce the new teaching methodologies based on constructivist learning approaches and implemented these methodologies with the participants in their classrooms over a period of month.

3. Part Three: The trainer helped the teachers integrate the new learning approaches discussed in part two into their lesson plans and helped them implement them in their classrooms.

Finally, a last meeting was held with the teachers to hear their feedback concerning the program in the form of a focus group. The aim behind the meeting was to evaluate the teaching training program holistically and to try to take all feedback into consideration in order to improve future programs.

Brief Literature Review on Effective Professional Development Characteristics

In a previous study conducted in 2015 in one of the universities in Lebanon (Al Chibani, 2015), findings indicated that little attention used to be given to professional development training programs because such programs used to be short and not followed up on by the administration or by the teachers themselves. However, beliefs changed where results from the teachers' findings showed positive significance, and attitudes towards long-term training workshops, where teachers had the chance to implement what they learned, shifted. When the teachers were provided professional development programs, their behaviors changed in a way that led to improvement and more effective teaching (Harwell, 2003). Little change was previously detected after such programs in the teachers' performance and attitudes; however, this negative attitude got changed over time and as studies showed better-educated teachers and what they did in class. Harwell (2003) explained that we could not expect change in students' attitude towards education if the teachers continued what they had been doing year after year. The professional development programs showed positive impact on teachers' motivation if the programs were designed to improve the students' performance too, providing the chance for the teachers to practice and implement what they learned in their actual classrooms. Joyce and Showers (2002) found that changes in teachers' beliefs were more likely to occur in settings in which the teachers considered learning a shared activity. If the teachers had the chance to implement what they discussed with the trainer and put into practice what they learned, they could positively affect their students. Harwell's findings stated, "Sustained, systematic professional development programs that unfold as processes over time are generally superior to individual workshops and seminars, which are one-time events" (2002, p.3). The teachers' professional development is important to the success of any education reform (Desimone, 2009; Desimone, Porter, Garet, Yoon, & Birman, 2002). Professional development programs were the main feature to the success of any reform initiative that led to school improvement and related program implementations (Fullan & Mascall, 2002). Teachers needed to be provided with enough professional development to be able to maintain their level of professionalism (Aminudin, 2012). Hargreaves (2000) explained that teachers started looking more towards professional development training to enhance their teaching. As a matter of fact, teachers' professional development comes from workshops and courses that are delivered to the teachers. However, due to the lack of opportunities, the teachers couldn't apply what they learned in such short workshops in actual classrooms. Gabriel, Day, and Allington (2011) reported that teachers who attended professional development training stated that such workshops improved their teaching and showed positive impact on their development as teachers. Moreover, participation in professional development was believed to have positive impact on the teachers' abilities and allowed them to have good professional thinking, planning, and practice with their students and colleagues (Borko, 2004; Gabriel et al, 2011). Powell, Terrell, Furey, and Scott-Evans (2003) indicated that teachers experienced immediate and long-term impacts of professional development. The teachers also showed continuous development on their ability to reflect more deeply positive impact on their teaching ability. Powell et al. also added that teachers showed more confidence in their teaching ability when they attended professional development training. Thus, they became more knowledgeable. On the other hand, Clarke and Hollingsworth (2002) explained that such one-day workshops did not show improvement of teachers' teaching performance nor show positive impact on their perception of teaching. They claimed that one-day workshops have been shown to be ineffective in changing teaching practice. This is why they suggest having more than one-day workshops and arranging longer training sessions in order for teachers to have time to implement what they learn in such workshops. Teachers were unlikely to change what they believed directly, and thus they needed time to absorb new materials and methodologies to apply in their classrooms (Desimone, 2009).

Purpose of Study

The purpose of this investigation was to study the impact of the training program on the teachers' skills perception on new teaching approaches and the training program on the teachers' teaching skills performance.

Research Questions

The research questions were;

1. To what extent are long term teaching training programs effective on the teachers' teaching skills performance?
2. How do training programs affect the teaching perception of new teaching approaches?
3. What is the impact of training programs on the teachers' teaching skills performance?

Methodology

Researchers employed a qualitative research approach in this study. Denzin and Lincoln (1994) defined qualitative research as "a multimethod in focus, involving an interpretive, naturalist approach to its subject matter" (p. 2). In addition, Creswell (2003) defined qualitative research as "an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem" (p.15). Patton (1980) clarified that when we deal with qualitative measurement, we should take into consideration the kind of data gathered. He explained that the qualitative data was made up of detailed events and situations performed by people concerning their situation. The researchers also chose to use a qualitative method because they wanted to capture what people said about different learning strategies, about the strength of a particular situation they had, and about anything the people concerned with the purpose of this study that could help them with to understand more and could answer the research questions of this study. According to Patton (1980), in qualitative methodology, the research sought to know and understand deeply what people had to say.

Participants
The training program was conducted with nine Preschool Teachers in a semi-subsidized school in the Bekaa area in Lebanon who teach 120 (K1 to 3) students.

Data Collection and Analysis
Employing a qualitative approach, the researchers had the chance to study the person's experiences in detail. This is why the data was collected in two parts.

To answer the first and second research question of this study, the participants completed two questionnaires to evaluate the program for future enhancement and to answer the research questions of this research:

- The first questionnaire was a pre-evaluation and a post- evaluation form in order to study the significance of such training programs and their impact on teachers' capacity building.
- The second questionnaire was an evaluation sheet in order to evaluate the program for future enhancement.

To answer the third research question, the trainer observed the teachers while teaching two of the lessons and completed an observation rubric based on the outcomes of the training workshops. The rubric was piloted and used by the trainer in a previous study the researchers conducted (Hajal Chibani, 2017). The rubric was divided into four main categories: Lesson Planning, Classroom Environment, Instruction, and Professional Development. Each domain was divided into sub-domains where the objectives behind each performance were specified. The observer had to choose 'Yes' or 'No' to indicate whether the performance was observed or not observed.

Finally, a focus group was conducted with the teachers for recommending future implementations.

Data Analyses
Document analysis was chosen as one of the research methods for this study as it was an unobtrusive method that provided stable data that can be reviewed repeatedly (Yin, 2003). This research method also had the advantage of providing broad coverage of information on professional development experienced by the teachers in the school investigated (Yin, 2003).

Consistent with the qualitative methodology used, the data analysis was done in two ways. First, data retrieved from both the diaries written throughout the program and from the pre- and post- evaluation forms filled by the teachers and the administration were analyzed. Second, the rubrics the trainer completed while observing two classes for each teacher -- 18 rubrics -- were analyzed

Results
Feedback from the trained teachers, showed that they agreed that the teaching training was beneficial and met its objectives. One of the teachers said "it is beneficial to attend such long training sessions and be able to apply them in our class." Another teacher said, "I started applying what we have been discussing in my classrooms, and technology is motivating the students."

The results obtained from the pre- and post-evaluation forms showed that the teachers gained more comprehension of the new teaching approaches. Their attitude towards the new non-classical approaches became positive, and considerable shift was shown from their answers.

Findings from the observation rubrics completed by the trainer showed that 77% of the teachers started adopting more of the new teaching approaches they learned during the teaching trainer in their classrooms. Their lesson plans included a variety of methods: 82% of the teachers' teaching methodology showed a noteworthy shift where they started moving away from the traditional methods. They had the initiative to prepare their own teaching facilities to simplify the learning process and engage the students more. Their instructions became clearer where they set a specific objective and focused on it until they made sure all the students acquired it.

Discussion
The purpose of this study is to study the impact of the training program on the teachers' skills perception on new teaching approaches and the training program on the teachers' teaching skills performance.

Al Chibani (2016) and Harwell (2003) have reported that teachers showed positive attitudes towards long-term training workshops where they agreed that they had the chance to implement what they learned. This is in line with this study's results where teachers agreed that the teaching training was beneficial. They agreed that they had the chance to implement what was discussed during the training sessions in their actual classrooms and to come back with questions to the trainers. In addition, the teachers also claimed that they gained more comprehension of the new learning approaches. Their attitude towards the new non-classical approaches became positive and a substantial shift was shown from their answers. This is in line with the findings of the study's literature review where Joyce and Showers (2002), Desimone (2009), Desimone et al.(2002), Fullan and Mascall (2002), Larke and Hollingsworth (2002), and Aminudin (2012) reported how the perception behind training programs changed and led to better educated teachers and what they did in class. They discussed the importance of professional development programs on teachers' motivation if the programs were designed to improve the students' performance too, providing the chance for the teachers to practice and implement what they learned in their actual classrooms. Moreover, Hargreaves (2000), Gabriel, Day, and Allington (2011), Borko (2004); and Gabriel et al, (2011) indicated that teachers who attended professional development training stated that such workshops improved their teaching and showed positive impact on their development as teachers. This is in line with the study results, which indicated that teachers started applying more of the new learning approaches they learned during the teaching trainer in their classrooms and moved away from traditional methodologies.

Limitation

The study encountered many limitations to be avoided in future similar studies:

- Study participants may differ from the general population.
- The present study is concerned with only one outcome of the learning and teaching process, which is the impact of professional development on the teachers' perception of different learning approaches and of the importance of adopting a constructivists teaching approach, without taking into consideration the students' performance.
- This study did not take into account the teachers' qualifications and considered all the teachers of the same educational level.

Conclusion and Recommendations

Conclusion

As a conclusion, the training workshop series achieved its objectives, and the teachers were introduced to new teaching methodologies, which they started to use in their classrooms. This reflected in return on the students' achievements and motivation, which is the end line objective of any learning process. Moreover, the program influenced all of the participants' teaching skills in terms of introducing them to different theorists, which helped developing their lesson plans and with full consideration of the students with special needs. This was reflected through their teaching throughout the training program. This initial study added to the literature in terms of encouraging teaching training in the public and semi-subsidized sector, which in return affected positively the students' motivation, engagement in the classrooms, and academic performance. Finally, the program introduced the teachers to different theories about teaching approaches, promoted the teachers' awareness and comprehension about effective teaching and learning skills in relation to the constructivist teaching approaches, integrated different learning approaches in the English daily lesson plan that encourage critical thinking skill development, applied different constructivist learning approaches in the English classroom, introduced the American culture (use American stories and books) into the preschool curriculum in underprivileged schools and integrated it into the curriculum, utilized technology to engage with classrooms as part of the constructivist learning approach, provided teachers with facilities to be able to change/tweak in the curriculum to fit with disabled students and students with special needs, studied the impact of the training program on the teachers' skills perception, and studied the impact of the training program on the teachers' skills performance.

Recommendation

Professional development for teachers is essential to maintain the level of education needed for the teachers to keep up with the changes in demand. Professional development for teachers is believed to be more effective in creating effective change to teaching practice when it is designed in a professional way to last long term. Some teachers have questioned the effectiveness of one-day workshops and claimed that one-day workshops do not show improvement on the teachers' teaching performance nor show positive impact on their perception of teaching. This is why it is recommended to engage the teachers with more than one-day training programs since it has shown that it is ineffective in changing teaching practice, and, since teachers are unlikely to change directly what they believe. They need time to absorb new materials and methodologies to apply in their classrooms.

Thus, a few recommendations based on both the quantitative and the qualitative results are addressed to the trainer in order to obtain more effective results and implement in future training sessions.

- Demonstrate in front of the teachers a lesson that allows the teachers to implement the theory they have learned in their lesson plans.
- Train the teachers again in the beginning of the next academic year.
- Engage the students more in the training program.
- Conduct more studies such as this one—perhaps with teachers in upper elementary , high school and university to see if similar results are obtained or models
- Engage teachers with more than one-day training programs since it has shown that it is ineffective in changing teaching practice, and, since teachers are unlikely to change directly what they believe.

State of the Research and Future Directions

This study can be considered a pre-pilot study for future studies in order to see the effect of the recommended professional development programs on the teachers and how much the constructivist learning approaches are integrated in the classrooms lesson plans and not only in the general objectives of the subject matter. A comparison between the Lebanese teachers' perception of different learning strategies can be compared to that of teachers of other nationalities.

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INVESTIGATING THE TEACHERS' PERCEPTION AND APPLICATION OF DIFFERENT CONSTRUCTIVIST LEARNING APPROACHES IN THE AMERICAN CONTEXT AND THE TECHNOLOGY USE IN CLASSROOMS: A MULTIPLE CASE STUDY

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Abstract

For the last two years, the researchers have been investigating the teachers' perception of different learning approaches in universities to construct a list of indicators for identifying the teachers' knowledge of different constructivist theories, to observe and examine the teachers' application of constructivist learning approaches, taking university classes as a case study, to observe and examine the teachers' use of technology as one of the methodologies, and to provide recommendations for future research in integrating different teaching methodologies in university classes in the United States of America. The sample of this study is a selected mid-sized and mid-eastern state university in America, and the participants are five university teachers teaching five different university classes of several levels.

Keywords: teaching methodology, andragogy, constructivist approaches, socio-constructivist approaches, prior knowledge, technology

Introduction of the Study

Throughout their teaching experience, the researchers have never thought of the difference between child education and adult education. They have always deemed that both are the same and the teacher should treat both students in the same way. However, after participating in the Fulbright program in one of the universities in the United State of America, the researchers got introduced to a new educational concept, which is Andragogy. Two basic questions led the researchers' readings: (a) Is teaching adults different from teaching children? (b) Should other teaching strategies be used/adapted in the classroom with adult learners than that with children learners?

For the last two years, the researchers have been investigating teachers' perception of different learning approaches in schools.

It has been taken for granted that university education is an extension of school education with students learning in the same way both at school and at the university. "Teaching is more than transmitting skills; it is a living act, and it involves preference and value, obligation and choice, trust and care, commitment and justification" (Ayers, 2010, p. 385). The purpose of this study was to construct a list of indicators for identifying teachers' knowledge of different constructivist theories, to observe and examine teachers' application of constructivist learning approaches, taking university classes as a case study, to observe and examine the teachers' use of technology, and to provide recommendations for future research to integrate different teaching methodologies in university classes.

Brief Review of the Study

The movement of constructivist education has been the interest of many people (Hajal Chibani, 2017). Dewey, Piaget, and Vygotsky, major theorists of constructivism, have had a lot of impact on the educational practice. Constructivism, based on child-centered approach, is when the individual constructs his/her knowledge. Research shows that the classroom environment is studied, so the researchers assume that when the classroom learning is being studied, it is expected that the students have previous knowledge about the content and that they build on this understanding and construct new facts (Phye, 1997).

Constructivist Learning

In the constructivism education theories, learners do not only acquire information inertly, but also they get involved in the learning process and craft their new knowledge and new experiences based on prior ones. Constructivism is contrary to the traditional methods where learners acquire the information word- by-word from their teacher. The new constructivist teaching approaches have shifted the understanding of the learning process to essential formation where learners' use the fresh ideas they get with them to the classroom and share them with their classmates. In a constructivist learning environment, learners learn best by shaping their own knowledge. Constructivists believe that knowledge shouldn't be implanted in the learners' mind, but constructed through experiences and activities. Here, the teachers should inspire higher-level thinking where learners are encouraged to summarize concepts by analyzing, predicting, moderating, and preserving their ideas (Hajal Chibani, 2017).

In addition, while studying the learning process and its relation with the constructivist learning approach, two things should be kept in mind: the relation between constructivism and the student's learning, and constructivism and the teaching strategy. Hajal Chibani (2017) explains that learning occurs in a constructive way where new information is always built on and linked to previous knowledge. She also adds that as students construct their knowledge by using what they know to learn new material, the teacher coaches and helps them *constructing mental scaffolding* in the class to build new acquaintance. Moreover, regarding the relationship between constructivism and the teaching strategies, Hajal Chibani explains that the teachers are shifting today from the traditional classroom instruction to the non-traditional ones where the student is the center of the learning process. Learning with a constructivist vision is active where the learning-teaching process is interactive in nature and needs negotiation of Mathematics and other subject matter meaning (Hajal Chibani, 2017; Yackel, Cobb, & Wood, 1991). There is a difference between the traditional understanding of knowledge and the constructivist understanding of knowledge (Novak & Gowin, 1984). The teachers' role in constructivist approaches is to facilitate, synthesize, and interpret. Constructivist approaches push the teachers to encourage the participation of students in the learning process (Moore, 2009). According to Hajal Chibani (2017), the subject matter taught eventually should be also reliable, interesting, and applicable. The students should be independent and motivated. They should acquire enough prior knowledge and skills to be engaged in the learning process in order to build on them (Rowe, 2006). Since the purpose of this study deals with the teachers' teaching approaches in adult education specifically related to constructivist strategies, it is of great importance to have a brief review of adult education and what is expected from them in the classroom.

Thus Hajal Chibani (2017) summarizes the main concepts of this theory as follows:

> As learning is based on child-centered approach, students have background knowledge of the content, and they build on previous background to construct new ones. knowledge is perceived only if the person is ready to acquire it as declarative based on tasks, concepts, vocabulary, and other information stored in the memory, procedural based on when the learner combine, incorporate or assimilate, and strategic based on when the learner knows how to use the first two knowledge. Remembering is very important in order for new knowledge to be acquired (p. 67).

Andragogy

As for adult education, Malcolm Knowles, the father of adult education theory, identifies that pedagogy is different from andragogy. Renowned adult educator Malcolm Knowles differentiated between pedagogy, an educational theory related to children, and andragogy, which he advocated for adults (Henschke & Henschke, 2016).

Knowles defined andragogy as the art and science of adult education and it refers to all forms of education: formal, informal, and non-formal (Kearsley, 2004-2007). Knowles states that the term andragogy "is based on the Greek word *aner* (with the stem *andr-*) meaning, 'man not boy.' Knowles had already begun building a comprehensive theory of adult learning that is anchored in the characteristics of adult learners. Knowles model of andragogy is based on five assumptions. The five assumptions about the characteristics of adult learning written by Knowles are:

- Self-concept
- Adult learning experience
- Readiness to learn
- Orientation to learning
- Motivation to learn.

Also according to Knowles (1984) there are four principles that are applied to adult learning:

1. Adults need to be involved in the planning and evaluation of their instruction.
2. Experience (including mistakes) provides the basis for learning activities.
3. Adults are most interested in learning subjects that have immediate relevance to their job or personal life.
4. Adult learning is problem-centered rather than content-oriented. (Kearsley, 2010).

To begin with, higher education should prepare students to come into the classroom with a highly critical thinking and analysis abilities. The definition of pedagogy seems to be different from Knowles, Tennant, and Brookfield's definition of andragogy in adult learning theories. Pedagogy is very much teacher-based and andragogy is more to do with SDL (self-directed learning) and is very much learner-focused with the teacher being the facilitator. Adult learners resist receiving any new education if they are forced to receive it (Fidishun, 2000). Based on his first principle, Knowles (1984) says, "Adults are internally motivated and self-directed" (p. 27).

As for the second principle of adult learning, which states that adults bring life experiences and knowledge to learning experience, Knowles (1984) suggests that adults like to be given responsibility, and this is why as educators, we should give them the chance to explore and feel responsible. They like to build on their previous knowledge and use what they know for developing new knowledge. This is why Knowles (1984) proposes to know more about the students' interest and facilitate the learning process for them rather than imposing it.

The third principle of adult learning states that adults are goal oriented. By this, Knowles (1984) means that in order for the adult learner to learn new knowledge, he/she should feel a need to learn it.

The fourth principle discusses the fact that adults are relevancy oriented. According to Knowles (1984), the adult learners need to find meaning of what they are learning. They do not like to grasp information and never be able to use it in the future. This is why Knowles suggests asking the students to reflect on everything they learn.

The fifth principle discusses the idea of adults being practical. Knowles (1984) states "adults are practical" (p. 29). As educators, we should make sure to explain clearly scientific reasoning when making choices about assessments, interferences and when prioritizing clients' scientific needs (Fidishun, 2000). The educators should be clear that how and what the adults are learning will be beneficial in the work in the future.

Educators teaching adult learners need to know the concepts of their learning theory and be able to incorporate them into their teaching style. Educators need to become *facilitators* of adult education, helping the adult learner to set and achieve goals, and guide them in choosing the subjects and courses needed to fulfill these goals. They need to keep in mind that the adult learners need to know why the course is important to their learning and life situation. The adult learners bring into the continuing educational arena a rich array of experiences that will affect the learning styles and assimilation of knowledge and they need to be able to apply the knowledge into their life situations.

Objectives of the Study

In a previous lager study, the objectives were specifically trying to investigate and examine the school teachers' knowledge of constructivist teaching approaches; however, in this study, similar objectives were related directly to the university teachers dealing with adult education.

1. To construct a list of indicators for identifying the teachers' knowledge of different constructivist theories excerpted from fieldwork.
2. To examine the teachers' knowledge of different constructivist learning approaches.
3. To observe the teachers' application of constructivist learning approaches taking university classes as case study.
4. To provide recommendations for future research in integrating different teaching methodologies in university classes in the United States of America.

Research Questions of the Study

The data of this study was drawn from a larger study addressing all the below questions, but in this study, we focused only on questions 1 and 2:

1. How much are teachers aware of constructivist learning approaches?
2. How is ICT being used in the classes as a teaching tool?
3. What type of observations can be extracted from fieldwork for use in wider assessment for identifying the teachers' application of constructivist learning approaches taking university classes as a case study?
4. What are the obstacles and opportunities that would potentially enhance adult education?

Research Design of this Study

To serve the purpose of this study, qualitative methodology was used where the data collected was used to describe details, events, teachers, and observed classrooms. A multiple case study was used in this study since such a design follows replication logic, and helps enhance the validity of the study. The sample of this study was that of a mid-sized and mid-eastern state university in the United States of America. Since it is a multiple case study; each class was considered a case study by itself. The participants of this study were five university teachers teaching five different university classes on several levels. In order to be part of how the teacher teaches, two observations were conducted in each of the five university classes. The teachers' teaching methodology was observed and an observation rubric was used that basically identified what needed to be objectively observed.

Findings of the Study

During the observation of the classrooms, the teachers were not under stress because of the observer. From the observations of the five classes, almost all the teachers showed that they were not familiar with the constructivist learning approach. Only one teacher used a teaching strategy that depended on the students' prior knowledge and built on it. It was clearly shown that the teachers identified the difference between traditional and non-traditional teaching. Three teachers integrated technology in their method of teaching in terms of blackboard usage and communication through Google Docs. Moreover, it was observed in the classrooms, the teacher, as the center of the teaching process, was very important in the learning process. Yet, the teachers were engaging the students with some group work, and they integrated technology and PowerPoint presentations in the classrooms.

When asked after the observation about their philosophy of education, the teachers agreed that the classrooms should be designed based on a student-centered approach. Also, they all agreed that the students learned from the culture and they might bring some of these previous learned things to the classrooms. However, all five teachers asserted that students couldn't build new information based on their previous knowledge without their teachers' help. On the top of that, although some teachers assigned their students to work in pairs to answer some higher order thinking questions, the learning objective wasn't met because the teachers neglected applying the cooperative work as it was recommended by constructivism theory and thus they merged it with the traditional methods of teaching. As a summary, the teachers did not have a clear idea about constructivist learning approaches, and that was reflected in their teaching methodology. In that case, the teachers were limited in meeting one of the university goals, which was to provide the students with an environment full of problem and project-based learning.

