Panagiotes Anastasiades
Nicholas Zaranis *Editors*

Research on e-Learning and ICT in Education

Technological, Pedagogical and Instructional Perspectives

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About the Editors

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Dr. Nicholas Zaranis graduated from the Department of Electrical and Computer Engineering of the National Technical University of Athens. He took the Master of Science in Computer Studies from the University of Essex. Also, he received his Master of Science and his Ph.D. from the National and Kapodistrian University of Athens. He has worked for a series of years in the private sector as Electrical Engineer in Hewlett Packard Hellas and in public sector as teacher of Information Technology in Secondary Education. He is currently an Associate Professor in the Department of Preschool Education at the University of Crete. His research interests include ICT in Education, Educational Software and Teaching of Mathematics using ICT.

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Research on e-Learning and ICT in Education

Nowadays, it is widely accepted that information and communication technology (ICT) is used in every step of education. Educators and students face a great challenge and have to cover a distance that separates the knowledge and skills given by schools, today, from the knowledge and skills necessary for the future of the citizens of the emerging knowledge society. If we really believe that the resignation and sterile negation are the other side of the same coin, then we need to look for new, original and innovative ideas that could lay the foundation of an alternative and creative approach to addressing educational issues. Moreover, ICT under pedagogical conditions can be one of the most important tools for educators and students to develop cognitive, social and technological skills in order to be able to respond critically and creatively, to supplement the needs of the new social and economic reality that is constantly changing. Therefore, it seems to be more important for students to learn how to be able to communicate, to share, to use information and to solve complex problems, instead of using ordinary skills. The crucial case, which is still open, is that students of the twenty-first century will need to be taught different skills than those learned by the students of the twentieth century.

There is a need for an evolution in the methods that we use to approach the learning process. Such innovative application can be highly promoted through teaching and learning methods that focus on reflection and action to create problem solutions. The learning process is not solely regarded as an instructional technique, but it should be widely examined in the future as an educational approach to design research, to integrate theory and practice and to apply knowledge and skills to develop viable solutions to problems.

In the meantime, the Internet and web technologies have attracted considerable attention in recent years. These technologies allow cooperative creation of collaborative hypertext through various working modes: individual work, joint, communication and evaluation. In general, the Internet and the web applications can support a wide range of practices, such as learning, collaboration, communication, interaction, exchange and reflection. While affordances of these technologies are without doubt in education, the educators still need to figure out how to utilize them to full potential.

Moreover, in the last decade, the idea of online educational communities and distance learning have attained growing interest among academics, policy makers and educators as an alternative to both the isolated way of working and the traditional teacher development approaches. Both are expected to improve teaching and schooling practices, since teachers have the opportunity to collectively examine and study new conceptions of learning. Also, both approaches are anticipated to share educational material, create shared views and improve their instructional practices. This should be thoroughly investigated.

The integration of ICT in the educational practice of teachers is a very difficult process that requires time and continuous effort. The future is not without challenges for both educators and students. Despite various educational policies and decisions, the educators play a key role in the adoption and development of any educational innovation; for this reason, educators are considered to be the most important factor in education reforms. Therefore, the attitudes of educators towards computers have been addressed and have been described as the key to successful integration of ICT in education.

Contemporary educational approaches draw on the principles of inclusive education that promote equal learning, participation and opportunities for all students, including students with disabilities. At the same time, the rapid development of ICT has significantly affected the field of education, providing a new dimension to the learning process in both general and special education. The stimulating innovative products of ICT have enabled changes in education and as such have attracted the interest of the educational community. It is important to address the contribution of ICT use in the classroom as a learning tool and especially in the education of disabled students as it assures accessibility and active participation for all students.

New momentum has been established within the European Union by the information society and is based on the organization of information and dissemination. The individual is re-incorporated in conditions of new technology development. Lifelong learning is a necessity that supports people to become part of the new systems in various areas of life. The training is conducted by the European Union on the basis of policy adjustments and settings that stem from technological developments. At the same time, the various forms of education or training are aligned to wider sections of the population. Many questions are focused on the initial approaches associated with the need for a lifelong education policy in cooperation with the information society.

The above-mentioned fields are in extensive research interest for the potential of technology used to support learning, and thus, many issues remain open such as:

- How can ICT improve learning in preschool, primary and secondary education?
- How can ICT and new Web tools improve e-Learning in Higher Education?
- How can technology be used to support learning for specialized uses?
- What is the global direction of European education policy and ICT?

This volume aims to contribute to the literature in ICT in education and e-Learning by addressing various core issues. This volume includes 21 chapters, among 49 submitted with an acceptance rate 42.86 %, covering a wide range of topics.

The first part contains three chapters which attempt to place ICT in the more general educational context. Makrakis and Kostoulas-Makrakis present an instructional learning model applying problem-based learning enabled by ICTs. Anastasiades explores ICT and collaborative creativity in modern school towards the knowledge society. Bratitsis concludes this part through an investigation of contextualized educators' training, focusing on the case of digital storytelling.