Constraints/Limitations of the Study

The study had constraints and limitations, which should be avoided in similar future studies:

- This study bears the characteristics of a qualitative study where the researchers were the primary source of data collection and analysis.
- The present study is concerned with only one outcome of the learning and teaching process, which is the teachers' knowledge of the importance of adopting a constructivist teaching approach, not taking into consideration the students' performance.
- This study did not take into account the teaching effectiveness and teachers' job performance and teachers' qualifications.

Conclusion and Recommendations

As educators, we need to change our attitude towards our classrooms. We are invited to build a strong knowledge base and believe in the fact that the classroom decision-making is important. Teaching should be a passion. We live to the extent of always working on our capacity building. The classes should be based on active learning, related to all, from creating the syllabus to assessing the learners. For example, adopting the new learning approaches such as the constructivist and socio-constructivist learning approaches is important. The teacher should accept the fact that the students have background and prior knowledge built on new knowledge with the guidance of the teacher. The teaching methodologies adapted by some teachers did not reflect their awareness of the importance of building on the students' prior learning. Thus, it is suggested that professional development programs be introduced to all schools where the teachers' knowledge of new methodologies are always up to date. Moreover, there should be training workshops and should include more constructivist learning activities, including student-centeredness, authentic problem-solving tasks, learning practices, and much more. The teacher should be introduced to authentic examples of teachers who adopt the constructivist learning approaches in their classes. Teachers should be aware that learners differ from each other and that constructivist learning approaches promote higher order thinking.

This study can be considered a pilot study for future studies about the learning process. A comparison between the American teachers' perception of different learning strategies can and that of teachers' of other nationalities can also be carried out.

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TEACHERS' REFRAMING OF PRACTICE DURING A DESIGN-BASED RESEARCH PROJECT

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Abstract

This study explores how eight teachers in one-to-one environments frame, reframe and develop different aspects of their practice during a two-year long study. The data consists of 23 hours of transcribed open-ended interviews, 35 reflective log entries written by the teachers, their educational designs and the researchers' field notes. The results show: (a) how different dimensions of the teachers' pedagogical reasoning are formulated, manifested and developed during the time of the study and (b) how different aspects of their technological, pedagogical and content knowledge are included in and developed through their pedagogical reasoning.

Introduction

In Sweden, as in most other European countries, information and communication technologies (ICT) have been increasingly introduced into schools. One trend is the introduction of so-called one-to-one schools, where every student is equipped with a computer. This digitalisation of schools could be seen as a natural consequence of the digitalisation of society. Additionally, hopes have been expressed that ICT could be used to create added pedagogical values by supporting teaching and learning in new and improved ways. However, as previous research has shown, introducing ICT into classrooms does not necessarily mean the creation of added values (OECD, 2015; Wastiau et al., 2013). Vrasidas (2015) argues that for this to happen teachers would need to reframe their practices and develop what Mishra and Koehler (2006) refer to as technological, pedagogical, content knowledge (TPACK). However, due to the complex and integrated nature of teacher knowledge and teacher practice, further research is needed to better understand and support teachers' reframing of practice in digital contexts (Olofsson, Lindberg, Fransson, & Hauge, 2015; Voogt, Fisser, Pareja Roblin, Tondeur, J., & van Braak, 2013).

The research reported here is part of a longitudinal design-based research (DBR) project, where the researcher has worked with eight upper secondary teachers of English as a foreign language (EFL) in four one-to-one schools. As has been commented on in previous research, relatively few studies have examined teachers' pedagogical reasoning and the meaning of TPACK for specific subject domains (Voogt et al., 2013). A central idea in the project has therefore been to explore ways of using ICT to create added pedagogical values in EFL, i.e., using ICT to support learning in ways that would not be possible without ICT. Shulman's model of pedagogical reasoning has been used in the process of distinguishing and analysing different dimensions of the teachers' ICT-supported practice (Shulman, 1987).

Thus, the purpose of this study is to explore teachers' pedagogical reasoning about how to integrate ICT to create added values in relation to: (a) the design of a representational repertoire (e.g., multimodal examples and demonstrations), (b) the design of learning activities, and (c) the evaluation of their educational design and assessment of students' knowledge representations. This is done by analysing how teachers' pedagogical reasoning is formulated, manifested and developed during the DBR project. The analyses focus on contrasting the discussions and educational designs constructed during the DBR project. The TPACK framework is used as a conceptual construct to analyse which aspects of teacher knowledge are included or lacking in this reasoning.

Teachers' Reframing of Practice

An important part of teachers' reframing of practice involves understanding and discovering the affordances of digital technologies (e.g., smartphones, wikis, RSS) and considering how they could be used in relation to different aspects of their practice (Holmberg, 2014; Norman, 2013). Shulman (1987) identifies different aspects of teacher practice in his seminal work on teacher practice and teacher knowledge. He refers to these aspects as *the processes of pedagogical reasoning and action*. The 'separation' of reasoning and action could be (mis) understood as a separation of *theory* and *practice*, but should actually be understood as an analytical and semantic division. Nowadays, teaching practice is characterised as complex, dynamic, relational and multidimensional (Fransson & Grannäs, 2013; Frelin, 2013). Schön refers to this process as an ongoing *reflective conversation with situations,* in which teachers reflect on their actions and their understanding in an integrated multidimensional and multifaceted process (Schön, 1987). In this paper, the term *pedagogical reasoning* is used to describe the integrated processes in which teachers *apply* and *reflect on* different aspects of their *professional knowledge* and *practice*.

Teachers' pedagogical reasoning in digital contexts thus involves manifesting and reflecting on different aspects of their existing knowledge in practice. Shulman describes the unique knowledge that for example differentiates teachers from content experts as pedagogical content knowledge (PCK) (Shulman, 1986, 1987). Mishra and Koehler (2006) argue that the increasingly important role of ICT in teachers' practices warrants a discussion about teacher knowledge using a conceptual construct that incorporates technological knowledge (TK) and its relation to pedagogical knowledge (PK), content knowledge (CK) and PCK. They have extended Shulman's categorisation of teacher knowledge and describe this "new" amalgamation as technological, pedagogical, content knowledge (or TPACK). The TPACK framework also includes technological content knowledge (TCK) and technological pedagogical knowledge (TPK), i.e., knowledge about the reciprocal relationship between technology and content and technology and pedagogy respectively. The TPACK framework has become a commonly used conceptual framework in research on the knowledge that teachers need to use ICT to create added pedagogical values (Olofson et al., 2016). It has also proved to be an intuitive concept when communicated and discussed in collaborations between researchers and teachers (Voogt et al., 2013).

However, Voogt et al. (2013) conclude in their review of the TPACK literature that defining teacher knowledge is "not enough" and that studies of teachers' pedagogical reasoning (i.e., teachers' use and development of knowledge in practice) are needed to better understand teachers' decision making about technology (p. 119). It is in the pedagogical reasoning that teachers' knowledge, skills, judgements, analyses, decision-making processes and so on are manifested and possible to study. The process of reasoning also includes aspects of making sense of past, present and future situations and understandings (Biesta, 2013; Weick, 1995). This way, reasoning facilitates sense-making and the construction and re-construction of understandings and influences present and future decision-making. Thus, the process of pedagogical reasoning may facilitate a reframing of the teachers' understanding of teaching, teaching practices, possibilities with ICT, etc.

In research, there is empirical evidence to suggest that teachers' reframing of practice to one that makes use of ICT to create added pedagogical values is helped by, for example, collaborative design work (Baran & Uygun, 2016; Koh & Chai, 2016). Researchers and teachers who collaboratively apply their respective understandings and skills *in pedagogical reasoning* and in authentic educational contexts are also at the heart of DBR. DBR is increasingly considered as a viable research approach in studies of teachers' ICT-supported educational design processes (McKenney & Reeves, 2012; Plomp & Nieveen, 2013).

Methodology

This study is conducted as part of a DBR project where the on-site researcher collaborated with eight upper secondary school teachers of EFL in four different one-to-one schools in Sweden over a period of two years. The on-site researcher met with the participating teachers at their schools at different intervals, depending on the current nature of the collaboration. In between the physical meetings, Skype meetings with screen sharing were held.

The data was collected over a period of two years and consists of: (a) 23 hours of transcribed open ended interviews with the teachers in relation to their design intentions, (b) the teachers' practical enactments of these intentions (i.e., their educational designs), (c) 35 written reflective log entries that the teachers then shared with the researcher and (d) the researcher's field notes.

The data was coded and analysed using qualitative content analysis (Schreier, 2012) with the aid of the NVivo software. The TPACK framework (Koehler, Mishra, Kereluik, Shin, & Graham, 2014) is used as a conceptual construct in both the analysis and the presentation of the results.

At the beginning of the DBR the on-site researcher's primary role was to explore the teachers' intentions for and de facto use of ICT and to gain a basic understanding of their pedagogical reasoning. The teachers' pedagogical reasoning was stimulated by the researcher's questions and was used as a 'think-aloud' methodology when designing and discussing plans and different ICT tools. The teachers' own questions to the researcher were recognised as a 'sort of' pedagogical reasoning and stimuli for their own pedagogical reasoning. The teachers' design questions and design ideas were interpreted by the researcher and discussed with the teachers in relation to theories of learning and available technologies. Thus, during the project the on-site researcher and the individual teachers participated in an ongoing reflective conversation with and about their design situations. In this reflective dialogue, both parties suggested ways of using ICT to create added values, although the teachers themselves took the final decision about implementation. If a teacher expressed the need for hands-on "technical assistance," the researcher provided this as far as possible and acted as a tutor until the teacher felt comfortable in his/her own use of the technology.

Results

In this section the results from the study are presented under three separate headings referring to the teachers' pedagogical reasoning about the use of ICT for added pedagogical value in EFL with regard to:

- the design of a representational repertoire
- the design of learning activities
- the evaluation of educational designs and the assessments of students' knowledge representations.

The major themes that emerged in the analysis are presented under the three headings. Thus, under each heading the results are presented in relation to: (a) the most common uses of ICT and the perceived added values of these uses, (b) the development of the teachers' pedagogical reasoning during the DBR project, (c) teachers' intentions for vs. their actual use of ICT and (d) reasons for any discrepancies between the intentions for and use of ICT with regard to TPACK.

Pedagogical Reasoning in Designs of Representational Repertoires

In Shulman's model for pedagogical reasoning and action he discusses the need for teachers to find ways to transform their understanding of the content, to "scrutinise" the teaching material to decide whether it is "fit to be taught" and if it is not, to decide how it could be "made more suitable for teaching" (Shulman 1987, p. 16). He refers to this process as *transformation*. Today, the amount of teaching material available e.g., on the Internet is practically unlimited. In this study, none of the eight teachers made use of a course textbook or any other kind of pre-ordered course material. Instead, they used ICT to find web-based content and create their own teaching materials. The teaching materials mainly consisted of:

- Authentic multimodal content in the form of written texts, videos and podcasts freely available on the Internet. These were mainly used as examples to model the intended learning outcomes.

- Explanatory and 'already transformed' multimodal content. This content was sometimes produced by:
  - 'official' educational stakeholders like the BBC
  - EFL or ESL (English as a second language) teachers from around the world
  - native English speakers
- Explanatory texts (sometimes scanned from books) or multimedia presentations (mainly PowerPoint) that the teachers had either received from colleagues or created themselves. At two of the schools, teachers teaching the same subject had used their learning management system (LMS) to create folders in which they shared different kinds of teaching materials.

The teachers admitted that finding and creating the teaching material took time, but that this was necessary because it allowed them to use and create material that was *authentic*, *up-to-date* and considered *relevant* by the students. The teachers also found it important to be able to work with topics and explanatory examples they themselves found interesting.

It could be argued that the teachers' decisions to sometimes use teaching materials created by others meant that they accepted other people's interpretations and transformations. Not using a textbook also meant the lack of a publisher 'guaranteeing' the quality of the teaching material. In general, the participating teachers showed signs of a highly developed CK and PCK. Their oral and written English was excellent and they understood which aspects of the learning content were problematic for learners (e.g., certain grammatical constructions, nuances in oral speech, etc.). However, if this is not the case, the wealth of online teaching materials of varying quality could be considered a potential problem if teachers simply 'accept' someone else's transformations.

The teachers considered that authentic educational material was easy to find, but expressed that they often wished they knew how to: "choose certain parts (of this content)," "comment on it," "build on it" and "save it for use in other contexts." Moreover, they also found it difficult to include external material in the school's LMS in a "logical way" without having to resort to less satisfactory solutions, such as word documents with long lists of links. It can be thus said that the teachers had the necessary curricular knowledge and CK to identify teaching materials with explanatory value and/or value as models for the intended learning outcomes. It could also be argued that, in theory, they had the *theoretical* TCK to envision the value of this functionality of ICT. However, at the beginning of the project they lacked the TK to curate, edit and annotate, i.e., digitally transform, this material to suit their own and their students' needs. In the design conversations towards the end of the DBR project, learning this in collaboration with the on-site researcher was mentioned as one of the benefits of being involved in the project.

The fact that the teachers did not know about or had not used annotation tools such as screencasting services and formulating this as 'a lack of TK' could be interpreted as the teachers not being "technologically competent." However, based on the on-site researcher's experience and their own statements, they could all be considered somewhat more ICT competent than the average colleague at their schools. Three of the teachers even had special roles as someone to whom their colleagues could turn for help with ICT-related issues. Moreover, when the on-site researcher introduced the teachers to the web-based screencasting service, Screencast-O-Matic, they immediately saw the potential of this as a teaching tool. Shortly thereafter, six of the eight teachers wrote about or showed the on-site researcher how they had learned to use Screencast-O-Matic for annotation or lecturing purposes. This illustrates that TK, as "knowledge about traditional and new technologies that can be integrated into curriculum" (Koehler et al., 2014, p. 102), is a rather blunt theoretical concept. In this study, the six teachers who quickly learned to create screencasts proved that they had the necessary knowledge and skills to use the required technology once they had been introduced to the idea of annotating and explaining by recording their screens using a web-based service. Another way of expressing this is that their *general* TK allowed them to understand the benefits of a certain digital tool and to quickly develop the necessary *specific* TK to use this tool to add pedagogical value to their representational repertoire.

Pedagogical Reasoning in the Design of Learning Activities

Teachers' work of designing a representational repertoire to help students' learning is intimately connected to ideas about how students could use these representations in different learning activities. For example, at the beginning of the DBR project, one teacher used two speeches made by Angelina Jolie and Leonardo DiCaprio that were available on YouTube as examples of powerful speeches, and as an illustration of argumentation and speaking techniques. This was done in the classroom by the teacher fast- forwarding; pausing and commenting "live." After being introduced to tools for editing and annotation by the on-site researcher, the teacher used a web-based service (www.tubechop.com) to select illustrative parts of these speeches and make a screencast to record and comment on the specific qualities of the speeches, and the techniques used by Jolie and DiCaprio. The screencast was made accessible to the students as a link in the LMS so that they could watch it whenever and wherever they wanted. Thus, these tools helped the teacher to add value to his/her representational repertoire. However, the teacher also realised that finding, selecting and commenting on other good (or bad) argumentative speeches was a good way for students to understand the qualities of speeches and the techniques used to deliver them. The teacher therefore designed a learning activity in which the students were asked to find argumentative speeches and to choose and comment on their illustrative parts. They then exchanged examples with a peer and used these to illustrate their understanding of what characterised a good argumentative speech and what needed to be learned to deliver an argumentative speech. In other words, the students used ICT to *transform* and convey their understanding of the content in a similar way to teachers.

During the initial design conversations with the individual teachers, most of them, albeit to varying degrees, said that they thought that ICT could be used to create added values that would help them to support collaborative learning to a greater extent. However, they also expressed that for various reasons they had not explored these potentials (Holmberg, 2016)). One of the reasons for this was that the teachers lacked functionality to support collaborative learning in the LMS shared by three of the schools: “I can see their texts, and that’s good, but the mass of knowledge that they (the students) have is seldom shared between them.”

Another reason was that they did not know the answers to a number of technology related questions: “Well it’s just…how do you record, practically speaking? Could everyone use their phone or iPad? How would they… how do you share it so that I can see it, and a number of students, but not everyone?” Some of the teachers also felt that they had to be able to support students if they asked them to use their own hardware to videotape themselves or each other. Here, it could be argued that in this regard the teachers did not have sufficient TK to realise their intentions for increased collaborative teaching and learning.

However, in dialogue with the on-site researcher, several free web-based services with built in social and collaborative functionality were introduced, explained and gradually adopted by the teachers and students (e.g., Wikispaces, Evernote, Blogger, Padlet, YouTube, and Diigo). Thus, students’ use of ICT to create knowledge representations and share these for peer modelling and peer discussion became an increasingly common type of learning activity in the teachers’ educational designs during the research project.

These digital knowledge representations were also increasingly created for *authentic audiences*, for example other students in the school, parents, or the entire world. The possibility of using ICT to make learning activities as authentic as possible was mentioned as an important added motivational value by all the teachers. Two major reasons for this became evident in the research material. First, creating and presenting for an audience outside the classroom was seen as a way to “force the students to get their act together.” The knowledge that a ‘real’ deadline and/or a ‘real’ audience was going to listen to the podcast or see the video created an incentive for the students to perform well. Second, the teachers also expressed that the creation of digital artefacts for use in ‘the real world’ also meant that the actual learning process became more authentic, because the students used digital tools and a language that was not ‘adapted’ for classroom use: “…because then you don’t get the…’do I have to write a complete sentence or does it have to be’…there is a context that can provide answers to those questions.”

These insights relate to TCK, i.e., an understanding that Swedish school English and native English differ and that the use of ICT could illustrate this. However, these insights also relate to TPK, i.e., how ICT could be used as a pedagogical tool to motivate students by allowing them to participate in authentic contexts. The teachers’ creation of educational designs that incorporated both these added values could be described as signs of TPACK.

Students' own digital multimodal knowledge representations were also used to support their reflections on their learning outcomes and learning strategies. Four of the teachers incorporated this as a regular part of their educational designs, where students used blogs or the LMS's log book functionality to reflect on their own recorded practices and the thinking and studying that had led to them. Students were also asked to compare the lessons learned from their reflections with their peers and to use the knowledge representations as practical examples in these discussions. Thus, ICT was used to support individual and collaborative metacognitive reflection in relation to the learning goals, the study process and the knowledge representations produced.

Pedagogical Reasoning in Evaluation of Educational Design and Assessment of Students' Knowledge Representations

Shulman (1987) discusses teachers' constant checking of students' understanding as an important and integrated part of teachers' pedagogical reasoning. However, during the initial design conversations with the teachers, they all, albeit to varying degrees, expressed that they spent more time than they wanted on administering tests. One teacher even went so far as to say, "We don't teach anymore, we just collect products for assessment." In relation to this, a number of the teachers mentioned the use of ICT for automated feedback as a potential added value. Some of the teachers used web-based services to create flashcards and word tests with automated feedback. However, they recognised that the potential added value of this use was limited to students' learning of factual knowledge, e.g., words and spelling.

Prior to the national tests of English that Swedish students take as part of their English studies, one of the teachers asked the on-site researcher for help in creating a standalone material that could be used to practise reading and listening skills and to provide automated feedback or material for self-correction. This teacher knew that s/he would have to work individually with some students to help them prepare for the test, but wanted the rest of the class to be able to prepare on their own. In dialogue with the teacher, a web-based service called Blendspace was used by the on-site researcher to curate and aggregate freely available resources with varying levels of difficulty from the web to build two *Blendspaces,* where students could practise their reading or listening skills. These resources were shared with three other teachers in the project whose classes would be also taking the national tests that term. When questioned about the potential value of these Blendspaces, the teachers were very positive (also on behalf of their students). The statistics available in Blendspace show that each Blendspace had approximately 350 views before the national tests by the student group consisting of approximately 100 students (four classes). The teachers used two lessons for voluntary work with the Blendspaces, which were only available to students who had access to their unique links. However, despite the perceived usefulness of such ICT use, only one of the teachers incorporated Blendspace as a recurring part of his/her practice. The reasons why the other teachers did not start or continue to use Blendspace included a perceived lack of time and/or technological knowledge to create a Blendspace, as well as *a sense of losing control of the assessment process* because they could not see the students' answers or results.

In relation to the assessment of students' knowledge representations, the use of ICT to support self-assessment (as part of the self-reflection described above) and peer assessment was increasingly mentioned as an added value during the time of the project. The teachers also used their newly developed knowledge of screencasting to formatively assess students' knowledge representations. The ability to do this in direct relation to a student's knowledge representation and to use their voice to convey nuances in this process were mentioned as important added values of ICT.

Discussion

Previous research claims that teachers use ICT to a lesser extent than could be *expected* and in ways that do not take advantage of the *potential* of ICT (Vrasidas, 2015; Wastiau et al., 2013). Vrasidas (2015) refers to previous research and argues that teachers use digital tools in the same ways as analogue tools and that a reframing of teacher practice is needed. Behind such a claim there must be, at least subconsciously, some idea about the *expected* ways of using ICT and their *potential*, what a reframing of practice would mean and how teachers' reframing efforts could be supported. However, if we recognise the uniqueness of every educational context and view teaching as professional conversations with situations in context, the added pedagogical value of ICT in a given context will most likely be discovered and created by a teacher through the pedagogical reasoning process. This in turn could lead to a reframing of practice that is attuned to the teaching context in question. According to this line of reasoning, the teachers themselves need to discover the added values of ICT and thus create incentives for the reframing of practice.

As has been shown in this study, the process of discovering, taking advantage of and/or creating these added values is intrinsically linked to the development and reframing of teachers' TPACK. Previous research indicates that TPACK can be successfully developed in authentic teaching situations and through collaborative design work (Baran & Uygun, 2016; Koh & Chai, 2016). These findings are supported by this DBR study, where the teachers worked *in context* and *in collaboration with* the on-site researcher to develop the necessary knowledge *and skills* to realise their pedagogical intentions in relation to ICT.

The results show how the teachers' reframing of practice is both enacted and elaborated through their pedagogical reasoning in which they apply and reflect on different aspects of their professional knowledge and practice. For example, during the study the teachers learned how to edit, annotate and record authentic material and to share this with their students, thus adding to its potential as teaching material in line with their expressed intentions. However, as their now extended TK allowed them to create designs in line with their intentions, they sometimes also discovered that expected added pedagogical values had to be reconsidered, for instance, in the example of ICT, for automated feedback. Thus, an extension of their TK sometimes led to a reframing of their TCK and/or TPK. Their newly developed knowledge and skills also inspired and made possible the design of new types of learning activities. For example, when the teachers' experiences of recording themselves led them to design assignments where their students recorded their own argumentative speeches as multimodal knowledge artefacts for peer modelling and meta-cognitive reflection. Moreover, the teachers increasingly used ICT to support learning in authentic contexts (i.e., on the web with people and tasks from 'outside' the classroom) and with collaborative technologies like wikis and blogs. The teachers also began using digital tools to annotate the students’ recorded knowledge representations (for example, argumentative speeches) as part of their formative assessment practices.

Over the course of the project, the teachers thus developed a practice in which ICT-supported collaborative learning became a more salient feature in their teaching. This reframing of practice is also reflected in the design conversations between the on-site researcher and the teachers. The development described above illustrates that the development of the teachers’ TK did not only have consequences for how they chose and transformed the teaching content (i.e., as part of their TCK), but also meant that they found new ways of designing for collaborative learning and formative assessment (i.e., as part of their TPK). By integrating this knowledge with their existing knowledge of how to teach certain aspects of EFL in a particular context (PCK), their pedagogical reasoning could increasingly be described as characterised by TPACK.

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ICT POLICIES AND EDUCATIONAL INNOVATION: PRACTICAL IMPLICATIONS IN COLOMBIA

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Abstract

This paper highlights the relevance of an underexplored dimension in ICT integration: the policy enactment of educational innovation. More concretely, this work focuses in the complexity of policy enactment in local contexts in which ICT policies yield uncertain effects. Drawing on an empirical study in one Colombian region, the findings reveal a set of issues related to policy translation and policy positions, two key aspects of Stephen Ball's policy enactment theory. The findings and reflections invite the expansion of research in the field of ICT polices. This work is useful for scholars examining ICT integration, school administrators and policy makers.

Introduction

Colombia is a country with a long history in the formulation and implementation of ICT policies for education (UNICEF, 2014). In the last few years a national system for educational innovation was released as an attempt to integrate disparate efforts related to ICT integration. Alongside nation policy, many different local programmes were developed across the country. This has led to an educational environment rich in a diversity of ICT policies. Scholars, for their part, have attempted to assess whether these national and local efforts to improve educational quality through ICT implementation have been successful. Drawing on a policy enactment approach, I will focus my analysis on the local context of Colombian ICT policies in order to understand specifically what effects occur at the level of translations and positions from different actors. Before going into the findings, I will begin with a brief description of this theoretical framework, and then I will describe the research context in which I undertook the analysis.

The Policy Enactment of ICT Integration: An Open Field of Study

When approaching the field of educational policies, it is important to remain note that policies can be studied in terms of stages or phases. Considering this policy-cycle, scholars focus on the formulation, implementation and evaluation of policies, involving different paradigms, questions and tools for their analysis (Honig, 2006). Sometimes, scholars become devoted to a particular stage, privileging one paradigm or approach among the others. This work focuses mainly on the realm of implementation studies but uses a theoretical approach that challenges the term *implementation*. The following section offers a short account of policy enactment theory to expand on the critique mentioned above.

Beyond Implementation and Impact Evaluation

It is common that scholars in education policy analysis develop their work in the most well established research paradigms: positivism or critical theory. The first paradigm considers impact evaluation and cause effect relations within education policies (Gertler, Martinez, Premand, Rawlings, & Vermeersch, 2011). What is central in this approach is a technical account of how policies are implemented, what factors affect such implementation and how to measure those factors (Granger, Morbey, Lotherington, Owston, & Wideman, 2002; Hjern, 1982;). The second paradigm considers a critical account of education policies, applying methods such as critical discourse analysis and Marxist approaches that focus on questioning hegemonic power exerted from governments over specific populations (Fairclough, 2003; Gramsci, 1971).

A policy enactment theory (Ball, Maguire, & Braun, 2012) challenges the first paradigm, but at the same time represents an alternative approach to critical theory. In relation to the first paradigm, the idea of a linear and technical implementation overlooks that policymaking occurs in local contexts. Beyond receiving and enforcing a document, policy enactment is comprised of at least three different dimensions: first, it addresses materiality, which considers contextual factors like historical and local circumstances, the existence of buildings, infrastructures, technologies and any kind of facilities where policies arrive, as well as professional cultures like those of teachers in a given school. Second, the discursivity of policies is considered. Hence, policies go beyond the problem of agency or the authorship of an education policy document (who wrote it and what intentions are behind). What matters in discursivity are the procedures to produce truth and knowledge. Inspired in a Foucauldian tradition, the question of discursivity is not what the *meaning* of a particular policy is, but what it *does* and what subjects it produces. As Ball (2006) mentions, policies are about what can be said and thought, but also about who can speak, when, where and with what authority. Finally, the hermeneutics of policies is related to the interpretation and translation of education policies. In this work, I will focus mainly in the last dimension as a previous work has shown the potential of tracing this particular facet of policy enactment when analyzing ICT policies (Cifuentes & Valero, 2016).

The Hermeneutics of Policies: Translations and Positions

Once a policy has arrived at an educational institution, there are two possible practices that should be considered in terms of a hermeneutical analysis. First, what such policies are telling us, what is the understanding we can achieve from those words, key terms, guidelines, standards, etc. This is called the interpretation of a policy. Conversely, policy translation goes beyond the literal meaning of those words, key terms, guidelines or standards; it implies concrete practices and mobilizations that take place within the institution in response to a policy document. What is fundamental here is that actors do not simply react to policies through passive enforcement; rather, there is a creative movement in which different actors rearrange the organization. This is called a policy translation, and it implies an active readership that does not assume that policies are closed packages to be enforced, but that they also can be creatively distorted and situated in a local context (Ball et al., 2012).

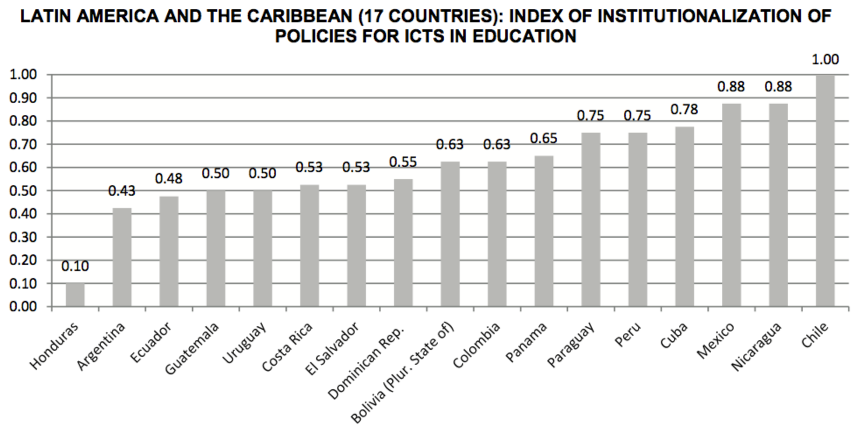
Along with this feature, the hermeneutics of policies also refers to the variety of positions that emerge when a policy arrives at an institution. Thus, policy enactment theory deploys a typology of actors that challenges our limited assumption of *receivers* of policies. For instance, there are: *narrators* of policies, those explaining and making sense of policy documents (even incoherent ones); *enthusiasts* of policies, those leading and promoting polices in their own practice through charismatic enthusiasm; *critics* of policies, who challenge the scope, meaning and practicality of a particular policy; and also *transactors*, such as administrative staff dealing with policies in relation to limited resources that set limits and possibilities for their enactment. As Ball et al. (2012) mention, "Translation activities need to be funded and staffed" (p. 58). This typology is provisional, and is likely to be extended and revised. As a matter of fact, policy positions in higher education have been analyzed to understand how ICT policies produce certain subjects and mobilizations (Cifuentes, 2015). Conversely, the following policy enactment analysis is done in the specific context of interest in this study: elementary schools in Colombia.

ICT Policies in Colombia: A Research Context

As stated in the introduction of this paper, Colombia has a long history in the formulation of ICT policies for education. As I have stated in previous analysis, this is a country with a will to innovate that has been settled through different ICT policies to improve education (Cifuentes, 2017). Different programs and national strategies for ICT integration reveal an interest not only from the government but also from the civil society. In 2007, a set of initiatives such as virtualizing academic programs, training teachers on ICT and producing digital educational resources, were spread all over the country. In 2013, the government launched a National System for educational innovation with ICT as a way to unite these disparate efforts and align to similar initiatives in Latin America (OECD/IRB/The World Bank, 2012). Figure 1 shows five different strategic areas such as teacher professional development, promotion and enhancement of research, management of digital educational content, e-learning, and ICT availability and access.

Figure 1. National System for Innovation with ICT (Source: NME, 2013).

Compared to other countries in Latin America, one could say that Colombia has an increased level of integration of ICT policies beyond this particular system for innovation. As the following graph shows, in this country it is likely to find not only official national policies for ICT, but also local educational institutions enacting them.



Source: Prepared by the authors using ECLAC data, Survey on policies and practices for ICTs in education.

Graph 1. Index of institutionalization of ICT policies (Hinostroza & Labbé, 2011).

Despite these efforts to integrate ICT, different factors such as change of government or the complexity of local policy-making call into question of whether Colombia has achieved a level of e-maturity for innovation in education. In this paper, we do not problematize if ICT integration for teaching and learning enhancement increases (impacts) academic achievement. Instead, what we problematize is the variety of mobilizations within institutions as a response to the discourse of educational innovation in the context of a national system that attempts to improve education.

To understand how different initiatives fostering innovation arrived at local institutions, and to understand policy enactment, a three-year project monitoring regions in Colombia was undertaken. In this country, the public educational institutions are distributed in 32 departments (provinces). This project selected two Colombian regions due to their geographical and cultural differences (not for comparison purposes). In each region, a sampling of institutions participating in at least three nation-wide ICT policies formed the sample. The following glossary deploys the name, acronym, and objective of those national policies. One of the assumptions for the research was that the coexistence of several ICT policies within an institution should allocate an appropriate context for analyzing policy translation.

Glossary of ICT Policies in this Study

- CPE: Similar to One Laptop per child, this policy provided computers for educational institutions all over the country.
- PVD: Provided three types of rooms with devices and other facilities in educational institutions across the country.
- CREATIC: A teacher-training program to develop ICT competences in educational institutions all over the country.

The following findings focus on only one of the selected regions as the project is still in its first stage of analysis. As a research design, a multiple case study was undertaken. In total, ten (10) different institutions were selected after fulfilling the required criteria (public schools, participating in the three national ICT programs). In each setting, interviews with the principal, the ICT coordinator and the teachers trained as part of the ICT national programs were conducted. Equally important was the interview with some of the coordinators of these programs that were occasionally appointed on each institution. The visit to each setting also involved taking an inventory of facilities for each ICT policy initiative. For instance, some of these programs included the allocation of a room for PC, laptops, media labs, Smartboards, etc. The research design was based on thematic analysis looking for patterns in the cross-case studies (Yin, 2003). The following section summarizes some preliminary findings depicting how different institutions enacted ICT policies for educational innovation.

Some Preliminary Findings on ICT Policy Enactment

Policy Translations

For each school, we found different kinds of mobilizations in relation to different kinds of internal and external artefacts. In the following we describe concrete examples of governmental initiatives that were interpreted but also translated through the actions of a variety of actors.

Quality assurance was both a discourse and a common practice in some of the institutions we visited. As one ICT coordinator told us, “We have a format for everything; we follow every process with a standard procedure.” In the interview the principal mentions that such policy was not mandatory for all the educational institutions, but that she managed to integrate it throughout the whole process (academic and administrative) in order to qualify the institution: “At the beginning of the year every student receives his grid so he knows the content of what he will study for each course, so we have a strict control of everything.” As Figure 2 shows, a concrete translation of this quality assurance discourse was identified at the entrance of the school: the logo of this national certification was located beside the coat of arms of the institution. As stated above, practices of translation were not only visual but also organizational in terms of daily activities performed within the institution.

Figure 2. Case of policy translation.

A widely distributed national ICT policy (CPE) provided computers, laptops and teacher training. It is worth mentioning that there has been both praises and critique of this ICT policy regarding the extent to which it achieves its goals. What we found was unintended uses for some of these devices in schools. One of the institutions we visited was carrying out the election for the student council. On that particular day, the computer room (provided by CPE) was allocated as a voting room for students; for this kind of activity special software was installed on these computers (see Figure 3). One could think such mobilization is not far away from the expected use for education; nevertheless such examples of policy translation contribute to the current controversy on the real impact of these computers for learning enhancement.

Figure 3. Case of policy translation.

A similar case reported in our institutions came from PVD. This program provided three special rooms allocating computers and special devices for content production. In one of the institutions a PVD room equipped with computers has also been used for applying a national standardized tests on students' competences named SUPERATE: "In this institution the teachers from math and language use these computers for this purpose. PVD was very useful as working offline implied downloading the application to obtain the information, collect it and send it afterwards," stated an ICT coordinator.

As we will discuss in the next section, every policy position depends on the personal background and status within the institution. In our analysis of policy translations, we sought to explore what kind of creative mobilizations emerged beyond literal enforcement of these national programs in the institutions. We found that the discourse of *the innovative teacher* had a strong role both in these policy documents and in the kinds of mobilizations of some actors. The teacher is in fact the actor who deals most frequently with just "implementing" technology in the classroom or creating alternative ways for enacting the discourse of the *innovative teacher.* In our interviews, some of the teachers' experiences with technology were a matter of passive reception but in many other cases we found possibilities for educational innovation:

> The suitcase delivered by CPE is useful for my practice, specifically in statistic spreadsheets help me to organize tables and different ways to display; Geogebra is also useful for graphing and variation. I think all this helps them because graph memory makes the process easier and more comprehensible, so the student can understand better.

Policy Positions

Comparing three different roles within the institution -- the principal, the ICT coordinator and teachers -- the value of an ICT policy was grounded on the practice and status of each one of them. A principal's appraisal of the impact of teacher training and students learning is aimed at reporting institutional performance to external organizations (i.e., Ministry of Education, Provincial and Major's office, etc.). An ICT coordinator values technical possibilities for enhancing teaching practices mainly in relation to devices and software. Finally, a teacher looks for best practices with technology to enhance teaching and learning. Despite these general findings, there are nuances in each case: some principals were also prone to monitoring teaching practices instead of reporting institutional performance; some teachers were concerned with technical features as they could see opportunities with new devices; and some ICT coordinators also paid attention to external actors that became allied or became obstacles for educational innovation. All in all, the following typology, inspired in Ball's work (2006), is as he said, not exhaustive but provisional and open to revision.

Narrators. First of all, we found individual acting as *sense makers* of ICT policies. No matter when or how these policies arrived, these narrators tried to find coherence between these policies. In some cases they also declared how these policies should work. This comment from one of the narrators offers an idea of this: "I think this program should be for all the teachers in the institutions, not all of them have been involved but they should (…) if you receive this particular training, therefore you can take advantage of the other two programs." These narrators also found ways to optimize resources such as infrastructure, expand possibilities using open access educational resources or create communities of practice through the opportunities held within these external programs. In other cases, this policy position implied the description of personal change. One interviewer said: "The change was mainly in me, in the way I use tools, in elaborating strategies. Once in a while there are some colleagues that look at what you're doing, how you are doing things, but all in all, I think I grasp such training for my own daily practice."

Critics. At all levels, we found critiques of these policies. However, there are different kinds of critique depending on the individual's background and status in the institution. Since this study focuses on education policies for ICT integration, the nature of these programs shows that an ICT coordinator is the actor whose role gives him or her the criteria to assess the quality of technical features. These actors typically had critiques of teacher training programs that analyzed issues like the relevance of content or technical features of equipment (e.g., lack of technical support from the government or software updating packages). ICT coordinators also mentioned that in themselves, these national programs were a good initiative from the government, but when they arrived at the institution, they were not integrated. Something exemplifying this perceived disconnection between ICT policies was the installation of technological devices in special classrooms and simultaneously having teachers trained that were not using them. As Ball et al. (2012) mention in relation to this policy actor, critiques can also give birth to new ideas and perspectives on current policies. For instance, in our study, from each critique came new ways to reframe those policies: "The idea of teacher training is good in itself but I say that it should be reoriented to content design."

Enthusiasts. According to the position of each actor, there are policies that deserve more attention and approval. One of the most appraised programs was considered necessary to achieve educational innovation as it included many key elements including infrastructure, facilities and devices, as well as a coordinator appointed on site in each institution. In the field of ICT integration, technologies represent promises associated with educational change and enhancement of teaching and learning, etc. As a result, we found at least two situations: disappointment after receiving failed programs or enthusiasm and expectations when a new program arrives. When responding to the question “Do you think that teacher training is useful?” an enthusiast answered, “Yes, definitively. When they receive such training, teachers understand there are other ways beyond the traditional ‘chalk and talk’ (…) there are millions of apps for all the subjects you can imagine.” As Ball et al. (2012) mention, enthusiasts become policy models or example for others; in our research, trained teachers on ICT were role models for innovation whose practice was shaped or transformed somehow. When a teacher was asked how she changed her practice after participating in a training program on ICT, she stated: “I design my own course contents. Actually, it depends on the subjects because I also teach physics. For instance, I use EducaPlay to design that content. I also organize my courses in Moodle where I assign content and activities.” Therefore, just as we found examples for enacting the *innovative teacher* discourse, we also found enthusiastic teachers advocating such innovation in their daily practice.

Conclusions

Impact assessment represents only a short account for all the complexity that scholars can study related to education policies in local settings. In this work, I have analyzed one particular kind, i.e., ICT policies for education. In the current context of national systems for educational innovation all around the world, a main concern for governments is the enhancement of teaching and learning processes through ICT integration. Hence, ICT policies are operationalized as national programs and projects like those we reported in Colombia.

This work offers an account of the policy play (Koyama & Varenne, 2012) that is experienced in different local settings in which ICT policies arrive. I have focused on policy translation and policy positions, both belonging to the hermeneutics of policy enactment. Beyond policy implementation, the analysis undertaken in this study allows us to understand uncertain effects of different policies according to the different positions of actors.

From a positivist framework, scholars are only focused on matters of facts (how to measure impact of one specific educational program). However, the research community should start paying attention to the particular enactment zones (Spillane, 2004) instead of merely measuring goal achievement and impact assessment of isolated policies.

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LOCAL MANAGEMENT AND LEADERSHIP FOR INNOVATION: A CRITICAL ANALYSIS FROM COLOMBIA

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Abstract

The purpose of this paper is to highlight the relevance of management and leadership as a key to understanding barriers to and factors promoting educational innovation. An empirical study in Colombia supports the claim that these dimensions are still underexplored and should receive more attention in order to understand issues related to ICT integration in education. Case studies reveal that different types of leaders using a variety of management deploy different strategies for successful (or unsuccessful) innovation. This work is useful for scholars studying ICT integration, school administrators and education policy makers.

Introduction

When analysing ICT integration in education for the enhancement of teaching and learning, scholars and practitioners are usually devoted to exploring variables that address pedagogical or technological matters in education. However, some other approaches have recognized that institutional and organizational conditions are also key to understanding barriers to and factors promoting educational innovation (Hew & Brush, 2007). This work focuses its attention on these conditions in the case of ICT integration in Colombia. An analysis of factors influencing ICT integration is necessary in this country since this government has made many efforts and allocated resources to promote the incorporation of technologies in education; indeed, a national system for educational innovation involving ICT has been in place since 2013. Assuming that the set of programmes and strategies comprised in this kind of initiative has transformed educational institutions, this paper explores one region where ICT polices have been implemented; in particular I focus on analysing leadership and management of innovation in this setting.

In the following section, a short literature review on ICT leadership and management for educational innovation is presented. It remarks on the need for a more comprehensive reflection from scholars on ICT integration. After describing the research context, the main findings related to leadership and management are also addressed as necessary fields for understanding what occurs in school settings in which innovation and ICT are at the forefront.

ICT Leadership and Management as Open Areas of Study

Literature on ICT in education tends to highlight pedagogical strategies, teaching practices, criteria for technology selection, assessment of students' learning, etc., as the most salient dimensions for analysis. However, literature about organizational variables fostering innovation is less abundant (Goodison, 2002; Hayes, 2007). Among the conditions that are underrepresented in the literature are the influence of an ICT coordinator (Tondeur, van Keer, van Braak, & Valcke, 2008) or having an ICT policy plan, that is, a blueprint of how an institution integrating ICT for education might look (Vanderlinde, 2011). Similarly, few scholars have studied the process of leading innovations through ICT. As MacLeod and Richardson (2011) state, there has only been a small amount of research on technology leadership, and similarly few recognizing the way ICT can promote educational innovation (Dexter, 2011). Even schools with high levels of access to technology do not necessarily improve teaching practices when using ICT due to other factors such as teacher`s ability and school level factors (Cuban, Kirkpatrick, & Peck, 2001).

Leading innovation through ICT is a practice that scholars refer to in at least two different ways. The first notion is the role of a school leader (Granger, Morbey, Lotherington, Owston, & Wideman, 2002), or the school technology leadership (Anderson & Dexter, 2008). Some of the features described for such leadership combine individual and school level conditions such as:

- An appointed ICT committee
- A financial plan for ICT integration
- The allocation of time for planning ICT integration by the principal
- Economic support from the government
- A concrete ICT teacher training program

A second way of understanding ICT integration from an organizational perspective is called ICT leadership (Vanderlinde, 2011). Considering previous literature on leadership, three practices are identified: setting direction, developing staff and redesigning the organization (Leithwood, Anderson & Wahlstrom, 2004; Leithwood & Jantzi, 2005). Consequently, the notion of ICT leadership involves the practice of setting the vision of ICT integration, fostering ICT teacher development, and finally providing conditions for access, support and policies for change within the institutions (Dexter, Anderson, & Ronnkvist, 2002; Zhao & Frank, 2003).

Drawing on a sociocultural approach that goes beyond the analysis of personal traits or charisma of a leader, Spillane (2004) develops a more robust model for understanding leadership as the complex interaction of leaders and followers who interact with artefacts in sociocultural situations. This framework can be useful for understanding ICT leadership: not only how a leader fosters innovation, but also the relationships and interactions between leaders and followers in complex situations. These situations involve artefacts such as ICT policy plans or other tools that shape the practice of the leader (Spillane, 2004).

In relation to the management of educational innovation, the literature on ICT integration is less abundant than that about leadership. In fact, management in education has been understood as something related to administrative and financial concerns, which are not related directly to the integration of technology. In other cases, the focus is on the management of technology within educational institutions, which is only one facet of managing an educational innovation. This implies, for instance, constructing the financial plan for the acquisition of technology or determining the technical support for the institutional platform. As a matter of fact, it is common that leadership and management become synonymous outside of academic contexts.

In higher education, there has been some reflections on this regard in terms of change management, which can take a top-down or a bottom-up approach. The former is driven by management and supposes consensus that could transform into opposition despite efficiency in time and resource management; conversely, a bottom-up approach is generated by early adopters who struggle to spread innovation with local enthusiasm but take the risk to be ignored across the institution (Brown, 2013). What is interesting is that some scholars (Keppel et al., 2010) have pointed out a middle term or alternative approach between these extremes named also as a distributed leadership (as cited in Brown, 2013). Hence, change is managed by different stakeholders across the institution. Nevertheless, it is important to say that such analysis is situated in higher education -- not at a school level embedding different organizational variables -- and not in the context of ICT integration.