The second part includes two chapters which focus on ICT use in preschool and primary education. Nikolopoulou and Gialamas investigate young children's engagement with computer use as a school activity. Kollias, Daropoulos, Davaris and Zaganas present a research-based learning environment's appropriation, as a context for informal professional development in ICT integration in the classroom.

The third part includes three chapters which focus on ICT use in secondary education. Vagelatos and Angelopoulos evaluate the use of laptop computers in secondary education in Greece. Panagiotakopoulos, Karatrantou and Sarris investigate teaching by producing educational videos, based on the problem-based learning methodology. Michaloudis and Hatzikraniotis address fostering students' understanding with web-based simulations in an inquiry continuum framework.

The fourth part includes three chapters which investigate how e-Learning can impact higher education. Papazoi, Papanikolaou, Gouli and Grigoriadou present how personalization may benefit the learning design process with Learning Activity Management System. Karasavvidis investigates the design, implementation and evaluation of a two-layer peer-assessment scheme in an undergraduate course Wiki. Katsigiannakis and Karagiannidis address the gamification and game mechanics based on e-Learning, a Moodle implementation and its effect on user engagement.

The fifth part includes three chapters which explore the e-Learning for educators. Tsiotakis and Jimoyiannis investigate the role of structure in online teachers' communities of learning. Vlachopoulos and Hatzigianni discuss e-Learning and self-regulation focusing on balancing between personal and social dimensions. Psillos investigates the development of a blended professional development model and its pilot implementation with science teachers.

The sixth part includes three chapters which investigate preservice and in-service teachers' views towards ICT. Zaranis, Oikonomidis and Linardakis examine the factors affecting Greek kindergarten teachers to support or oppose ICT in education. Vourletsis and Politis investigate the differences in attitudes towards ICT in education between freshmen and senior students of Department of Primary Education in Greece. Psillos and Paraskevas discuss the teachers' views of Technological Pedagogical Content Knowledge and focus on compulsory education science in-service teacher trainees.

The seventh part includes two chapters which address specialized topics for ICT in Education. Gelastopoulou and Kourbetis address the use of information and communication technologies for inclusive education in Greece. Chanioti investigates dyslexia in primary school and focuses on a new platform for identifying reading errors and improving reading skills.

Finally, the eighth part includes two chapters which address the European education policy and ICT. Kalerante and Eleftherakis discuss the parallel association between the European educational policy on lifelong education and the introduction to information society. Riviou and Sotiriou present the impact of a teachers' Continuing Professional Development Programme and professional development community in the theme of competence-based learning.

The following sections describe the parts and chapters in more detail.

Part I: ICT in Education

Makrakis and Kostoulas-Makrakis address that the well-known classic 4Cs skills (communication, collaboration, creativity and critical thinking) are transformed to 10Cs transversal skills including critical consciousness, connectivity, critical reflection, coresponsibility, cross-/intercultural understanding and constructing knowledge. Also, they support that the 10Cs transversal skills are then integrated into the six key processes of our interdisciplinary problem-based learning model and the six pillars of global learning goals for twenty-first century that can be enabled by ICT and a specially developed graphic organizer. In order to clarify this, the authors use the controversial topic of "smoking ban" as an example.

Anastasiades explores ICT and collaborative creativity in modern school towards knowledge society. He highlights the collaborative creativity with the use of ICT, as one of the most important tools teachers have in order to respond critically to the demands of our times. He concludes that prerequisite for encouraging collaborative creativity is to redefine the pedagogical dimension of ICT in order to support teachers and students in building a new participatory culture.

Bratitsis discusses a multilevel contextualization procedure, based on the examination of a training programme about digital storytelling as a teaching methodology. Several variations of this training programme were realized, and a discussion is raised, based on the experience gained through them. Overall, this chapter aims at demonstrating how easy it is to contextualize educators' professional training by operating as a guide for designing similar programmes.

Part II: ICT in Preschool and Primary Education

Nikolopoulou and Gialamas conduct a pilot study aimed to investigate young children's engagement in computer use in kindergarten (knowledge, skills, dispositions and feelings portrayed). The participants were 29 children who used the computer in the classroom at the beginning of the academic year 2013–2014.

The results of the study show that most of the children were assessed as moderate to very good with regard to dispositions, feelings and behaviour.

Kollias, Daropoulos, Davaris and Zaganas present the design, implementation and assessment of a small professional development intervention for promoting deeper ICT integration in the classrooms. The intervention combined good practices of teacher professional development with the steps of transformative learning in Mezirow's theory of transformative learning. It was centred around the adaptation with minimal change of a research-based learning environment that was designed in a different national context. The intervention was successful in bringing forth to critical reflection and reflective dialogue habits of mind of the participants that are relevant to teaching with ICT.

Part III: ICT in Secondary Education

Vagelatos and Angelopoulos evaluate the use of laptop computers in secondary education in Greece. The project was implemented in 2009 in all first-grade high school classes throughout Greece. The evaluation took place four years later through an extensive questionnaire that was fulfilled by the educators that took part in the action. The outcomes of the evaluation highlight interesting points regarding both the strategy that was adopted in the deployment of the project as well as for the lessons learned and the actual use of the laptops within the classroom.