Given this gap in the literature, my framework considers some of the aforementioned areas that have been overlooked. Hence, I will use as a standpoint four areas of management for educational institutions at a school level as they are situated in this particular context (NME, 2008): *strategic management* relates to leading and steering the organization through intelligent decision making processes; *academic management* encompasses curricular design, follow up on implementation and assessment of pedagogical practices, and monitoring student performance. Perhaps the most acknowledged is the *administrative and financial management*, which deals with budgeting, spending, infrastructure acquisition but also human development. Finally, *community management* encompasses the interaction with external actors and populations with special needs in the community. Despite that all these areas are seemingly unrelated to ICT integration, they can certainly be useful to understanding how educational institutions innovate through the integration of ICT.

In short, management and leadership has received less attention than other aspects of ICT integration despite some scholarship that has been devoted to analyze these factors. In the following, a situated study focuses the attention in these two dimensions of ICT integration and aims to produce some preliminary findings of an ongoing research project.

A Relevant Research Context: The Colombian Case

Colombia has an interesting history of formulation and implementation of ICT policies to promote educational innovation. More than 25 years of history can be traced and framed in four strands such as policies for infrastructure, development of human talent, the enhancement of teaching practices, and also the management and production of educational resources (UNICEF, 2014). As stated earlier, a national system for innovation using ICT was launched in 2013 (NME, 2013) though this was neither the first nor the last government effort to improve the improvement by integrating technology.

At this point, a natural assumption would be that across the country educational institutions have the resources necessary to enhance educational quality using ICT. What I have described elsewhere as a will to innovate (Cifuentes, 2017) is related not only to a particular government (top-down approach) but also from the civil society (educational institutions, NGOs and other organizations) for promoting innovation and welfare for population.

The ideas presented in this work draw on a three-year project whose aim was to analyze two different regions in Colombia enacting this will to innovate through concrete practices of leadership and management for educational innovation. These regions were selected for their geographical and cultural differences. Indeed, the research project assumed that such differences create opportunities for educational innovation. Additionally, as key variables leadership and management are embedded in sociocultural and organizational settings that deserve more attention from the research community.

In each region, a group of educational institutions were located. A set of interviews with teachers, ICT coordinators and school directors were undertaken to explore the role of the aforementioned variables on ICT implementation. The findings presented in the following sections focus in only one of the selected regions as the project is still in its first stage of analysis.

Disentangling Management for Innovation

Regarding the first dimension, management, this study explored how identifying different types of management was necessary to understand the enactment of educational innovation. Administrative and financial, academic and strategic management were practical forms that merited analysis as they involve different actors and artefacts.

An important finding about strategic management indicated that in most cases, despite the absence of an ICT policy plan (a vision of ICT integration for improving education in the institution) the leaders interviewed were keen to take decisions addressing innovation. This is relevant given that literature mentions how strategic planning is essential for allocating resources, staff, time, etc. In most of the cases, we found that ICT policy planning was not a common practice, that is, formulating an explicit document mapping out how to integrate ICT for educational purposes, and only in few cases were there documents that specifically described a vision and operative description for ICT integration. One of the principals mentioned in the interview the need to make a formal statement about this, “Since 2000, when I was appointed as a principal, I decided to include ICT as part of the formal vision of the institution.”

Regarding academic management, ICT leadership is related to establishing strategic alliances to benefit students on a curricular level. A common practice we found was establishing external allies. For instance, one of the principals sought technical training for students through agreements with a national service that offers this kind of education. Another external actor which is strategic for the principals is the government itself. In Colombia, some of the

ICT policies are offered as public callings. This means that institutions must apply so they can demonstrate their interest. Since this model implies that each institution mobilizes efforts in order to be selected, the role of principals became fundamental.

As part of teacher development, we found that principals evaluated the various options open to the institution. In the case of PVD -- a specific national ICT policy -- an ICT coordinator commented on its underutilization, “The PVD includes an audiovisual room and a sound lab which are still brand new.” What the interviewer pointed out was the potential of using these facilities to offer teacher training instruction and other courses for the community.

A similar interaction between institutions and external entities was present in the area administrative and financial management. Thus, allocating the internal institutional budget for resources, staff, infrastructure, etc., was a daily practice for the leaders interviewed. Management of external funds is an even more challenging practice that implies establishing a dialogue with the provincial government and the mayor`s office: “In 2013 the Secretary of Education gave us an iPad as a reward for achieving a high enrolment rate (...) as both teachers and students were enthusiastic about such device we started asking for additional financial aid to get more of them using the COMPES.”A COMPES is a social policy that offers financial support from the Ministry of Education directly to the institution. Once again, allocating budget for innovation is a matter of management and leadership: “In 2003 there was a merge of institutions, so two rural schools joined my institution. At that time, there was not a single computer in these schools. So, I provided them with a laptop per institution. Currently I have five external schools,” mentions a principal in relation to the allocation of financial support and how to deal with other school mergers.

Sustainability in ICT integration was also part of the management for innovation. In our study, we traced some struggles to achieve it. For instance, different ICT programs included acquisition of equipment. After their implementation, different kinds of devices had to receive permanent support and maintenance so they could operate properly afterwards. We could see that in some cases, such sustained support was not guaranteed. Both the principal and the ICT coordinator had to assume the consequences in that regard, like having useless devices or receiving frequent complaints from staff members.

ICT Leadership Practices on the Ground

As mentioned in the introduction to theoretical framework, a leadership practice is only possible through the interaction of leaders and followers in socio-cultural situations (Spillane, 2004). Despite the utility of this social approach, it is unavoidable to notice the importance of certain personal traits in the leaders interviewed and the way in which these impacted their leadership practices, and thus, the ICT innovations. Some of them were more enthusiastic, others were critics, and still others had a collaborative style. These personal traits in the leaders were relevant to understanding the kind of interactions they established inside and outside the institution. Within the institution, it is important to mention the relevance of collaborative work with teachers and administrative staff as facilitators of ICT leadership practices.

On the other hand, external relations were pivotal for opening a range of possibilities for innovation. Among the most important actors was the provincial`s office as it provided financial resources for all the institutions in a specific region. Cases studies showed that dealing with this establishment in order to allocate resources destined for a school's ICT project -- sometimes diverted to other institutions -- was perhaps the most important struggle for principals. As was previously mentioned, the relation with the municipality was also complex since "it is a local authority that is not only certified but also receives all the financial resources (…) the Government of Cundinamarca receives up to $840.000 million pesos from COMPES."

Beyond struggles, good relations with the mayor´s office becomes a strategic asset that is necessary for accessing ICT programs. A principal mentioned that such relationships allowed the institution to participate in different initiatives. In fact, related to a distributed leadership approach we found that coordination with the mayor´s office was key to the financial and administrative management of some of these programs.

Considering that setting the vision for ICT integration in the institution is a foundational practice of ICT leadership, it was found that principals mobilized efforts based on their own vision had: "Why do you think it was important to participate in those calls from the government? Because undoubtedly, the world is now functioning entirely on a technology base."

In relation to teacher development -- a second practice that features ICT leadership -- one of the principals remembered that in 2014 the national ICT policy *Digital citizen* was launched as part of a teacher training initiative. As she mentions, this policy "allowed that *all my teachers* to become certified." When asked if they were invited to participate, she remarks sarcastically "No, I'm afraid they are not."

We found that a concrete competence in the practice of these leaders was their ability to envision opportunities for teacher training. For instance, a principal told us about some opportunities that could perfectly matched with teachers' needs -- such as multimedia production -- despite that other types of professional development opportunities specified in the ICT policies were underused.

In other institutions, providing conditions for the access to technology in order to promote educational change was part of ICT leadership. From a distributed leadership approach, it is important to highlight that a solo viewpoint of the leader taking decisions is a limited perspective to understand the practices we found. Indeed, the role of the principal for the acquisition of such technology was intertwined with the process of decision making at the school board in which she is involved.

As previously mentioned, the literature does not make a clear difference between leadership and management. We have tried to distinguish these terms when referring to innovation. Nevertheless, we are conscious that in practice, both are connected. One specific example is the kind of leadership and management for concrete ICT policies at the institutions we analyzed. In fact, the difference between successful and unsuccessful programs was related to appointing a coordinator that could be physically settled in the institution.

Conclusions

This work shows that leadership and management for educational innovation deserves a deep analysis as both contribute to successful integration of ICT. Although both dimensions have been analyzed separately, we have also shown that they need to be understood as intertwined practices. In other words, different types of management are embedded in concrete leadership practices. Regardless of whether we call those practices ICT leadership or technology leadership, from a distributed leadership approach, we found that personal traits are necessary but not sufficient for promoting ICT integration. For instance, charismatic or team-oriented leaders must deal with internal and external relations and conditions that shape their practice and the achievement of goals.

In the institutions we studied, one of the main issues we found from the principal's perspective was the lack of support from the provincial and the mayor's office level, especially as this external partnership guaranteed the allocation of resources for innovation. Considering the three main features of ICT leadership practice, it was found that fostering teacher development was the most frequent concern within the institutions. If defining the vision or providing infrastructure was meaningful for our leaders (principals or ICT coordinators), they actually focused more on providing conditions for teacher training to promote educational innovation.

We can also highlight the closed relation of management and leadership with other common dimensions such as teacher training, infrastructure, ICT support and curricular integration. Interestingly, management and leadership are not necessary areas included in an ICT policy plan, but they are a pump for its successful implementation. It is worth saying that in our visits to the institutions the design of this artifact was not common. Instead of this document, what we found was ICT policy planning, that is, the practice of leading innovation (Vanderlinde, 2011). From a critical point of view, institutions are wasting opportunities for strategic guidance when they do not formulate this kind of document but once again, practices of management and leadership from a bottom-up perspective were at the forefront in our study.

Obviously, leadership is an art shaped by personal experience; different types of management such as those analyzed here involve different skills and organizational conditions. If ICT integration for innovation involves different areas at pedagogical, technological and administrative levels, it should be supported by ICT policy plans. Educational administrators and ICT coordinators have to be more observant of these kinds of practices and artefacts in their institutions as they determine and open possibilities for innovation.

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THE EVOLUTION OF AIR TRAFFIC CONTROLLER TRAINING IN THE UNITED STATES

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Abstract

Training for air traffic controllers has undergone changes over the years resulting in a loss of capability relative to university programs. New Federal Aviation Administration (FAA) initiatives currently underway offer some new paradigms that may represent improved training processes. The FAA's Aviation Rulemaking Advisory Committee is investigating outsourcing alternatives. A Center of Excellence in Technical Training and Human Performance was established by the FAA in 2016 to modernize and update air traffic controller training, and research has begun in key areas to support the transformation of training of air traffic personnel using distributed and adaptive learning technologies, modeling and simulation, and part-task training.

Introduction

In 1989 the Federal Aviation Administration (FAA) entered into a partnership with several U.S. colleges to provide training for students desirous of becoming air traffic controllers. This program was known as the Collegiate Training Initiative (CTI) and involved five colleges/universities. The FAA expanded the program to include academic programs at 36 colleges/universities. Graduates who had scored well on the qualifying exams were accepted for training at the FAA ATC Training Center. Various proposals were presented to Congress to allow colleges/universities the opportunity to fully train an air traffic controller thereby saving the government millions of dollars. Typical of these proposals was one by a university president in which he described how several millions of dollars could be saved by sending college graduates with air traffic controller training directly into the On-the-Job-Training (OJT) workforce" (*The Status of the Air Traffic Controller Workforce*, 2004, p. 35). Such requests as these went unheeded until recently.

The National Airspace System is undergoing an unprecedented redesign through the NextGen program. As NextGen continues to be implemented, the specialized skills required by those who will use and manage the systems must be upgraded in equal measure. That upgrade will be realized through enhanced training – moving away from the decades-old model of instructor-led training in a classroom in favor of a modern, national training approach using part-task trainers, modeling, immersive human-in-the-loop simulation, and adaptive learning technologies that are found in other technical workforces. The FAA recognizes that its databases must be centralized and linked to provide the analytics necessary for an effective, efficient system. To accomplish this, the FAA created a new Center of Excellence in Technical Training and Human Performance.

Purpose

The purpose of this paper is to trace the evolution of air traffic controller training in the U.S., including the latest technology and pedagogical research efforts being conducted to transform training for the FAA's Air Traffic Organization (ATO) workforce. This purpose is achieved through the background discussion of: the current air traffic controller training system, which includes a description of the FAA's Collegiate Training Initiative (CTI), and through various efforts external to the FAA to change the training paradigm. Next, the narrative transitions to the FAA's current initiatives to address training pedagogy and technology; this is accomplished by examining recent efforts of the FAA Aviation Rulemaking Advisory Committee (ARAC) and the FAA's creation of a Center of Excellence to conduct research into new methodologies for training air traffic controllers. Several research databases and various government documents were used to develop this explication.

The FAA's Collegiate Training Initiative

In 1989 the Federal Aviation Administration (FAA) entered into a partnership with several U.S. colleges to provide training for students desirous of becoming air traffic controllers. This program was known as the Collegiate Training Initiative (CTI) and involved five colleges/universities. Over time the FAA expanded the program to include academic programs at 36 colleges/universities (Coyne, 2014). Upon completion of university programs, the graduates who had scored well on the qualifying exams were accepted for training at the FAA ATC Training Center in Oklahoma City. This training was from 11 to 15 weeks (Celio, Jarvis, & Poore, 2005). The cost to the government for this training averaged approximately $128K per student (Brady & McGuirk, 2014c).

The CTI partnership between the CTI universities moved along at a reasonable rate with CTI graduates enjoying what was believed to be preferential hiring. This changed dramatically in 2014 when the FAA abruptly changed the manner in which it recruited and hired new air traffic controller candidates. This prompted one university to report (Brady & McGuirk, 2014a, p. 1):

> After more than two decades of working with the FAA to supply highly educated candidates for the position of air traffic controller, the FAA, appears to have abandoned this partnership leaving 3,000 to 3,500 AT-CTI graduates and current air traffic control students without portfolio. Many AT-CTI graduates and current students have amassed upwards of $100,000 each in student loan debt in pursuit of air traffic degrees. In place of this program, the FAA opted to employ a general public announcement seeking to recruit U.S. citizens without regard to air traffic control background or education to fulfill future personnel requirements at air traffic control facilities. AT-CTI graduates who currently have a valid AT-SAT (Air Traffic Selection and Training) score were forced to re-compete through a Biographical Questionnaire for the "opportunity" to take or retake the AT-SAT. The latest

> Biographical Questionnaire tested roughly 28,000 applicants to yield about 2,200 individuals who were eligible to move on to take or retake the AT-SAT aptitude test.

The result of this action by the FAA was that enrollment in air traffic education programs in all CTI schools plummeted. For example, the largest university program enrollment dropped from more than 600 students to less than 300. Students enrolled in the CTI programs felt that the FAA had abandoned them. Many of those students banded together and brought a class-action lawsuit against the FAA. In responding to a letter sent to the White House, the FAA's Assistant Administrator for Human Resource Management stated, "I want to assure you that the FAA's goal in implementing the interim hiring process was to ensure the agency selects applicants with the highest probability of completing our rigorous air traffic controller training program…" (Bostick, 2014 as cited by Brady & McGuirk, 2014b, p. 1). The FAA achieved just the opposite; it closed the door on hundreds of highly qualified college-educated applicants.

External Efforts to Change the Training Paradigm

Various proposals were made to Congress to allow colleges/universities the opportunity to fully train an air traffic controller thereby saving the government millions of dollars; instead, students paid tuition to the universities for air traffic training. Typical of these proposals was one by a university president in which he said, "If [our] graduates were allowed direct entry into the OJT workforce, those savings to the FAA alone could approach as much as $18 million annually…" (*The Status of the Air Traffic Controller Workforce*, 2004, p. 35).

FAA's Current Initiatives

To investigate options for training air traffic controllers the FAA has undertaken several new initiatives. Most prominent among those are the efforts of the FAA's Aviation Rulemaking Advisory Committee (ARAC) and the creation of the Center of Excellence for Technical Training and Human Performance (TTHP).

Aviation Rulemaking Advisory Committee's Working Group

In September 2016 the FAA's ARAC (FAA Order 1110.119R, 2016) created a working group entitled Air Traffic Controller Basic Qualification Training Working Group. The group, composed of 12 representatives of industry, education, labor union, and the FAA was charged with providing to ARAC, "an analysis on options for external training provider solutions that restructure the FAA air traffic controller candidate pipeline" (ATCWG, 2017, p. 3). Two models were described:

> Model 1 • Candidates that apply for training at the ETPs [External Training Providers] would be self-funded • ETPs would provide the training track(s) (i.e., Initial Tower Cab Training/ Initial En Route Training) with the ultimate decision resting with the candidate • Upon completion of training, students would receive an examination from an FAA Examiner • Students would apply to FAA vacancy

> announcements • FAA would conduct Aptitude and Behavior testing • FAA would issue successful students a Tentative Offer Letter pending completion of medical and security requirements • FAA would issue Firm Offer Letter to students for direct hire to their designated facility.
>
> Model 2 • Candidates for the training would be self-funded • Candidates would apply to FAA vacancy announcement; the vacancy announcement would identify the track (i.e., Initial Tower Cab/ Initial En Route) • FAA would conduct Aptitude/Behavior testing and Medical/Security clearance • FAA would issue a Tentative Offer Letter • Candidates would select an Approved ETP • Students would complete training and successful examination from an FAA Examiner • Pending successful completion of training at a certified ETP, students would be issued a Firm Offer Letter and assignment to his/her designated ATC facility (ATCWG, 2017, p. 10).

The committee indicated a preference for Model 2. Both models assumed that the cost of training would be provided by the student as is the case now in CTI schools. Adopting either model would result in a savings to the FAA of approximately $119 million over a 10-year period. This would occur without a reduction of the quality of training that a candidate receives from the present program.

Accepting either model represents the culmination of an initiative begun by a university president in 2004 (*The Status of the Air Traffic Controller Workforce,* 2004).

Center of Excellence

The creation of Centers of Excellence (COEs) is a widely used strategy to address a host of issues faced by an industry or even a nation. For example, the National Operations Center of Excellence was begun in 2015 to serve as a single point-of-contact between the various stakeholders, to provide access to knowledge, to promote best practices, to support capacity building, and to provide a forum for exchange of ideas (Lockwood & Noble, 2014). Similar in concept, University Transportation Centers support vigorous research, and ongoing education through conference, webcasts, newsletters, and reports ("UMTRI-led effort," 2006). These and many other Centers of Excellence perform fundamentally like purposes.

The Federal Aviation Administration's (FAA) Air Transportation Center of Excellence program was begun in 1990 pursuant to Public Law 101-508 to address aviation challenges for the public good. The COEs are awarded to university teams to provide for multi-year, multi-million dollar grants, typically in the form of 10-year cooperative agreements, to research areas that are critical to the FAA and the flying public. COEs have been established in areas such as aircraft structures, general aviation, operations research, airworthiness assurance, aircraft noise and aviation emissions mitigation, advanced materials, airliner cabin environmental research, airport technology, and commercial space transportation (FAA Centers of Excellence Facts, 2017).

Between 2012 and 2021, it is estimated that over 12,000 air traffic controllers will retire, resign, be promoted, or lost to attrition. As the FAA hires new personnel who grew up in a digital world with a preference to digital technologies, the traditional means of training using static methods will become increasingly outdated (Hadar, 2015). Training for these new professionals entering the workforce will need to leverage multimedia and interactive devices, training and simulation with augmented reality, and other strategies to fully engage the learner.

To meet this challenge, the FAA announced on December 21, 2015, that it intended to form a new Center of Excellence in Technical Training and Human Performance (TTHP) (FAA Center of Excellence in Technical Training and Human Performance Solicitation, 2015). The FAA considered numerous applications and announced its decision on August 12, 2016, to award the COE to a combined team led by Embry-Riddle Aeronautical University and the University of Oklahoma. In announcing the award, FAA Administrator Michael Huerta stated, "This world-class, public-private partnership will help us focus on the challenges and opportunities of this cutting-edge field of research. We expect this team will help us educate and train aviation professionals well into the future" ("The FAA Announces," 2016, para. 2).

Core members of the team include: Auburn, Drexel, Embry-Riddle, Inter-American University, Oklahoma State, The Ohio State, Purdue, Tennessee State, Tulsa Community College, The University of Akron, University of Akron – Omaha, University of North Dakota, University Oklahoma, University of Wisconsin-Madison, Western Michigan, and Wichita State. In addition, 9 affiliate universities and 36 industry partners are members of the COE (COE SOAR, 2017).

Current research. Collaborative research projects are currently underway in the COE to address the technological and educational transformation needs of the FAA's Air Traffic Organization. This research is occurring in six broad categories as detailed in Table 1 (COE SOAR, 2017). These funded projects offer a clear indication of the type of research the FAA believes will solve the technological, pedagogical, and management shortcomings of the current approach to air traffic controller training. These projects are consistent with the FAA's desire to take advantage of "advancements in teaching, such as part-task training, modeling, immersive human-in-the-loop simulation, and adaptive learning technologies that are standard in other technical workforces (FAA Centers of Excellence, 2016)." The agency also noted:

> The COE will examine human factors issues such as changes in learner expectations and academic best practices for training a new generation of learners. The center also will research innovative training methods for this new generation. This includes new technologies such as mobile learning as well as new ways of collecting and managing training data. (FAA Centers of Excellence, 2016)

Table 1

Current COE for TTHP Research Projects

1. Curriculum Architecture	
Project Title	**Purpose (brief)**
Field Training Standardization	to assist the FAA with overcoming inconsistencies in technician and controller field training
Standardization of Training for Training Administrators	research and compare the training needs of multiple facilities to recommend a standardized training program that would "train the trainers" and enhance their knowledge base along with their performance level
Curriculum Architecture Gap Analysis	use Artificial Intelligence (AI) methods to identify and measure the gap or redundancy in training curriculum by automatically analyzing information in curriculum materials using a data-driven approach ….
Enhanced AT-CPC Training	research and develop recurrent and skill enhancement training to Certified Professional Controllers through a variety of methods
Modular Curriculum Design	research curriculum architecture design leading to modular curriculum to develop targeted performance competencies in Air Traffic Management and Technical Operations Training
2. Content Management and Delivery	
Virtual Training Delivery	a virtual training delivery methodology, associated maintenance processes, infrastructure requirements will be proposed and recommended
Course Development	examine current course development strategies used by the FAA and then create a course development structure for the FAA eLMS that assures standardization among contact developers
Development of Learning Taxonomy	exploratory and pilot study identifying common language, vocabulary, and understanding of interactions between items related to learning to develop a learning taxonomy and possible strategies for implementation of proposed taxonomy
Research Alternative ISD Model	exploratory qualitative study of best practices within U.S. aviation industry and government for centralized development of occupation education and technical training

3. Simulation and Part Task Training	
Optimize Simulation	investigate the use of simulation in FAA training and will report on the benefits, limitations, risks and challenges
Explore use of Gamification for Training	model the application and impact of gamification, serious game design [game-based learning (GBL)], and simulation/virtual working environments (VR) to provide state-of-the-art training solutions to aviation safety training
Analysis of Technical Training Courses for Specific Part-Task Training Implementation and Enhancement …	identify specific “chunks or part-tasks” of technical training of an FAA chosen course curriculum and follow the evaluation of the training to successful completion of tasks in a full simulation environment
4. Human Factors	
Universal Design for Learning and Multi-Modal Training	benchmark, adapt, and introduce new approaches in UDL design-based learning and multi-modal training for air traffic controllers through classifying current pedagogical practices, benchmarking existing and new state-of-the-art learning technologies, recommending adapted and new learning pedagogies, and developing protocols for assessing student learning outcomes
Applied Game Theory to Enhance ATC Training	explores the use of decision analysis techniques, game theory in particular, to enhance ATC training for addressing uncertain operating conditions
Characterization and Application of ATC Visual Search Patterns and Control Strategies…	characterize and classify the visual scanning patterns and control strategies of expert air traffic control operators (ATCOs) in order to support the efficient and effective training of air traffic control candidates
Human Factors and Scenario Based Training w/Advanced Weather … Using Probabilistic Hazard Information Displays	advance weather-simulation capabilities and behavioral-modeling techniques to improve weather-related flight skills among pilots and controllers
5. Analytics	
Learner Data Management	apply text analytics, knowledge extraction, and machine learning techniques to integrate data from existing FAA databases and transform it into useable information for efficient and effective management of Aviation Safety Training

Analysis of Technical Operations Job Tasks	research current job tasks for Technical Operations personnel and to develop a proposed model for integration of this job task analysis into existing courses that have outdated or no task alignment
Technical Training Knowledge Architecture	explore the industry best practice and latest research advancement on building effective knowledge search engine, through literature review, consulting with industry partners and, if possible some test runs of those methods
AJI-2 Customer Satisfaction Process	developing a recommendation for the implementation of a process to collect, analyze, respond to customer satisfaction data, and maximizing customer satisfaction with AJI-2 technical training products and services
6. Safety	
International Harmonization and Standardization	focus on: a global level investigation of the stakeholders to inform alignment within the instruction, curricula, and infrastructure for the technical training of air traffic controllers, aviation safety inspectors, engineers, pilots and technicians …

Summary

Training for air traffic controllers has undergone changes over the years resulting in a loss of capability relative to university programs. New FAA initiatives currently under way offer some new paradigms that may represent improved training processes. The FAA's Aviation Rulemaking Advisory Committee is investigating opportunities for outsourcing controller training. Further, the FAA has identified that the training it provides its air traffic control workforce has become outdated and inefficient, and it has established a Center of Excellence to conduct research to modernize this training with the infusion of technology, to develop training paradigms that workers who grew up in a digital world can more readily embrace, and to develop integrated systems that track and manage training data. Promising research has already begun in many of these areas.

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HARNESSING OPEN EDUCATIONAL RESOURCES IN HIGHER EDUCATION: PROGRESS, ISSUES AND CHALLENGES

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Abstract

Technology proliferation, has transformed higher education to a student controlled centered-based teaching and learning environment. The change of attitude towards the students by the institutions has shifted students' learning environment into a more active role as collaborators. This degree of openness through creating and developing of Open Educational Resource (OER) material can be more productive than the traditional learning environment, but main barriers related to copyright law should be addressed. Furthermore, research on comparative effectiveness is required to streamline and optimize the process, in addition to incorporating support of OER creation and development recognition into university policies.

Introduction

Universities and colleges' main mission is the creation and dissemination of knowledge. This is accomplished by providing the necessary development of skills and habits of minds tailored for lifelong learning. This mission is executed in a variety of ways by engaging the learners in stimulating and productive activities (D.C.C, 2009). The Internet has opened interesting opportunities for universities to rebrand their teaching and learning environment and the way to disseminate knowledge. This is attributed to higher education institutions' capability in generating information and communication technologies (ICT) that are being utilized to fulfill and empower their mission. Despite the ICT capabilities, the changes in learning and teaching are less pervasive than in other disciplines, such as in the finance and entertainment industries. This resistance to change perhaps might be recognized to the degree of openness and strict intellectual copyright issues, as well as institutions' rigid policies, which are hampering adaptation of major changes in the learning and teaching environment. The paper will address the issues of openness, an introduction and motivation behind OER, and a discussion on progress and challenges with emphasis on intellectual property, which is considered as one of the main barriers.

To a great extent the degree of openness plays a major role in fostering innovation and creativity by providing wide access, which enables wider participation, and therefore more individuals or groups of people who have a variety of ideas, for example to improve an invention. Yet the main challenge is how to credit the main or lone creator and how his or role in the invention will not be underestimated. This, in addition, to technology proliferation had promoted the (OER) concept, where the *all rights reserved* model is transformed into *some rights reserved* (Prabhala, 2010). In the learning and teaching environment context, this implies that the content can be used, and shared freely and in some circumstances can be modified as well. It is important to highlight that not only may educators and learners use the material freely, but, importantly, they may also participate actively in production and modifying such resources. So not only will the knowledge grow, but also the number of knowledge creators will grow. In addition, UNESCO is advocating and promoting the OER model so that developing countries with modest to poor resources will be able to provide good quality education for their citizens regardless of their socioeconomic background and thus, developing countries will be able to catch-up with developed countries.

The main question is how do we define openness? It is worth noting that the concept of openness can be applied to institutions or information or processes. We refer to an institution's degree of openness, as to whether the institution provides access to learning and teaching material and shares the outcome of research output freely or the institution imposes some degree of restriction. So the degree of openness ranges the spectrum, of full restriction to complete free access or no restriction. For example, if a scientific journal provides and shares the data only through subscription, then its degree of openness is much less than a journal that provides the data completely free without a charge to the public. Furthermore, if the creators and the users have the ability to contribute and modify the content and the permissibility of redistributing it, then this is what we call responsiveness, so the degree of responsiveness is associated with the degree of openness. Responsiveness is also an important concept, due to the fact that widespread learners or users can apply the original knowledge further and in some cases contribute to the engine of innovation by active participation in the learning and teaching process. To some degree, ICT or the Internet can enhance responsiveness, but openness is not impacted by technology. It relates to the attitude and the degree of welcome of potential contributions, from expected and unexpected resources: even from those whose contribution is unanticipated, due, for example, to being affiliated with a different institution or related to a completely different discipline. Not only the attitude of the institution, but also its members can influence and impact the degree of openness, if, for example, researchers recognize students as fellow investigators this implies a greater degree of openness.

A good example of openness is an open source software. The software is distributed as broadly as possible to the public, the hope being that some programmers and users out there, can detect the errors and bugs and make suggestions on how to fix them. So there is an influx of ideas and feedback from many users on how to improve the software and fix the bugs, but not all suggestions are good, and if we change the software every time there is a suggestion, then we will not be able to use it. The conclusion from this discussion is that openness has some limitation, in this particular case limits on the responsiveness for the proposals to improve it. It is worth noting that this limit of responsiveness is essential to maintain a good strategy to improve the software by the wider participation of the community, but with emphasis on maintaining quality control and stability. This example highlights the necessity of exercising some degree of limitation on openness, and greater openness is not always the right way to achieve a certain purpose. We are inundated with lots of open source information, and we are experiencing some degree of difficulties to filter those that are reliable and trustworthy from those that are not.

The progress in the technology development of the Internet from a vehicle that provides vast amount of information to users, to one that encourages and fosters collaboration of individuals and groups regardless of their geographical area has made a great impact on higher education teaching and learning environment. This environment has created and empowered teachers and students to collaborate, but also made a shift in the teachers' and students' roles as the reciprocation of knowledge is bouncing back and forth between the two parties. This certainly has fostered and encouraged innovation as the students can built upon the ideas of the teachers, but also can participate actively on adding their own ideas and refine and improve the ideas of their masters. So the environment of teaching and learning is transformed to an interesting vehicle of collaboration where the teachers and the students can learn from each other. This transformation has influenced higher education policy makers to make the learning environment more open. To that end, the degree of openness is enhanced, and this is the current trend that the higher education environment is adopting. In addition, many of the students might feel somehow constrained by universities or institution with less connectivity as compared to what they used to have at home or at high schools, as many of them have used the Internet from a very young age and never used a printed encyclopedia or dictionary. The Internet has accelerated the effect of globalization through the greater openness in many domains. A key aspect of this is that knowledge is a public good that should widely be available for everyone. This has been demonstrated by the addition of knowledge as an item in the European commission's list of items that should be moving freely through the European Union internal borders ("Summit Backs,"2008, March 14). Degree of openness can be influenced by geopolitical events, for example, post 9/11/2001 the number of foreign students from Muslim countries attending higher education institutions in the US remains significantly lower as compared to the number of students from other countries. Furthermore, the number of US students attending and visiting Middle Eastern countries remains significantly lower; this highlights the importance of policymakers in higher education to act to alter this situation to promote better understanding of the Muslim world especially among the younger generation where future US leadership is nurtured.

The State of OER and Its Progress

Due to the advancement in technology, and enhanced access of knowledge through a variety of ICT,, the Open Access (OA) movement arose. This movement had advocated for authors to publish preprints or archive their papers electronically, and recommended the creation of ePrints archives by universities and scientific organizations (Kiel-Chisholm & Fitzgerald, 2006).

Subsequently, they have published software that facilitates management of such ePrints archives, advocated utilization of the Open Access metadata standards to enhance the ease of discovery, and the communication with various governments that support and not impose obstacles on open access to authors of preprints.

The first online archive was created in 1991. The xrXiv.org, started as preprint services to physicists, and soon after self-archiving was popular. In 1997 the US National Medical Library followed suit with Medline, the most comprehensive medical literature index. In 1998, the first open access medical journal was created, *JMIR- Journal of Medical Internet Research*, publishing its first issue in 1999. To further promote the cause of OA, a meeting was held in Budapest, Hungary in 2001. Proponents of Open Access to scientific and scholarly journal literature attended the meeting. In February 2002, the Budapest Open Access Initiative (BOAI) (2017) was signed by 16 academics; the goal of the initiative was to accelerate open access for peer reviewed journal literature, through self-archiving and a new type of open access journals. The Bethesda Statement for Open Access Publishing (2013) created in June 2003, stated that all stakeholders should promote the rapid and efficient transition to open access publishing. The stakeholders are: the organization that fosters and support scientific research, the publishers who facilitate the peer reviewed distribution of the results, and scientists who depend on the knowledge of the published materials. The Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities. (2017) was signed later in October 2003 on the heels of the Bethesda statement to further encourage and promote BOAI.

MIT, through its Open Course Ware (OCW) in 2001, pioneered open access in education (Iiyoshi & Kumar, 2008), and numerous well-known universities followed suit. Though, the concept of Open Educational Resources was introduced the first time in 2002 by UNESCO, to enable free sharing of knowledge through any designed materials intended for teaching and learning. Important documentation (Kurelovic, 2016) for OER, relevant to providing guidance and recommendation for wider acceptance includes: Cape Town Open Education Declaration (2007); the Dakar Declaration on Open Educational Resources (2009); the 2012 Paris OER Declaration; and the Commonwealth of Learning and UNESCO *Guidelines on Open Educational Resources in Higher Education* (2015).

Teaching and Learning Using OER

There has been transformation in the OER in higher education. The transformation is caused by technological development of the World Wide Web, which transformed the teaching and learning environment into a more participatory one. In phase 1 of World Wide Web development, the capability of uploading teaching materials and placing them on the Web enabled students to access the material remotely. With phase 2, the mechanism of active learning was introduced, and therefore students and teachers can participate collaboratively by downloading the course material, modifying it and retransmitting (Hilton & Wiley, 2009) it back to the teacher and other peers. This active participation provided a vehicle of enhanced innovation to be created. By encouraging this student-centered collaborative approach, teaching and learning is moving away from teacher controlled delivery of discipline-based facts and knowledge into a more student-centered approach where the students have more responsibility and therefore become more independent. To some extent there is similarity in modifying the OER to scholars building upon previous research or findings. This can enhance the ability of solving community problems due to a large population of participants' engagement.

But the main question is whether this theory is capable of delivering superb results. As of today there is no concrete evidence to support this, but things are still evolving. However, the main notion is that there is a great difference between developing top notch materials and tools and developing and identifying the best strategies to incorporate them into critical mass and meaningful learning environments. How OER is affecting the teaching and learning environment is yet to be critically researched since too little information is available regarding how effective it is in higher education. We do know that open educational resources are being downloaded millions of times, but we do not know who the users are, where they are located and how they choose a particular educational resource, what they do with the material, and what the outcome is of the use of such OER material.

Some early research on OER at Carnegie Mellon University (2015) is very encouraging. Results indicate that newly created computer mediated learning material that incorporates embedded assessments, feedback loops and cognitive tutoring is as effective as traditional good lecture delivery. In fact it was noted that OER is more effective due to the fact that it is available 24/7, and it did achieve the learning outcomes of the course. Furthermore, the fact that the assessment is done automatically enabled the tutors to spend more time on material preparation rather than assessment and has cut total time spent substantially. The most important outcome of the studies is that students can master the skills and complete the course at faster pace than in a traditional learning environment. This has enabled them to finish the degree in a shorter time and join the work force and be more productive sooner.

Then the question is why we are not adopting OER more quickly? Unfortunately, lessons learned and sharing what is working as compared to what is not working in the educational environment related to the physical and cyberspace world are not generally effective. There is a great deal to be learned and adopted from the corporate environment. In general information about teaching and learning is hard to capture, tacit and difficult to formalize, and above all there are great challenges in disseminating the information, especially the case for implementation. Moreover, many institutions have not put great emphasis on how to educate their staff to be excellent teachers. The outcome of the above discussion is we need to invest more in research in comparative effectiveness of digital education material including OER and traditional material, and perhaps governments should encourage and support this undertaking.

OER Issues and Challenges

In the above discussion, the status of the art related to OER was discussed and this section is dedicated to challenges and issues associated with OER development and implementation (D.C.C, 2009), in order to gain the most impact and accomplish the learning outcome.

How OER Should Be Defined

Any digital material that is completely free, and can be accessed without restriction by anyone 24/7, and can be modified and redistributed with no restrictions is defined as Open Educational Resource (OER) material. Based on this definition, OER covers the far end of the openness spectrum. The main question is should we comply strictly with the above definition or should we adopt a more flexible definition that complies along the lines of the above definition? For example, if the material can be accessed by a small insignificant fee, then can this digital material be considered OER, or if the digital material is restricted to a certain geographic area to maintain quality and good standard then is this considered as OER? The answer for this question is yes. We should not restrict supporting the good cause of sharing knowledge and contributing to solving challenging problems for the better wellbeing of our community and society and other societies despite the fact that the degree of openness is a bit restricted. Sometimes those restrictions of access to limited people are imposed strategically in order to nudge or persuade right holders to give away more existing closed materials.

The Supply Side -- One Focus

Due to lack of comprehensive information about OER, in terms of who are the users, why they are interested in this specific OER, how they use the downloaded OER, and what is the end use of the modified and repurposed OER, and to what communities it was transmitted, these issues will shift the focus on the user aspect of the OER rather than on the creators. It has been noted, that the notion that with creation users will follow a flock approach is not working, and special attention to the users is required. This implies that there are many OER resources out there, but unfortunately they are not utilized, and therefore a large amount of time is being wasted due to one side being focused on creation rather than tailoring the product and addressing the users' needs.

Locating and Evaluating OER

A recent UNESCO and Commonwealth of Learning report (D'Antoni, 2008) has highlighted OER building capacity, promotions and awareness gaps between users and creators related to certain areas in the world where they are most impactful. It is essential to diminish this gap, in order for OER to be used effectively. Thus, we need to develop ways to emphasize where OER are located, including detailed instruction on how to use those resources so that potential users will be able to make informed decisions about OER. For example, by uploading the OER on a well visible website or OER repository, we can utilize data mining to get better ideas on who are the potential users, from which geographic areas they are from and for what reason they are interested in this type of OER. Evaluating OER is one of the main challenges facing potential users. Since the OER will be modified on a constant basis, with updating the OER number version, it is difficult to judge whether the new version is better than the older version, so in terms of OER quality it will be difficult to assess. Possible resolutions are to depend on a third party evaluation, or based on crowd sourcing, where potential users can assign a rating; this might help users make more informed judgments of which version to go with. But even those solutions are limited due to barriers in culture and languages associated with particular geographic areas; something that is working in one area might not work as well in another one.

OER Environment and Coordination Is Required

There is a complete lack of collaboration on the supply side by the OER companies. While it is good to have a decentralized supply chain, as this will foster innovation, it is also good to some extent to collaborate on marketing, and to share data to prevent duplication of efforts in product development, in order for potential users to have an ease of discovery. Furthermore, if standards need to be developed for ease of interoperability then some sort of minor coordination is required. This certainly does not imply that users and groups should follow the same path.

OER Creation and Incentives Development

To encourage faculties, institutions and students to be involved in OER creation and development there should be some sort of incentives to embark on this undertaking. One incentive is to promote certain good causes or a goal to help the community in a certain problem. This moral incentive is crucial to the success of OER development and creation. From the point of view of a faculty embarking on this effort, it will require the institution to provide incentives, such as awards, funds and promotion that go beyond the traditional path of research promotion since this effort is tailored to a more effective and productive teaching environment. From the point of view of the institution, , while the initial investment in creation and developing OER is relatively high, the outcome of a successful OER is cutting the assessment time, freeing the faculty to concentrate on preparing materials, in addition to recognition on the national and international level of the quality and the merit of utilizing OER. For example, MIT's Open Course Ware (OCW) has enhanced the reputation of their faculty and the institution and leveraged the students' enrollment through the highly recognized OER courses. From the students' perspective, the material is available 24/7, the students are actively participating and the material will be revised and repurposed by students for variety of projects. In addition the students are engaged actively, and they will be responsible for the maintenance of the repository.

OER, -- the Role of the Government

It is favorable for a government to provide support and funding to OER creation especially in disciplines that lack OER or where underserved OER exists. OER utilization and incorporation of curricula have transformed teaching and learning to create an effective and productive environment. Therefore, a government should provide funding for research on comparative effectiveness of digital materials and traditional material, in order to come-up with the best forms of education and practices to deliver productive and superb results. But the main question is whether a government should engage in those activities to address certain OER voids and what is the implication of this in terms of competition with private parties? There should be no problem for private vendors to capitalize on governmental funded OERs and develop products around those OERs.

Intellectual Property (IP) Right and OER Development

One of the major barriers of OER development is the ownership of intellectual property rights of the material that will be available freely online. There is great reluctance of copyright holders to make their material accessible freely without a charge. In addition, it is often the case that it is difficult to locate or identify the copyright holder of such materials. Thus, in order to clear those obstacles the only legal avenue to move forward in order not to hamper OER creation and development is to go ahead and purchase the copyrights from the holders, which will add significant cost to OER development. Obviously, no one should undermine copyright protection in spurring innovation; however, for OER to be able to be used freely, be modified and repurposed and transmitted, some more flexible less restrictive, less expensive and less time consuming mechanism of right clearance should be conceived. So, for the long run, purchasing the copyrights from holders is not sustainable. This has prompted looking into other avenues, such as the institution persuading the faculty who created the copyrighted material to be more generous and less restrictive. It has been demonstrated that to a certain extent being more open and less restrictive can enhance the institution's and faculty's reputations by enhancing the sales of textbooks of faculty who created OER material through the recognition of their work, and may increase the enrollment at the university. Recognizing the value of sharing through OER will cause a more even distribution between the rights of the creators and the rights of the users, who may serve as follow on innovators. This recalibration of the relationship between the creators and users will provide more acceleration of innovation through OER, which is the vehicle of quicker diffusion of knowledge. Prior to technology proliferation, recognition was in terms of intellectual property rights in the domain of the creators, but due, to the Internet and the advancement in technology, there has been a shift towards the users, which are the follow on innovators. This shift has caused creators to push for more restrictive copyright protection, which entails less room for user's innovations and underproduction.

Fair Use and Educational Exceptions

The United States compared to other countries has generous and robust use of the fair use doctrine, which allows the use of portions of copyrighted material for educational purposes without the permission of the author or the copyright holder, as this will not be considered as a copyright infringements. Unfortunately, the use of the fair use doctrine for OER material is limited, and, therefore, with maturation of OER, new legislation might be required. This might be accomplished through more exceptions and flexibility being granted towards non-commercial educational users of OER.

Intellectual Property Licenses for OER
The main challenge is how OER should be licensed given the current status of intellectual property law, which enforces strict copyright protection for the holder of an invention. One recent important development in intellectual property arena is the emergence of Creative Commons (CC), where the organizations have created more flexibility of copyright protection and permissions including opening up the work of creators for others to build upon, subject to the requirement of attribution to the original owner. The variety and flexibility of the various CC licenses has created some issues related to interoperability between different OER supporters. This has prevented integrating or mixing and matching of different intellectual property OER. CC recognizes the issues and problems associated with standardization of licenses. These issues need to be addressed in order for CC licenses to be more widely accepted.

Standards and Operability
Identifying, locating and utilizing OER has been impacted negatively by a lack of standards, in analogy to impediment of OER free exchange due to lack of standardized intellectual property. There is great need to have an OER standard that runs across the board, on all platforms, with no restriction such as on desktops, laptops and mobile devices. Furthermore, OER needs to be displayed effectively in many media, including print. In addition, a standard needs to be developed specifying that once OER is created and deposited in a repository it can be visible and accessible on all OER repositories; it is like create once but appear on all. These factors can provide an ease of discovery and will reduce the time and cost of learning due to common educational instructions. Even though standardization can promote openness it has some challenges associated with its adoption. For example, if the standard is adopted too early, this might stifle innovations by freezing the current status of development, and if it was adopted too late, will hamper recognition and utilization on broader scales.

Learning About Co-Creation
OER material based on the definition is digital material that is shared, modified, repurposed and retransmitted among users. This sharing nature of the material necessitates the effective developments of models and best practices for co-creation, in order to deliver clear measurable output, through strict time deadline compliance. For collaboration to be successful there should be recognition from all participating parties of mutual benefit and the common shared sense of ownership.

Sustainability
Is there a need for an OER business model that is sustainable? Is substantial direct support required, and how we can maintain OER existence in the long run? These issues are important, since the initial development of OER was started through the volunteer work of individuals, and then was sustained by faculty members and certain institutions and the vision of private foundations. For example the creation of the open source LINUX was supported by IBM, a major corporation, which maintains strong support for the open source software. This has helped IBM to maintain its dominance in the IT market. Is

a similar business model needed to be developed to maintain the sustainability of OER, or is the emergence of different business model required? We are on hold, wait and see, period, but the reality is that OER is to be sustainable, and, hence, some sort of support is required. This might come from corporations that are developing products or commercial activities building upon OER, or direct support from colleges and universities that broaden the utilization of OER in their courses, or direct government support for OER for the public good and fees collected from institutions based on training their OER users.

Case study: OER Uptake by University Staff

A study (Hart, Chetty, & Archer, 2015) investigated to what extent the institutional intent for developing and utilizing OER was implemented within an organization. Furthermore, what were the inhibiting factors, and what types of support is required to realize this commitment in order to contribute and harness the potential of OER benefits for the learners? The study made an effort to link the adoption initiative with the intervention actions taken to harness OER among staff and learners. The creation of OER by the staff is essential to the success of the OER mission. Therefore, the attitude of staff towards creating OER should be examined and monitored because this can impact OER development, as the institution matures with regards to OER utilization. The major elements that will influence a new idea or innovation (Rogers, 2003) are the innovation or the idea itself, the communication channel, time and a social system. In this case we are considering OER as a disruptive idea or innovation that must be widely adopted by the staff, in order to be self-sustainable. The study followed the uptake progress of staff and highlighted the appropriate support, communications and implementation effects at each stage of the following five stages of the innovation adoption process (Rogers, 2003): knowledge (awareness), persuasion (interest), decision (evaluation); evaluation (trial); and confirmation (adoption). Each stage in the innovation adoption process is associated with information and support needs. The University of South Africa has implemented the first two stages of knowledge and persuasion by raising the awareness of faculty and staff. The institution plays a crucial role in making the community sensitive or more engaged with innovative ideas, then providing scaffolding support in order to grow the knowledge. (The institution demonstrated this via internal communication and by providing the relevant information via a repository.) The stages of decision and implementation were supported by confronting real or perceived barriers related to OER and by trying to find workable solutions. The final stage of implementation will be accomplished through embedding OER in teaching and learning with the appropriate infrastructure of reliable ICT. Also, and essential for the last stage to be successful, the staff that advocated for OER utilization should take the championship and ownership of the OER initiative, which also can provide the sustainability aspect of it. It is realized from the above discussion that institutional policy with regards to OER initiatives and removing barriers are essential for OER uptake among faculty and staff. The barriers can be compiled into three groups: the intrinsic nature of OER, institutional infrastructure, and the personal attributes of the staff. Despite efforts to overcome come them, these barriers were associated with the University of South Africa's staff; previous research in developed countries indicated similar results associated with OER barriers. The barriers discussed above are related closely to the degree of institutional maturation for OER adoption.

Conclusions

The explosion of technology and advancement of the Web to a second phase where collaboration capability augmentation is experienced, as compared to Web phase 1.0, has transformed higher education to a student controlled-centered based teaching and learning environment. Due to this transformation, universities started to adopt more openness in their teaching and learning, treating students as fellow investigators that can build upon the ideas of their teachers and repurpose the material tailored to their interests. The change of attitude of the universities has transformed students teaching and learning into a more active role as collaborators. This degree of openness through creating and developing OER material can be more effective and productive than a traditional learning environment. However, more research on comparative effectiveness is required to streamline and optimize the process, in addition to incorporating support of OER creation and development into university policies.

OER penetrations in higher education environment are less pervasive compared to other industrial disciplines due to lessons learned sharing ineffectiveness and challenges in disseminating the knowledge across the board with regards to implementation. Therefore, unless a mechanism of disseminating the knowledge focused on implementation is developed and put in place, similar to what is available in the corporate environment, disruptive teaching and learning technologies such as OER will remain less diffusive in higher education environments. It is therefore vital that institutions play a critical role to develop strategies to incorporate and embrace OER. This should be implemented by approving an OER strategy and an OER coordinator appointed in the Provost and/or Vice Chancellor's office. There are also certain barriers that need to be addressed. The role of governments and institutions is critical in support of OER initiatives. Government's role includes: fund projects on comparative research effectiveness of digital material, as well as conventional material; expand the permission of usage beyond the classroom for non-commercial copyrighted material under the educational exception; review the educational exception for non-commercial copyrighted material due to open educational resources; be actively engaged in funding best practices for collaboration and eliminating barriers to enhanced collaboration; and reconsider intellectual property laws, mainly in recognition of individuals follow on innovation. Universities should: consider posting course material online with options for the users to remix; repurpose and redistribute the material; promote the engagement of faculty in creation of OER material, and consider this activity for faculty promotion and tenure; provide faculty training and support to those interested in OER development; encourage student involvement in OER creation and maintaining the repositories through academic credit; work with IP holders to get their approval to make their material open to the public; and promote the use of Creative Commons Licenses by faculty.

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A DESIGN METHODOLOGY FOR INVESTIGATING DOMAIN-SPECIFIC ASPECTS OF TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE THROUGH THE TEACHING OF MUSIC: THE IMPORTANCE OF AFFECT

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Abstract

The present study addresses the lack of a theoretical framework for the integration of technology in music teaching and learning, and explores, within the framework of Technological Pedagogical Content Knowledge (TPCK), the importance of affect in instructional design. The study extends the theoretical framework of TPCK to a design framework and proposes a methodology and instructional design guidelines that address both the cognitive and the affective domains of learning. The research has both practical and theoretical significance as it provides teachers with explicit guidance on how to design music lessons based on TPCK principles and examines interactions among content, technology, and affect.

Introduction

Over the past two decades, many studies have emphasized the role of technology in transforming the teaching of composition, listening, and performing in music teaching. However, current teacher practice does not really demonstrate technology's efficacy in facilitating real musical experiences and powerful pedagogical strategies for the subject-matter of music (Bauer, 2014; Savage, 2007, 2010; Webster, 2007). At present, technology is not extensively used in music teaching, and, often, it does not serve the needs and objectives of music education (Swanwick, 2011; Bauer, 2014). Most teachers use technology for viewing music clips from YouTube, multimedia presentations, or, for administrative purposes, such as, creating handouts, making musical scores for rehearsals, and recording students' musical activities (Bauer, 2014). According to several authors, limited technology integration in music instruction may be attributed to teachers' insufficient knowledge in music technology software and their affordances, conceptual bases, principles, and design methodologies for integrating technology in music teaching (Bauer, 2014; Savage, 2007; Webster, 2007).

Recently, Technological Pedagogical Content Knowledge (TPCK), a theoretical framework for guiding technology integration in teaching and learning, has been proposed by educational researchers to remedy for the lack of such theories (Angeli & Valanides, 2005, 2009, 2013, 2015; Mishra & Koehler, 2006; Niess, 2011). This study adopts the TPCK model of Angeli and Valanides (2005, 2009, 2013) in order to examine domain-specific aspects of the model within the field of music education. The authors acknowledge that the emphasis of the research related to TPCK so far has had a focus on the cognitive domain of learning, although, at the same time, they recognize that the affective domain has been severely overlooked. Consequently, the researchers in this study aim to further develop the work reported by Angeli and Valanides (2005, 2009, 2013) by proposing instructional design guidelines that deal with the importance of affect in the learning design and uncover relationships among emotions, musical content, tools, and pedagogy. It is noted that in this study, the terms affect and emotions are used interchangeably.

The contribution of this research has both theoretical and practical significance, because it explores the undetermined relations of cognition and affect in technology-enhanced learning, and, extends the existing TPCK instructional design guidelines with specific design principles that address both the cognitive and the affective domains of learning.

Technological Pedagogical Content Knowledge and Domain-Specific Aspects: The Case of Music Education

About a decade ago, several researchers used Shulman's framework (1986) about Pedagogical Content Knowledge (PCK) as a theoretical basis for developing TPCK - a framework for guiding technology integration in teaching (Angeli, Valanides, & Christodoulou, 2016). There are different models of TPCK proposed in the literature each having a different concentration (i.e., a concentration on practice, instructional design, context, etc.), and theoretical interpretation about the nature and development of TPCK (e.g., Angeli & Valanides, 2005, 2009; Mishra & Koehler, 2006; Niess, 2011).

The model proposed by Angeli and Valanides (2005, 2009, 2013) has a focus on instructional design and consists of five knowledge bases, namely, technology, pedagogy, content, context, and prior knowledge and conceptions of learners. The model views TPCK as a novel body of knowledge derived from the interaction and contribution of the five knowledge bases. The work of Angeli and Valanides (2009) diverges from the work of others in that it links TPCK theory with practice through a set of clear instructional design guidelines for designing technology-enhanced learning. These principles are as follows:

1. Identify content for which technology integration can have an added value, i.e., topics that students have difficulties in grasping or teachers have difficulties in presenting/teaching.
2. Identify representations for transforming the content to be taught or learned into more understandable forms that are not possible to implement without technology.
3. Identify teaching methods that are impossible or difficult to implement with traditional means and without technology.
4. Select appropriate tools with the right set of affordances.
5. Design and develop learner-centered activities for integrating technology in the classroom.

In addition to the above principles, Angeli and Valanides (2013) proposed Technology Mapping as an instructional approach for steering technology integration into the learning design and developing teachers' TPCK. Mapping indicates the method of detecting associations between the affordances of a tool, content, pedagogy, and learners' content-related difficulties during designing lessons with technology (Angeli & Valanides, 2009, 2013; Ioannou & Angeli, 2013).

In order to guide teachers' design processes more effectively, recently, various researchers pointed to the need for understanding domain-specific aspects of TPCK including the role of affect in the design of technology-enhanced teaching (Voogt, Fisser, Pareja Roblin, Tondeur, & van Braak, 2013; Angeli, Valanides & Christodoulou, 2016; Chai, Chin, Koh, & Tan, 2013). This gap may be related to the fact that the general TPCK framework is in essence a cognitive model that does not provide guidance in integrating affect or associating cognition and emotions in technology-enhanced learning. Therefore, the authors herein take on the general TPCK instructional design principles proposed by Angeli and Valanides (2005, 2009) and expand them to incorporate directions concerning the teaching of affect with technology, so as to deal with the requirements of music pedagogy and effectively help music teachers.

Music Pedagogy: Needs, Problems and Difficulties

Most music curricula in the western world require that students become able to compose, perform, and demonstrate musical understanding during listening (Swanwick, 2011; Paynter, 1992). However, student views of school music become increasingly negative, while their enthusiasm, enjoyment, and engagement decreases dramatically as they grow older (Boal-Palheiros & Hargreaves, 2001; Savage 2007; Hallam, 2011).

The fact that music unfolds in time and is abstract causes students to be inattentive during listening and analysis activities, while personal preferences in certain musical styles have also a negative impact on student receptiveness and concentration (Swanwick, 2011; Todd & Mishra, 2013). In addition, students have problems in recognizing, remembering, and comparing musical characteristics, structures and forms, and, in describing and reflecting critically on music (Todd & Mishra, 2013; Dunn, 2008; Tan & Kelly, 2004).

The implementation of creative activities is even more problematic, because most students are not able to read or notate their compositions relying solely on acoustical memory. Thus, they cannot receive substantial feedback or retain, revise, and extend musical ideas during subsequent lessons (Freedman, 2013). Furthermore, students' imaginative and expressive use of musical materials is directly related to their limited musical training (Burnard & Younker, 2004). From the teachers' perspective, composition is regarded as the most challenging. Teachers report problems in designing and teaching creative activities that stimulate both creative thinking and music learning, and acknowledge lack of knowledge in composition and/or pedagogies for managing creativity in music classrooms (Bauer, 2014; Coulson & Burke, 2013; Dogani, 2004).

Apart from the variety of skills required, and, the difficulties in teaching and carrying out music tasks, researchers assert that classroom activities often are not meaningful or related to students' out of school musical endeavors and interests. For this reason, some researchers propose offering activities that resemble the musical experiences students come across in informal settings, including online collaborative music making (Hargreaves, Marshall, & North, 2003; Savage, 2010; Green, 2007). Other researchers argue that enthusiasm and motivation will increase by shifting the emphasis from the development of skills to understanding the role of emotion in music (Hallam, 2011; Dogani, 2004).

Due to the power of music to influence feelings, people listen to music to modify moods or relieve emotions, relate their current emotional state, have a good time, or cheer themselves (Juslin & Sloboda, 2011). Moreover, emotions influence and shape all aspects of music making. Musicians use musical materials and form to express, communicate, and evoke emotions. A true musical experience (including listening, performing and composing), therefore, must not disconnect the understanding of music's cognitive aspects (musical characteristics) from the discovery of its emotional effects and expressive character (affect) (Paynter, 1992; Swanwick, 2011). Instead, it should encourage communication of emotions, feelings, and identity through composing, performing, or interpreting music (Hallam, 2011). In spite of the great significance of affect in music, there is currently a lack of research studies that examine or guide the integration of affect in music activities (Hallam, 2011).

Teaching Music Composition and Listening-and-Analysis with Technology

Online music collaboration sites and associated tools that can be used locally or over a network (i.e., www.cocompose.com, www.kompoz.com, DigitalMusician.net, explodingart.com/jam2jam, etc.) allow young people to manipulate sound, create and upload their own music, or explore and remix music of others. These types of experiences encouraged researchers to suggest that such informal approaches have the potential to transform music education (Brown & Dillon, 2007; Gall & Breeze, 2008). Associated music technologies, including MP3 files, DJ remixing software, loop-based music composition tools that use ready-made pieces of music, and generative algorithms, do not require classical music training and are appealing to young people who use it extensively in their free time (Crow, 2006). However, these approaches were criticized for implicating a very small number of concepts and musical styles, not developing in-depth understanding about structure, form, and musical materials, and for producing long, effortless, mechanized, unimaginative and inexpressive music (Crow, 2006; Swanwick, 2011; Savage, 2007). Thus, some researchers proposed using these technologies at an introductory stage and then moving on to approaches that allow for more creative thinking (Bauer, 2014; Freedman, 2013).

Processes of composition using music notation or sequencing software were investigated in another body of studies (Nilsson & Folkestad, 2005; Breeze, 2011). According to research evidence, due to their instant playback feature, these technologies facilitate the development of musical knowledge and literacy, and enable students who do not understand music notation to fully participate in the creative process. They allow students to create, review, edit, extend, save musical ideas, and, share with others for feedback (Savage, 2010; Wise, Greenwood, & Davis, 2011; Breeze, 2011; Freedman, 2013).

Studies related to the teaching of algorithmic and electroacoustic composition are rare (Brown & Dillon, 2007; Field, 2007). Finally, with reference to listening and analysis activities, there are publications that examine the use of listening guides or propose related teaching strategies (Kerchner, 2013; Dunn, 2008; Gromko & Russel, 2002), but, there is a lack of studies that investigate the teaching of music with animated and interactive listening maps taking into consideration affect.

A Design Methodology for Investigating TPCK Through the Domain of Music: The Importance of Affect

The design methodology proposed herein has been tested and revised extensively in experimental and control secondary education classrooms during the academic year 2015-2016. The term *design methodology* refers to the development of a method or process for designing technology-enhanced learning within the domain of music education. The methodology was the result of a three-cycle design-based research that focused on investigating affect in listening and composition activities, as shown in Figures 1 and 2. The aim of the design-based research was to find a robust methodology for designing technology-enhanced learning within the context of listening and composition activities in music. In developing the design methodology, the authors first invested efforts in understanding the interplay between technology, music, and affect, and, consequently, devised a set of instructional design guidelines to guide systematically the design of learning activities in music taking into consideration affect.

In more detail, as shown in Figure 1, the process begins with a listening excerpt during which students identify emotions expressed or induced without having any visual stimuli. Then, technological tools are used to support visualizations and explorations of the cognitive aspects of music, i.e., concepts and constructs, such as musical instruments, motives, phrases, sections, mode, melodic motion, and dynamics. Musical knowledge is presented through animated and interactive listening maps, and experimentations with musical concepts using notation software. Along with supporting music learning, transformations and experimentations with technology can also promote understanding of moods related to a specific musical element or combinations of elements in different musical contexts. Moreover, they can support relating moods to contrasting or different uses of a musical element. As soon as learning and exploration of musical materials is completed, students are prompted to create a short composition using technology that will convey a mood or a feeling, and, are guided to make decisions about how to use musical elements and structural devices to achieve the desired emotion.

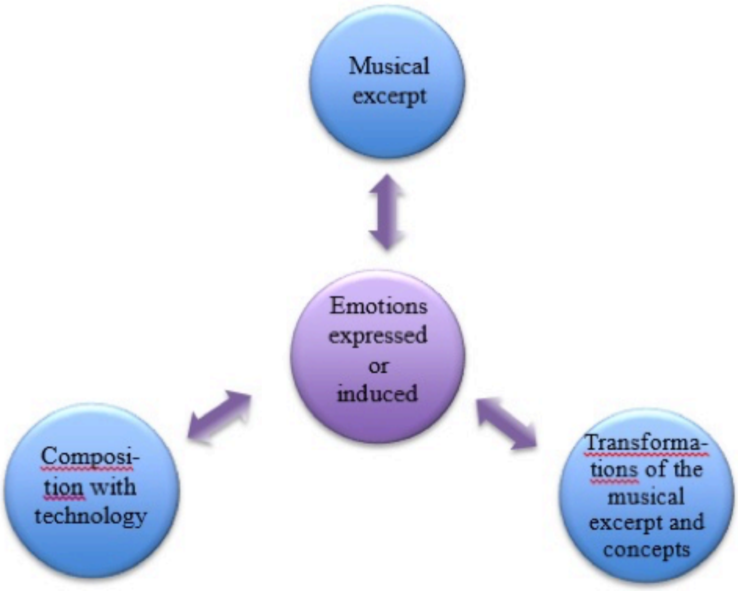

Figure 1. Musical concepts, technological transformations, and emotions.

In the process just described, there are interactions taking place between musical content, emotions, and technology. These interactions are denoted in Figure 2. While transformations of musical content facilitate learning, manipulations of materials with technology influence instant changes in moods or feelings enabling the development of relations among emotional and cognitive aspects of music. Furthermore, technology's resources and affordances, including combinations of sounds, instrument lines, control of materials and constructs, and instant and accurate playback, facilitate the generation of new emotions and ideas during the creative process and help in communicating them more effectively.

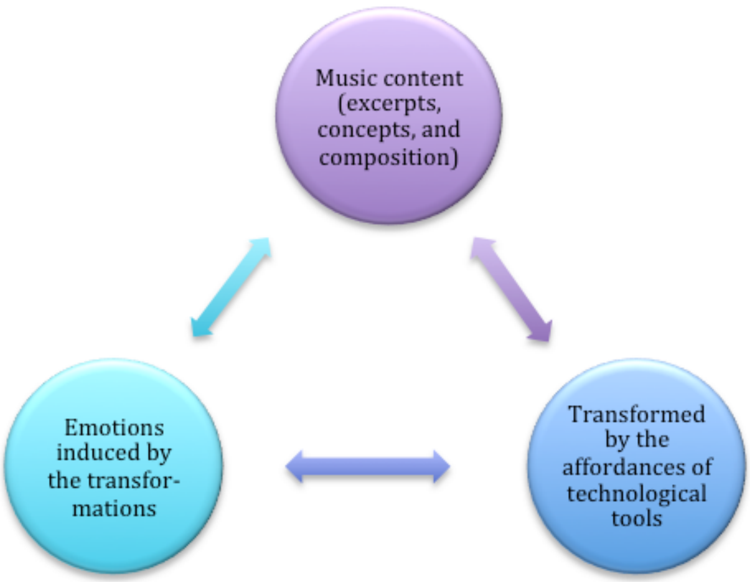

Figure 2. Interactions among musical content, emotions, and technology.

An example is provided for illustrating the preceding discussion. In the example, students experiment with tempo using the notation program MuseScore, and, a file containing a melancholic song in A Minor set at a slow tempo (70bpm). After listening to the slow version of the song, students are guided to open the Play Panel from the Display Menu (see Figures 3 and 4),

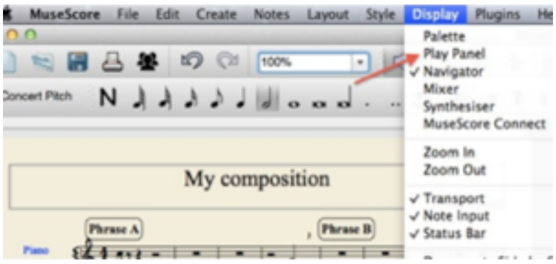

Figure 3. MuseScore: Display Menu.

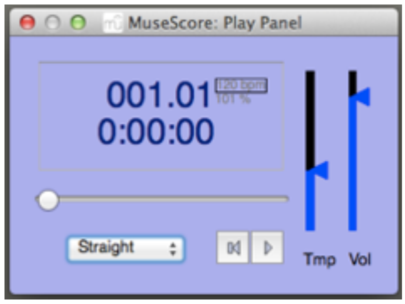

Figure 4. MuseScore: Play Panel.

set the tempo slider at 121bpm, and listen to the song again. While experiencing a happier mood despite the minor mode of the music, students are prompted to write their opinion about how changes in tempo induce different feelings. Similarly, other explorations can be carried out with various elements or combinations of elements using short excerpts in MuseScore. For example, students may explore the emotions elicited by sequentially trying out soft and then loud dynamics on a single melody, and, hence, by repeating the process on a harmonized melody. Exploration may continue by adding a third parameter, i.e., by changing the instrument sounds in the given arrangement.

In learning with technology, two considerations are worth mentioning. First, the affordances of technology can enable students to sidestep their limitations and support practices and uses of musical materials that are very difficult or impossible to realize when composing with real instruments, such as, playing very fast or very slow tempi, or manipulating and transposing motives, changing instrument sounds, and identifying places in the music that sound wrong and revising them. Second, teachers do not need to spend additional time to teach the technical functions of MuseScore. Through the various activities, i.e., presentation of excerpts and concepts, exploration of musical elements, and creative exercises, students gradually become familiar with the program's functionalities as well as the usage of musical materials in relation to affect.

Accordingly, based on the processes described in Figures 1 and 2, the authors herein propose a design methodology consisting of a set of design guidelines that extend the second and third instructional design guidelines proposed by Angeli and Valanides (2009, 2013) (described earlier in the paper), and guide the application of TPCK theory in the teaching of music and affect.

1. Use affect (emotion elicited from a musical excerpt) to motivate students to engage in analysis and exploration of musical excerpts and related concepts.

   1.1. Ask students to identify emotion(s) felt or expressed by the music and write it/them on their handout without having any visual stimuli.

2. Use technology to help visualize, explore, and support understanding of the cognitive aspects of music (structures and elements) according to curricular objectives, such as melodic contour, dynamics, melodic motives, ostinato, phrases, sections, etc.
   2.1. Present an interactive/animated listening map of a *short* musical excerpt.
      2.1.1. Students, working in dyads, explore the animation's resources and complete short questions on their handout. They are also provided with a printed version of the map.
   2.2. Alternatively, play reductions of musical excerpts using a notation software, and/or provide different representations of concepts using the affordances of the software (i.e., piano-roll editor view, mixer, palette).
      2.2.1. Students identify contrasting or different treatment of musical materials and complete very short questions.

3. Use the different transformations that become possible with the affordances of technology to relate cognitive and emotional aspects, i.e., understand how musical elements influence emotion induction (affect).
   3.1. Discuss which musical or structural elements most likely affected the emotions identified earlier (design principle 1), or, how the mood might change if these elements change.
   3.2. Use a notation file that has been prepared before the lesson, and have students (a) experiment with contrasting dimensions of a musical element in order to understand how a change of feeling or mood can be induced, and/or (b) apply the new device or element in a short task using a semi-completed template file so that students can become more familiar with technical, cognitive and affective aspects of a particular concept or combination of two-three concepts (i.e., soft vs loud dynamics, thin vs thicker texture, ascending vs descending melody, conjunct or disjunct melody, etc.).

4. Use a template composition file and provide a handout with restrictions and guiding questions about the treatment of musical characteristics explored in the unit.

5. Prompt students to create musical compositions with emotions in order to express or communicate feelings and mood.

6. Repeat steps 1-5 to teach new concepts, gradually engaging students in more musically and emotionally coherent and technically informed compositions.

Future Directions and Concluding Remarks

In the present study, the authors propose a methodology and a set of instructional design principles addressing both the affective and cognitive domains of learning for guiding technology integration in music teaching and learning. The study attempts to contribute to the further development of TPCK by bridging domain-specific aspects of music education (and more broadly the creative arts), such as, affect, with the affordances of technology in the design process. Furthermore, the contribution of this research has also practical significance as it provides teachers with guidance on learning design. The results of this study can be used as baseline data for future studies aiming at developing theory and methodologies in instructional design and the creative arts. Undoubtedly, including affect in the design process is a complex and mostly unexplored area, and, thus, further investigations toward this direction of research are fully warranted.

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ADAPTATION OF A RESEARCH TOOL IN GREEK LANGUAGE WHICH MEASURES TEACHERS' PERSPECTIVES ABOUT INTEGRATING ROBOTICS IN PRIMARY EDUCATION TO ENHANCE STEM TEACHING AND LEARNING: EVALUATION OF VALIDITY AND RELIABILITY OF THE TOOL

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Abstract

The continuous technological explosion, forces the education policy makers reconsider curriculum, teaching methods and means in order to provide young learners a high-tech knowledge and skills. Considering that such skills can be developed through the fields of Science, Technology, Engineering and Mathematics (STEM), it's obvious that a high-tech teaching method must be adopted to enhance STEM learning. Robotics seems to be a very promising method. This work is about the adaptation of a research tool in the Greek language in order to measure teachers' perspective and attitude regarding the integration of robotics in primary education to enhance STEM teaching. Evaluation of the validity and reliability of all questions is conducted in order to finalize the questions that need to be kept or discarded from the questionnaire.

Keywords: STEM education, educational robotics, validity of a questionnaire

Introduction

Providing a high quality education to prepare children in a way that they could seamlessly respond to the needs of the contemporary life is an issue that has always been a priority for the educational systems all of the world. Obviously the rapid evolution of technology demands a change on both teaching methods and means, so that education can synchronize with society and can 'catch up' the continuous technological development. Educational robotics seems to be a very innovative teaching method and tool to make teaching a real challenge and help students meet the high-tech learning expectations (Goh H. & Mohamad B. A., 2014· Adolphson, 2002). Robotics has been used as a teaching method and tool in high schools the last few years with great success. Both teachers and students declare satisfaction whilst higher interest, commitment and efficient learning have been observed through researches about integrating robotics in schools (Altin, H. & Pedaste, M., 2013· Barker, B.S., Nugent, G., & Grandgenett, N., 2008· Mataric, M.J., Koenig, N. & Feil-Seifer, D., 2007). There is a strong opinion that the learning outcomes would be much better if kids could get earlier into courses of robotics and STEM education and particularly if this starts from their primary schooling (Goh H. & Mohamad B. A., 2014). Of course such an attempt is not an easy issue. It requires a series of actions that will prepare the ground properly for effective STEM teaching through robotics. Primary school teachers' attitude and perspectives is one of important variables to be examined and definitely has to be taken into consideration. Since no other research has been found in the Cypriot context regarding teachers' attitude and perspectives regarding the integration of robotics in Cypriot primary education to enhance STEM learning, this work is believed that will highlight with important information regarding the readiness and the attitude of teachers to accept and adopt this innovative teaching method.

The main purpose of this work is to adapt a research tool in Greek language, so that the perceptions of primary school teachers regarding the integration of robotics in primary schools of Cyprus to be measured. Because of the absence of such a tool in the relevant literature, the integration of new technologies was considered very close to educational robotics and a research tool measuring teachers' perceptions about integrating Information Technologies for Communication (ICT) into primary education was chosen instead. The statements of that tool were formulated to fit the question of the integration of robotics into education, whereas those statements that did not fit with educational robotics were replaced by others. The questionnaire was proceeded to 150 teachers working in public primary schools in Cyprus. All collected data were analyzed through the statistical package SSPS 2.0. Suggestions for improving the questionnaire after evaluating the results of the reliability and validity tests are also provided in this paper.

Literature Review

The idea of integrating robotics into education era is based on the pedagogical principle of 'learning by doing' suggested by the philosopher and educator John Dewey as well as the constructivist theory firstly introduced by Jean Piaget, and later developed by Papert Seymour (1971). According to this theory the best way of teaching is through real objects. This method helps to engage actively students in the learning process (Stager, G.S., 2001). The more time kids have on task the better the learning outcomes suggests the research for school effectiveness (Creemers, B. & Reezigt, G. (1997). Understanding that kids learn better when they are actively involved in the learning procedure and much more when this procedure involves hands-on activities educational robotics seems to be an innovative teaching method that gives students the opportunity for a deep thinking about technology, especially when a robotic kit used in the class allows both the programming and constructing (Eguchi, 2014). Today kids are very interested in technology and spend a lot of their day time on using different kind of technology apparatuses. The fact that their life is surrounded by technology even before they are born has to be seriously taken into consideration for the development of school curriculum (Eguchi, 2014).

STEM Education

STEM teachings refer to the interdisciplinary approach of teaching the cognitive subjects of Science, Technology, Engineering, and Mathematics (Chew, Noraini Idris and Leong, 2014· Francis Poscente and Davis, 2013). According to the literature, robotics can be effective for teaching STEM courses. (Alimisis, D., 2013) as it allows practical application of concepts of engineering and technology and contributes to the clarification of abstract concepts of physics and mathematics (Nugent et al., 2010).

Educational Robotics

Robotics as a concept is directly related to the programming of a machine in order to follow specific instructions. The pedagogical approach and exploitation of robotics technology in education provides opportunities for practical applications and interdisciplinary teaching of lessons coming from the field of STEM courses. The positive contribution of educational robotics in teaching and learning STEM courses has being extensively referred in literature (Altin, H. & Pedaste, M., 2013· Barker, B.S., Nugent, G., & Grandgenett, N., 2008· Mataric, M.J., Koenig, N. & Feil-Seifer, D., 2007). This is explained by the fact that educational robotics allows the practical application of concepts coming out of Engineering and Technology and assists in understanding abstract concepts from the subjects of Mathematics and Physics (ChanMin K., Dongho, K., Jiangmei, Y., Roger, B.H., Prashant, D. Chi, N. Th., 2015· Nugent et al., 2010). Besides, other experimental researches conducted to measure students' performance in mathematics when using robotics in both primary and high school classes have shown improvement in the learning outcome and particularly for intermediate level students (Lindh, J. & Holgersson, T., 2007). Similarly, there were positive learning outcomes recorded when investigating the performance of primary and secondary school students in Physics (Karahoca, D., Karahoca, A., & Uzunboylub, H., 2011).

In the curriculum of Design and Technology course in Cyprus control systems and technology are consisted one of the main chapters of the syllabus for this course that students are being taught from the age of six up to eighteen in a spiral learning approach. Different kind of simple robotic systems like Egg box, Probot and Engino Robotic Platform are introduced to kids in primary schools in order to give young learners the experience of building and programming of a robot. Through these lessons, students are required to learn and assess the various technological products or constructions, as well as the modern developments in the areas of robotics, entrepreneurship, nanotechnology and biotechnology in a way that they learn to be creative, innovators and able to transform their ideas through collaboration, into products and procedures. (Mistry of Education of Cyprus, 2012). Additionally, educational robotics becomes more and more popular especially in the afternoon lessons that are provided by private institutes mostly to young children who belong in the age group of 9-15 years old. Furthermore, in the island of Cyprus an internationally recognized Cypriot company which designs and manufactures its own patented construction system under the brand name Engino, provides an innovative robotic kit also suitable for the ages 9-15 years old, which is accompanied by a set thirty-two fully designed lesson plans to enhance STEM teaching through robotics.

Methodology

Because of lack on local and international surveys examining teachers' perspectives about integrating robotics in primary education to enhance STEM teaching and learning, the research on integrating new technologies was considered very close to educational robotics and a questionnaire on that topic was adapted and translated into the Greek language for the purposes of this work. A quantitative methodology was used to collect data for the validation of the tool. Some demographic information about the participants were asked in the first page of the questionnaire (i.e. gender, age, years of working experience, lessons that usually teach and studies). The rest of the questionnaire was divided into three sections asking teachers' opinion about a) the integration of robotics in primary education for STEM teaching, b) difficulties to integrate robotics in primary education and c) the benefits to students' learning when using robotics in class. Teachers had to answer twenty-nine questions in total based on a five point Likert scale, where 1 means totally disagree and 5 totally agree. The face validity of the questionnaire was ensured by the opinion of an expert in the field. A pilot research was conducted with 5 primary school teachers in order to refine the questions and estimate the average time required to complete the questionnaire. The time needed in any case did not exceed the 10 minutes. The sample of the research was consisted of 150 primary school teachers, working in public primary schools in Cyprus. An introduction letter was attached to the questionnaire where a brief explanation of the purpose of the research, a short definition of educational robotics and an assurance of protecting the anonymity was given to the respondents.

Statistical techniques used to test validity and reliability of the questionnaire. Validity and reliability tests of the research tool were conducted through the analysis of the survey data. The statistical package SPSS 20 was used for this purpose. In order to verify the validity of the tool, a check on the regularity of the values of the variables was performed first. As almost all the variables showed a normal distribution, then the correlation of the variables was checked with Pearson's method. The data from all variables that had shown a statistically very significant correlation and their Skewness asymmetry was within the allowable limits ($-1 < \text{Skewness} < 1$) were then inserted into a Factor Analysis after the Preliminary tests KMO and Bartlett's test of Sphericity. A rectangular rotation test of the variables loaded on each factor was performed to examine the charges of each variable to the factors created. In addition, the Principal Component Analysis was used to investigate the variance among the variables charged to each factor. The reliability of the tool was checked using the Cronbach's alpha method for each set of variables found after the factorial analysis to load into a factor. All the statistics finding relating to the validity and reliability test of this questionnaire are presented and analyzed in the "Results" section.

Results

The descriptive analysis of the demographic characteristics of the data had shown that 21 were men, representing the 21% of the respondents and 129 were women which represents the 86% of the sample. The proportions of male and female teacher education respond to the proportion that exists in all primary school teachers in Cyprus. According to data, 44 teachers (29.3%) are in the age range 25-35 years old, 89 teachers (59.3%) in the range of 36-45 years and 17 teachers (11.3%) in the age range of 46-55 years. Both the age group "under 25" and the "55+" does not appear at all in the sample. Regarding the working experience of the teachers in the sample, only one teacher (0.7%) has experience less than one year, five teachers (3.3%) have 1-4 years of experience, twenty-eight teachers (18.7%) have experience of 5-10 years, seventy-one teachers (47.3%) have experience of 10-20 years and forty-five teachers (30%) have experienced more than 20 years. Fifty-four teachers (36%) have a Bachelor degree in Education, 87 teachers (58%) have Masters and 9 teachers (6.0%) have PhD. Very high seems to be the percentage of teachers who teach at least one course of STEM (87%) subjects, a fact which confirms the need for evaluation of their attitudes and perceptions when it comes to introduce an innovation in teaching courses like the integration of educational robotics.

The findings of the descriptive analysis on the variables of the first section of the questionnaire, have shown that most of the teachers believe that using robotics helps students to concentrate more in a STEM lessons (mean=3.65). It is also strongly believed by teachers (mean=3.95) that students have a better understanding when working with robotics because they work in a more practical way. Moreover, teachers believe (mean=3.97) that students develop a stronger memory of what they learn when educational robotics is integrated in the lesson, because of the hands-on activities included. They also have the strong belief (mean=3.91) that educational robotics facilitates the differentiation of teaching during a lesson and that encourages the interdisciplinary approach of teaching (mean=3.74). A statistically significant correlation among these five variables was derived after a conduction of Pearson's correlation coefficient check. The regularity of the values, the satisfactory correlation of the variables ($r>0.400$) and the fact that the Skewness value of each one of these variables was in the acceptable range of -1 up to 1, allowed the factor analysis of the variables, through which one main factor was extracted. These variables were found to have a statistically significant correlation with the variables of the third section. A descriptive analysis was also conducted on the data related to the fifteen statements measuring the teachers' opinion about the difficulties in integrating educational robotics in primary education. Moreover, all variables of the second section had showed a normal distribution and skewness in the accepted range of values ($-1<\text{skewness}<1$). Missing values were taken into consideration and they were not included in the analysis. Though the value of skewness of four questions was out of the limits all questions were considered important and they were submitted for a factorial analysis. From the correlation test that was conducted on the fifteen variables of the second section, it was found a statistically significant correlation index ($r>0.400$). The gender and study variables do not appear to have any correlation with other variables. The examination of the correlation coefficient among the variables is considered to be necessary for the assessment of the validity of the variables. All variables that had a significant correlation coefficient index were considered to have high validity and they were submitted for factorial analysis. Table 1 shows the factors extracted after the factor analysis of the fifteen variables of the second section of the questionnaire.

Table 1

Table of Factorial Structure for Difficulties of Embedding Robotics in Didactic Practice

	Component				
	1	2	3	4	5
QB3 / Teachers, parents and students are not sufficiently informed about the educational value of robotics	0.868			0.129	
QB1 / STEM teaching with robotics is not included in the Cyprus Curricula.	0.848				
QB4 / The use of robotics in teaching is not the goal of my own school or educational system in Cyprus	0.831		0.137	-0.109	
QB2 / The stakeholders involved in educational policy are not aware of educational robotics.	0.781			0.167	0.164
QB11 / Not enough PCs connected to the Internet to access free programming software		0.893			0.149
QB10 / There is not a sufficient number of PCs in each school to support programming programming	0.122	0.86			
QB12 / There are technical difficulties and problems with school computers.		0.816		0.145	
QB13 / There is a lack of teaching material (robotics set, course plans, software) for teaching STEM with robotics.	0.195	0.443	0.199	0.428	-0.12
QB5 / The school timetable is very strict and robotics will add extra school activities	0.267		0.761	-0.125	
QB6 / For teaching through robotics, the syllabus needs to be reduced.			0.735	0.386	0.138
QB8 /Teaching of basic computer skills is not included in the Cypriot curricula which is required for learning programming.	0.125	0.34	0.589	0.148	-0.19
QB9 / The price of many robotics sets available on the market is too high.	0.185	0.133	0.396	0.37	0.37
QB14 / Teachers need training to use robotics to teach STEM.	0.138			0.86	
QB7 / Teachers will need the support of specialists to incorporate robotics into STEM teaching.		0.162	0.375	0.659	
QB15 / The organization of the school space as it is today in the schools of Cyprus is suitable for teaching Robotics with robotics					0.915

The descriptive analysis of the questions of the third section of the questionnaire had shown that the teachers strongly agree to the statement that educational robotics allow the teaching of problem solving skills in STEM education through the modeling method (mean=4.08). Teachers also agree that through educational robotics students learn to write simple programs by using special software, and that coding contributes to the development of children's critical, analytical and synthetic thinking (mean=4.10). They also seem to strongly believe that students understand better how digital devices work when they learn to program their own robots (mean=4.29) and that the development of students' logical thinking through error detection and correction processes is achieved (4.19). Additionally, they very strongly agree that students have more motivation to learn as they remain committed waiting to see the outcome of their work (mean=4.29) and that through educational robotics there is a targeted use of technology to create, organize, store, manage and retrieve digital material (mean=4.10). They also have the very strong belief that students recognize the value of robotics and programming beyond school (mean=4.24). In final, teachers agree that the educational robotics will allow the school curriculum to get synchronized with the new trends and needs of the labor market (mean=3.83). As all nine variables of the third section had shown normal distribution and they appear to have a statistically significant correlation, they were used for factor analysis.

A reliability test on the variables of the six factors derived out of the factor analysis of the three sections of the questionnaire was conducted so that their internal consistency to be determined. The value of Cronbach's Alpha for each group of variables that were loading into these factors was estimated by submitting data into the SPSS 2.0 statistical package. Cronbach's Alpha value for a>0.7 was considered as a satisfactory reliability index. According to the Table 2 Cronbach's Alpha value for the first factor (factor a includes variables QA1 - QA5) was .821 which proves a high level of consistency amongst these variables. Similarly, the results from the reliability test on the variables of the second factor (variables QB1, QB2, QB3, QB4) have given a satisfactory level of consistency (a=0.875) as well as the Cronbach's Alpha and the third factor (variable QB10, QB11, QB12, QB13) where a=0.817. The factor which was consisted of the four variables QB5, QB6, QB8, QB9 had a slightly low level of consistency (a=0.642), whilst the consistency of the fifth factor (variables QB7, QB14) seems to be even lower. Very high level of consistency seems to be amongst the nine variables of the third section of the questionnaire (a=0.911)

Table 2

Reliability Test

Cronbach's Alpha	N of Items	VARIABLES
0.821	5	QA1 - QA5
0.875	4	QB1, QB2, QB3, QB4
0.817	4	QB10,QB11,QB12,QB13
0.642	4	QB5, QB6, QB8, QB9
0.564	2	QB7,QB14
0.911	9	QG1 - QG9

Conclusions

Following the validity and reliability tests carried out in the research tool that is examined in this study, it appeared that almost all variables had a high validity and reliability index. This reasonably leads to the conclusion that all the variables are measuring the perceptions and attitudes of the teachers about the integration of robotics in elementary schools for teaching STEM. Only the case of the two questions in section two (QB7 and QB14) need to be reviewed if they will remain in the questionnaire. The writer considers both these two statements which are referring to teachers' training and support by specialist as important issues that will cause difficulties during the procedure of the integration of robotics to enhance STEM teaching if not anticipated with professionalism by education policy makers.

Validity tests conducted to the questionnaire through factor analysis on the variables of the three different sections, had shown one main factor coming out of the first section, five factors out of the second section and one main factor out of the third section. The validity of the variables of this questions was ensured by satisfying all tests, (Normality, correlations, KMO B Bartlett's Test of Sphericity). A high reliability index was observed when Cronbach's Alpha method was used. Specifically, for the variables concerning the first question of the questionnaire 'What is your opinion regarding the integration of robotics in elementary school for STEM teaching', the factorial analysis carried out showed only one strong statistical factor.

From the factor analysis of the variables of the second section of the questionnaire five factors were extracted. After a careful study of the factorial structure it seems that the first factor refers to the awareness of teachers about the existence of educational robotics in the curricula. Teachers seem to have no awareness about the introduction of robotics in Cypriot context. Apparently, this is happening because only very recently educational robotics was included in the curricula and not sufficient time was given to teachers to get familiar to this new teaching tool or get introduced to some teaching ideas (lesson plans). Another thought regarding this finding is that usually only one teacher from each school is teaching the Design and Technology subject so they were very few teachers in the sample of this research that knew about robotics in the educational system of Cyprus. The four variables loading to the second factor are related to the proper materials and technical support that are needed for the seamless integration of robotics in education. Sufficient numbers of computers to support the teaching of programming, a high speed connection to internet for free access to programming software, robotic kits, teaching materials and sufficient technical support are relatively high costing issues. It is important so bigger budgets to be allocated in education by the Cypriot government if we really want to have a contemporary educational system. The third factor involves all changes needed to be done in the structure of the existing curriculum in order to integrate robotics into primary education like a reduction of the curriculum, and introduction of computer science lesson which is prerequisite for teaching programming in robotics. The question QB9 which refers to the price of many robotic kits was not expected to load on this factor. It looks as a problematic statement and must be discarded from the questionnaire. As very few questions are loading to the fourth and fifth factors of section two, it seems that the questionnaire needs to be enriched with few more statements that would refer to teachers' professional development and the form that classes must have to enhance teaching through robotics. In last, the findings of the analysis of all variables in the third section have high validity and reliability and can remain as they are in the questionnaire. The findings regarding the correlations had shown that the variables this section were highly correlated to the variables of the first section which was also referring to the educational benefits on student's learning when using robotics in class. This finding leads to the idea of merging these two sections of the questionnaire under one statement and naming it 'the educational benefits on student's learning when using robotics in class'.

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EVALUATING THE USE OF ICT IN EDUCATION: FACTORS AFFECTING TEACHING WITH TECHNOLOGY

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Abstract

The purpose of this research was the implementation, measurement and control of the reliability and validity of a tool that measures the factors affecting the integration of information and communication technologies (ICT) from primary teachers in educational practice. Three-factor analysis performed for the variables of the three parts of the questionnaire to create factors whose reliability and validity was tested with certain statistical techniques. The factor analysis of the questionnaire variables produced ten factors: P1: The skills of teachers in the education of students to become competent users of ICT, P2: School climate and support, P3: Fear - reticence - technophobia to integrate ICT, P4: Positive perceptions of teachers about the value of ICT in teaching and learning, P5: the computer and technological means as a factor of change in teaching and learning, P6: Knowledge in the use of ICT to design teaching and management of the classroom, P7: Knowledge of common software, P8: Knowledge of advanced software, P9: Use of common software, P10: Use of advanced software. The coefficient Cronbach's Alpha was greater than 0.803. The content validity was ensured in the pre-audit stage. To examine the convergent and discriminant validity of the questionnaire multiple profiling was used. The results of correlation of the data with the cumulative scales to which they belong were satisfactory (greater than 0.40). The survey results are considered satisfactory with respect to the reliability and validity of the questionnaire.

Keywords: integration of ICT, attitudes of teachers, validity of a questionnaire

Introduction

The attempt for integration of the information and Communication Technologies (ICT) in the learning process is highly significant. The last decade a dramatic increase in the use of new technologies has been noted (Ioannou & Charalambous, 2004). The application of ICT in primary education can bring many innovations in the educational system (Tzimogiannis & Komis, 2004). Despite the multiple benefits that arise from the use of ICT, the incorporation of technology remains a complex issue and it is challenging for many teachers (Noor-Ul-Amin, 2013, Pelgrum, 2001; Papanastasiou & Aggeli, 2008). The role of the educator is crucial and it is highly important to examine the factors which influence his/her decisions regarding the use of ICT during the teaching and learning procedure (Bullock, 2004). Overall, the integration of ICT can be influenced either by external factors or teacher's personal characteristics. Personal characteristics refer to his/her knowledge, skills, perceptions, attitudes and beliefs (Wood et al., 2005, Papanastasiou & Aggeli, 2008; Paraskeva, et al., 2008), whereas external factors mainly are related to the degree of support provided by the working environment, such as director, coordinators, colleagues and so on (Tearle, 2003).

Literature Review

Knowledge - Attitudes and Perceptions of Teachers to Integrate ICT

An effective integration depends not only on teacher's knowledge regarding the various technological means (Papanastasiou & Aggeli, 2008), but also his/her attitudes towards the use of ICT play a major role in the whole process (Huang & Liaw, 2005; Sanchez et al. 2012).

Attitudes. Attitude is a determinant factor which influences the integration of the ICT. The educators, which have adopted a positive attitude toward the new technologies, perceive different software tools as an auxiliary tool, which facilitates the learning process (Veen, 1993; Papanastasiou & Aggeli, 2008). Teachers shaped attitude**s**, is an indicator which can predict their willingness to use those tools during the teaching practice (Bakr, 2011). Although the majority of teachers have developed positive attitudes (Tsitouridou & Vrizas 2003), they are sceptical to use ICT (Tsitouridou & Vrizas 2003, Tzimogiannis & Komis, 2004).

Stress - technophobia in ICT. Many educators face difficulties in implementing ICT during the educational practice and feel uncertainty since they are not able to anticipate any unforeseen situations (Tzimogiannis & Komis, 2004). The educator feels technophobia and anxiety in every innovation and therefore perceives these innovations as a threatening factor which comes to disrupt the traditional structures of teaching (Panagiotopoulos et al. 2011; Jimoyiannis, 2008).

Confidence in the use of ICT. Confidence is an important factor that determines the involvement of teachers and students in ICT (Proctor, 2006). Examining the parameters that affect self confidence, it has been shown that the degree of focus of the educator on his/her goals and the expectations that the individual has from himself/herself are the main factors for its formation (Peralta & Costa, 2007). Additionally, the experience is another factor which can increase confidence (Wilson et al., 2015).

Perceptions. Many studies confirm that teachers' perceptions are important parameters, which often decisively influence the technology integration process in the classroom (Papanastasiou & Aggeli, 2008). However, in practice it can be clearly seen that teachers do not integrate ICT into their teaching (Rosen & Weil, 1995).

Abilities / Skills in the use of ICT

Teachers do not have the skills and experience of integration (Ottenbreit-Leftwich et al, 2010). For that reason, education and training of teachers in ICT is what allows them to have the ability to impart the skills and knowledge to students (Peralta and Costa, 2007).

Capacities regarding the teaching design. Self-efficacy of teachers is an equally important factor for the integration of ICT in the classrooms and can predict their behaviour and their teaching options (Bandura, 2006; Schoretsanitou & Vekyri, 2010). Self-efficacy of the educator is directly linked to the perception of the skills and confidence to perform specific activities (Schoretsanitou & Vekyri, 2010; Ropp, 1999).

Capacity in supporting students to use technology. A lesson, which is based on the use of ICT and in the educator's capacity to support students, contributes significantly to the acquisition of the basic skills (Anastadiades et al., 2010). A technological tool, such as interactive whiteboard, helps to the development of cognitive skills through the creation of appropriate knowledge for students. It also contributes to the cultivation of written and spoken language skills and the development of skills, such as problem solving, communication, collaboration, etc. The ability of the educator to design and support students through active participation activities, experimentation and interaction using the interactive whiteboard and other technological tools, greatly contributes to increasing attention and interest of students (Anastadiades et al., 2010).

School Climate and Support

Knowledge – training. The majority of teachers have inadequate training in ICT implementation in the educational process (Tzimogiannis & Komis, 2004) and as a result this constitutes an obstacle in the use of technological tools (Sabzian & Gilakjani, 2013). For this reason it is important to provide specialized technical training to teachers aiming at learning ICT integration practices in order to encourage them to use them in a professional manner (Vanderlinde & Van Braak, 2010)

Logistics. The poor technical support at school contributes to reduced access in various educational software (Mitkas et al., 2014). Proper support of technological equipment and direct access to the various technological means encourages the teacher to incorporate more easily ICT, surpassing any personal insecurity (Solomonidou, 2004). Unsurprisingly, teachers need organizational support, which includes not only the technical part, but mainly focuses on pedagogical support (Divaharan & Koh, 2010; Tondeur et al, 2008). Moreover, as Cuban (2001) claims in his book, no matter what the technology infrastructure is, it is still inadequate according to teachers.

Methodology

A valid and reliable measurement instrument was created after taking into account other relevant measurement tools (Sánchez, Mena, & Pinto, 2012; Hatlevik, 2016; Tondeur, Aesaert, Pynoo, Van Braak, Fraeyman, & Erstadt, 2016; Papanastasiou & Angeli, 2008). The various questionnaires and variables identified measured the factors that affect teachers in integrating technology in teaching and learning. Although many different tools in educational technology were found that can be used to collect data on the various aspects of the integration of ICT, not a single tool was detected that could be used to collect information on all aspects of this region. Therefore, the purpose of this project was the development of a questionnaire to measure all the factors that affect the integration of ICT in teaching process.

The questionnaire, which consisted of closed ended questions expressed in 5-point Likert-type scale, was distributed to schools and completed the first half of December 2016. The questionnaire consists of three modules of variables which are divided into seven parts. Part A collected the necessary demographic data: gender, age, teaching experience, level of teachers' education and information about computer knowledge, source of computer knowledge, use of computer in the classroom, possession of personal computer and teacher participation in training seminars on integrating ICT in teaching and learning. Part B collected information about the knowledge of teachers in different kind of computer software (15 items). Part C provided information regarding the frequency of use of different kinds of software by the teachers for personal purposes (14 items). Part D to G collected information on the following issues: attitudes of teachers about computer and ICT integration in education (40 items), confidence of teachers using ICT in learning process (13 items), school politics and encouragement that teachers receive from various stakeholders in relation to the integration of ICT (13 items) and teacher competencies in managing and integrating of ICT in learning (18 items).

The final questionnaire was administered to 250 teachers of Primary Education. The survey population consisted of all primary teachers, who were teaching at the time the questioner was distributed and three of the five districts of Cyprus, Nicosia, Limassol and Paphos. Questionnaires were distributed to all teaching staff (250 teachers) in 15 primary schools, which were selected by stratified random sampling. The sample was representative of different types of schools (large/small, urban/rural) and teachers who taught in different grades and subjects. The 154 questionnaires were returned completed (rate of successful completion 61.6%) and served as the research sample.

We ensured face validity and content validity of the questionnaire through pilot distribution.

The analysis of quantitative data was done with the SPSS 21. The following techniques were used to assess the validity and reliability of the questionnaire:
(a) Regularity control, Skewness and Kurtosis index,
(b) Factorability of the data. Correlation analysis of the variables was contacted using Pearson method for export of the correlation ratio and the degree of importance (p) of this indicator.
To investigate the structural validity of each theme, exploratory factor analysis was use. Factor analysis and test of results was completed through the examination of appropriate indicators examined:
1) Principal Component Analysis with Orthogonal Rotation of the shafts with the Varimax method was used for the extraction of factors.
2) K.M.O. (Kaiser- Mayer- Olkin) test was used for measure sampling adequacy for each variable.

3) Bartlett's Test of Sphericity was utilized for further examination of the suitability of data for factor analysis.
(c) Cronbach's Alpha was used to measure the internal consistency of any factorial structure

Results

Our inferential statistical analysis gives the following results in order to ensure the validity and reliability of the questionnaire.

Skewness and Kurtosis index measurement is less than 2.5 for every variable of part B and C. This indicates that statements/variables have approximate normal distribution. Questionnaire normality test for Part D to G verified that 74 out of 84 variables have Skewness and Kurtosis index less than 1 ($-1<Skew<1$). The remaining variables had Skewness and Kurtosis index less than 2. Due to the supple size ($100<N<300$) we can accept values less than 2.58 ($Skew<2.58$) (Tabachnick & Fidell, 1996; Munro, 2001; Field, 2009). Correlation analysis for Parts B, C, D-G presented that most of the variables have statistically significant linear relationship between them. Most of them have correlation coefficient higher than 0.5 ($r>0.5$) and correlation significance (p value) less than 0.05.

In order to test the suitability of the sample, K.M.O. (Kaiser-Mayer-Olkin) was used. For the complete test of data suitability for factor analysis, Bartlett's Test of Sphericity was contacted. K.M.O index measurement and the Bartlett's Test of Sphericity for Part D to G (Factor Analysis [KMO = .903, Bartlett's (3486) = 12264.52, $p <.05$]), for Part B (Factor Analysis [KMO = .904, Bartlett's (105) = 1625.95, $p <.05$]) and Part C (Factor Analysis [KMO = .868, Bartlett's (91) = 1066.23, $p <.05$]), have showed that the sample was suitable and sufficient and that there is the potentiality to insert the data in an exploratory factor analysis.

In order to determine the construct validity of the constructs measured in this questionnaire, an exploratory factor analysis was performed. Since the questionnaire was divided into distinct sections that were not comparable to each other and which also had different measurement scales, the factor analysis was performed separately for each section of the questionnaire. The varimax rotation was used in these analyses for the clearer interpretation of the factors.

The first factor analysis that was performed was based on 15 items that asked the teachers to do a self-report on their knowledge regarding various computer software programs. The analysis produced two factors that explained 64.78% of the variance of these 15 items and have eigenvalues higher than 1.
The first factor, “knowledge of specialized software applications” (P7), that explained 39.83% of the variance is composed of ten items that measure teachers’ skills in using specialized software applications (e.g., FrontPage, EasyLogo, Kodu, StarLogoTNG, Scratch, Alice, Blockly, TurtleArt, EasyLogo, Model-It, Stella, Stagecast Creator, Interactive physics, Web 2.0 tools), which teachers infrequently use because either they do not know how

to use them or they do not have a need for them. The loadings of the variables of this factor were high and ranged from 0.533 to 0.877.

The second factor, "knowledge of common software applications" (P8), that explained 24.95% of the variance, included five items that measured teachers' self-reported ability to use common-use software applications. These common-use applications are those that one is most likely to learn how to use in a technology training course or a basic computing course. Such computer programs include Word, Internet, Email, PowerPoint and Kidspiration. The variables on the second factor have given loads of 0.538 to 0.879.

The second factor analysis that was performed examined 13 items that measured the frequency of using computer software for personal and educational purposes, as it was reported by the teachers themselves. This analysis also produced two factors, which explained 53.70% of this section's variance and have eigenvalues greater than 1.

The first factor that was composed of five items accounted for 32.80% of the total variance and named "use of common applications" (P9). The P9 included: email, internet, Word, play games, PowerPoint. All the loads of the first factor were higher than 0.504. The second factor was composed of nine items and accounted for 20.91% of the variance of this section of the questionnaire. This factor, which labeled "use of specialized applications" (P10) included the use of more advance and complicate software such as FrontPage, Kidspiration, Model-It, EasyLogo, Kodu, StarLogoTNG, Scratch, Alice, Blockly, TurtleArt, EasyLogo, Photoshop. The second factor loadings were greater than 0.612.

As shown in table 1, the remaining items of the questionnaire produced six factors that explained 61.2% of the variance while eigenvalues cut-off point for the creation of the factor was set to 2.1.
The first factor as we can see in table 1 was composed of twenty items (table 1), which measure whether teachers feel confident in those abilities and skills that enable them to teach their students in such a way as to become digitally literate. The first factor was named "ICT competencies of teachers in order to train students to become competent users of ICT" (P1) and explained 36.1% of the total variance. The P1 presents loadings higher than 0.711.

Table 1

Rotated Component Matrix of Computer Attitudes and Integration Factors

	Items	P1	P2	P3	P4	P5	P6
P1	I am able to support pupils to present information by means of ICT	.862					
	I am able to offer pupils opportunities to express ideas in a creative way by means of ICT	.856					
	I am able to support pupils in processing and managing information by means of ICT	.849					
	I am able to select ICT applications in view of a specific educational setting	.840					
	I am able to support pupils in searching information by means of ICT	.839					
	I am able to provide pupils with activities to exercise knowledge/skills by means of ICT	.829					
	I am able to provide pupils with activities on subject matters to learn with ICT	.826					
	I am able to support pupils to communicate with ICT in a safe, responsible and effective way	.819					
	I am able to support pupils to work together with ICT	.814					
	I am able to stimulate pupils to use ICT in a critical manner	.813					
	I am able to motivate pupils to use ICT in a positive way	.812					
	I feel comfortable with the idea of the computer as a tool in teaching and learning	.780					
	I am able to educate pupils to use ICT in a conscious way (respecting ergonomics, intellectual property)	.777					
	I can teach my students to select appropriate software to use in their projects	.771					
	I am able to use ICT to differentiate learning and instruction	.762					
	I am able to design and redesign ICT applications in view of a specific educational setting	.762					
	I can design technology-enhanced learning activities for my students	.749					
	I am able to select ICT applications in view of a specific educational setting	.723					
	I can select appropriate software to use in my teaching	.720					
	In spite of the existing limitations, I think I have a positive attitude towards the integration of computing resources in the teaching-learning process	.711					
P2	I often exchange ideas about technology integration with other teachers		.603				
	The ICT consultant encourages me to integrate computers in teaching and learning		.607				
	Teachers in my school are well informed about the value of computers in teaching and learning		.652				
	The ICT coordinator encourages me to integrate computers in teaching and learning		.678				
	Other teachers encourage me to integrate computers in teaching and learning		.721				
	The principal encourages me to integrate computers in teaching and learning		.728				
	The inspector encourages me to integrate computers in teaching and learning		.732				

	In faculty meetings, we frequently discuss the subject of integrating computers in the school curriculum	.736				
P3	Working with ICT in the classroom is something that overwhelms me		.750			
	The use of computer in teaching and learning scares me		.737			
	The idea of using a computer and ICT in teaching and learning makes me skeptical		.681			
	The use of computers in teaching and learning stresses me out		.660			
	The computer is not conducive to good teaching because it creates technical problems		.634			
	The computer is not conducive to student learning because it is not easy to use		.626			
	Students are usually better prepared than me in the use of computing resources		.599			
	As a teacher, the use of new technologies is still difficult for me		.587			
P4	New technologies help me to improve the academic performance of my students			.348		
	The use of ICT increases my satisfaction as a teacher			.445		
	Students are more motivated when ICT in the classroom			.488		
	New technologies help me to obtain more resources to evaluate students' performance			.362		
	Unmotivated students with traditional methodology improve their learning by using computers in the classroom			.503		
	Students reading abilities are improved by the use of computing resources learn more easily when using ICT			.495		
	The use of ICT increases my motivation as a teacher			.591		
P5	The computer will change the way I teach				.316	
	The computer will change the way students learn in my classes				.364	
	The integration of computing resources in the classroom encourages the improvement of the teaching learning process				.562	
	The computer helps students understand concepts in more effective ways				.323	
	The computer helps students learn because it allows them to express their thinking in better and different ways				.327	
	The computer is a valuable tool for teachers				.337	
	Students learn more easily when using ICT				.541	
	Computers, Interactive Digital Whiteboards and projectors are really necessary in my classroom				.353	
	The use of informational technology at school is unstoppable				.664	
P6	I can use collaborative writing tools on the Internet					.393
	I am able to track the learning progress of pupils in digital way					.305
	I can edit digital photos or graphic					.517
	I can download and install programmes					.528
	I can use a spreadsheet to draw a graph					.523
	I can teach my students how to make their own web pages					.379

All items loaded less than 0.3 are omitted.

The second factor, "school climate and encouragement from colleagues" (P2), included eight items (table 1) that explained 6.32% of the variance of this section of the questionnaire and exhibit loadings higher than 0.603. P2 is constructed from items that concern support and encouragement that teacher receives to integrate ICT in teaching practice by colleagues (head teacher, inspector, counselor, other teachers) and the technology infrastructure of the school.

The third factor, labeled “anxiety - skepticism - technophobia” (P3), measured teachers’ comfort level in using ICT at school class. This factor was composed of eight items (table 1) that explained 5.53% of the variance of this section of the questionnaire. All items that compose the P3 are negative and have loads higher than 0.587.

The fourth factor, “Positive beliefs regarding the value and utility of ICT in the classroom” (P4), was composed of eight items and explained 3.44% of the variance. The loadings on this factor range from 0.348 to 0.591.

The fifth factor, “The computer and the technological means as an agent of change” (P5), reflects the beliefs of teachers about the value of the computer and technological means that are used in the educational process. P5 was composed of nine items (table 1) and explained 3.25% of the variance. In this factor, loadings occur from 0.316 to 0.664.

The last factor (P6), “Knowledge in the use of ICT for lesson planning and management of the classroom”, was composed of seven items and explained 2.95% of the total variance. The loadings of variables for this factor are higher than 0. 379.

All items loaded less than 0.3 are omitted. Five or more items with high loadings are desirable and suggest a strong factor (Costello & Osborne, 2005). All factors consisted of six or more items.

The intercorrelations of the ten factors that were created in this questionnaire were also examined. According to the overall results of this analysis, with the exception of two pairs of factors, the rest of the factor pairs were significantly correlated with each other ($p<0.05$).

After creating each factor, we estimated its internal consistency with Cronbach’s alpha (table 2). The Cronbach’s Alpha index ranged from 0.803 to 0.972, with all factors charged higher than 0.8, values which are considered highly satisfactory.

Table 2.

Cronbach's Alpha Index for the Factors P1 to P10

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Cronbach's Alpha	0.972	0.913	0.902	0.866	0.917	0.912	0.921	0.830	0.803	0.880
Cronbach's Alpha Based on Standardized Items	0.973	0.913	0.906	0.865	0.917	0.912	0.925	0.863	0.804	0.894

Discussion

Technologies of Computer Information and Communication (ICT) have become an integrated part of our daily life and are very close to become an inseparable part of students' and teachers' lives as well. However, the integration of technology in the curriculum is a complex, difficult and challenging process (Cooper, 1998; Papanastasiou & Aggeli, 2008), during which numerous socio-technical factors, such as teachers' competencies and skills in ICT, beliefs of teachers about the value of ICT in teaching and learning, attitudes towards ICT, the use of ICT in teaching and learning, school climate, colleagues support etc. must be taken into account.

The results of this study show that the responses to the questionnaire have a reliability coefficient that is adequately high. Also, the results and the statistical techniques used to assess the validity and reliability of the questionnaire proved that the questionnaire shows sufficient reliability.

Regarding the reliability of the questionnaire, Cronbach's Alpha index was found to be high (Cronbach's Alpha = 0.961) and the Cronbach's Alpha for each of the factors is higher than 0.800. In addition, the construct validity evidence is based on a factor analysis that created ten easily interpretable factors, namely, P1: ICT competencies of teachers in order to train students to become competent users of ICT, P2: school climate and encouragement from colleagues, P3: anxiety -skepticism – technophobia to integrate ICT, P4: Positive beliefs regarding the value and utility of ICT in the classroom, P5: computer and the technological means as an agent of change in teaching and learning, P6: Knowledge about the use of ICT in lesson planning and management of the classroom, P7: knowledge of specialized software applications, P8: knowledge of common software applications, P9: use of common applications, P10: use of specialized applications.

Thereby, it becomes apparent that the integration of ICT by teachers should not be treated as one-dimensional concept and that the most important factors that lead in successful integration of ICT at schools are those of teachers' actual knowledge and use of various computer software / applications for professional and personal purposes, teachers' confidence and attitudes toward technology, support provided to them in schools and beliefs of teachers about the use of technology as an agent for change.

The reliability and validity of questionnaires is crucial in order to ensure good results by conducting a survey. When a measurement tool is used, regardless of whether it has already been weighed or created for the purposes of a survey, it must be tested for reliability and validity.

A limitation of this study lies in the fact that this was a self-report, and it is likely that some of the teachers may have responded in socially desirable ways. It would be useful and interesting to perform a test-retest reliability on the questionnaire. Cross-validation is also essential to establish the congruence between the teachers' beliefs about their ICT skills and ICT use with the opinion of an external observer. Once congruence is established, more detailed research would have to be performed on this dataset to determine how ICT can be integrated in schools more effectively.

he questionnaire under examination evidenced to exhibit adequate reliability and validity. Face and content validity were also satisfactory. The questionnaire is easy and understandable. Therefore it could be safely used as a measuring tool of ICT integration factors in the classroom. The existence of a questionnaire in the Greek language, which measures those factors that determine the integration of ICT in the school process, is essential.

Additionally, it would be very contributive for research if the questionnaire is administered also to secondary education teachers in order to collect and compare this data with data from Primary teachers.

Further research can be done in order to export results that highlight relationships or significant differences between the various factors of ICT integration and relationships or significant differences between the factors of ICT integration and independent variables such as gender, level of education and years of service.

In addition, the use of this questionnaire could provide important information to competent bodies in order to organize and upgrade the curricula, so as to incorporate to a greater extent ICT in education or build training seminars for teachers, who don't possess the skills / competences to integrate ICT in the classroom.

Overall, it is important for further research to examine the relationship between self-efficacy, use of ICT and digital competence with a longitudinal research design. Further, more research is also required on how to develop teachers' self-efficacy, their strategies to evaluate information and their digital competence according to the competence aims in the curriculum.

We hope that the findings of this research prove useful for Cyprus and other contexts where the integration of educational technology is still in embryonic form and the research in the area is limited.

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International Conference on Information Communication Technologies in Education

Proceedings

ICICTE 2017 seeks to address the many challenges and new directions presented by technological innovations in educational settings. With the keynote speaker, plenary sessions, workshops, and forums examining the integration of technology into all facets of education, the conference provides participants with a forum for intensive interdisciplinary interaction and collegial debate. Those attending ICICTE 2017 leave with an excellent overview of current thinking and practices in applications of technology to education. Thematic streams include alternative processes, procedures, techniques and tools for creating learning environments appropriate for the twenty-first century.

Conference themes include: Pedagogy in the evolving tech environment, the architecture of learning; accessibility, the evolution of the classroom; instructional design and delivery, evaluation and assessment; strategies and tools for teaching and learning; simulations and gaming; informal, non formal and formal adult education; multi-grade education; open/Distance learning; impacts on educational institutions: effects on faculty, staff, administration, and students; curriculum and program development; teacher training; building communities of teachers/educators; cooperative learning; the internationalization of institutions and of education, political economy and educational technology: Intersections, effects on training institutions and industry; ethical considerations in the use of information technology in teaching and learning; the use of technology in education to promote democratic ideals, technology in creative arts education, ethics, human rights and access to open educational resources, and the application of psychology to learning mediated by technology.

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