Panagiotakopoulos, Karatrantou and Sarris present the results of an experiential type workshop aiming at introducing the problem-based learning methodology to teachers. Teachers with various vocational specialties were participated in the workshop gaining experience with the method, focusing on educational video production and successively invited to implement acquired skills in their school settings. Results indicate significant positive correlations between instructors' skills and methodology effectiveness. Both teachers and students report willing to utilize this methodology to future work.

Michaloudis and Hatzikraniotis study the use of network simulations and alternative after-class teaching methods in educational process, as well as studying the effects on learning ability and understanding. Inquiry continuum was used as a framework for the design of the simulations. Students worked with worksheets, developed on the Predict–Observe–Explain Strategy, with varying guidance according to inquiry continuum. Results showed an increased performance for all students, regardless their previous knowledge and an increased certainty about the given answers. Students were able to develop new skills in handling technological tools and critical thinking, as well as dealing with complex problems and managing the processes required to complete the given tasks.

Part IV: e-Learning in Higher Education

Papazoi, Papanikolaou, Gouli and Grigoriadou present how personalization may benefit the learning design process with Learning Activity Management System. This chapter combines research in the area of Adaptive Learning Environments with the learning management systems area by analysing the design process of personalized courses in Learning Activity Management System. Results provide evidence about the potential of designing personalized lessons in cultivating various types of knowledge such as pedagogical and technological but also their combination, the technological pedagogical knowledge.

Karasavvidis examines the use of Wikis for peer-assessment purposes in higher education. He describes the design, implementation and evaluation of a two-layer peer-assessment scheme which was based on a common social networking practice: voting up. Ninety-one undergraduate students participated in the study in which a semester-long Wiki was integrated. The findings indicate a convergence between instructor and peer assessment in the case of high-profile Wiki contributions. The results also showed a considerable variability in terms of criteria the students employed to justify their selections.

Katsigiannakis and Karagiannidis present a practical implementation of gamification and game mechanics-based e-Learning. For the purposes of this study, two identical e-Learning courses were developed through the Moodle Learning Management Systems, and achievement badges were implemented to one of them. The courses were evaluated within a class of 32 students over a period of six weeks. The evaluation was carried out through a systematic approach and demonstrated that game mechanics elements made the educational process more engaging in terms of frequency and duration of use, participation and activity completion.

Part V: e-Learning for Educators

Tsiotakis and Jimoyiannis analyse the design and the implementation of two online communities with different organizational–functional characteristics, a self-directed (open) community and a semi-structured community. The findings indicated that the semi-structured community was very effective and cohesive, since the majority of the participants were very active and self-organized in groups, and they developed strong interrelations among them. On the other hand, the open community turned out to be very centralized, evolving around the coordinator's initiatives.

Vlachopoulos and Hatzigianni focus on research around the field of self-regulation in online learning. This chapter reviews relative research in the field of self-regulation and also reports on a study exploring the perceptions of fully online distance learners of four different types of reading activities in relation to some predefined dimensions of self-regulation. Findings of the study reinforce the significance of social learning, support the adoption of a different role for tutors and also underline the importance of investing in learning design.

Psillos analyses the basic design principles, structure and content of the blended learning programme called Meikto for compulsory education secondary science teachers, which included a combination of face-to-face and distance sessions and activities. He presents selected results concerning the views of the trainees who attended its pilot implementation in two training centres. The trainees' responses to a questionnaire after the programme show considerable interest, acceptance and positive response regarding the distant activities and their combination.

Part VI: Teachers' Views Towards ICT

Zaranis, Oikonomidis and Linardakis examine the factors affecting Greek kindergarten teachers to support or oppose ICT in education. The participants were 418 kindergarten teachers from the areas of Athens and Crete (Greece). A five-point Likert scale questionnaire with 30 questions was designed to assess the attitudes of kindergarten teachers towards computers. Using the binary logistic regression analysis found that only the variables "additional studies", "in-service years" and "level of software and ICT knowledge" are statistically significant and affect Greek kindergarten teachers to be positive towards ICT.

Vourletsis and Politis investigate and compare the attitudes of freshmen and senior students of the Department of Primary Education, University of Thessaly, Greece, towards Information and Communications Technology (ICT) in Education. The survey results have showed that the freshmen students of the specific sample display a more positive attitude towards the computer as an essential teaching tool; they also recognize to a greater degree the necessity of consistent ICT use in contemporary education and are more willing to incorporate computer use in their future teaching assignments. Moreover, the most powerful factor that affects the attitudes of prospective teachers is the viewpoint of their university professors who teach ICT-related courses.

Psillos and Paraskevas investigate the views of compulsory education science teachers regarding the B-Level Professional Development Programme and what it offers in terms of technological pedagogical content knowledge, and their readiness to apply it in the classroom. The teachers' views were for the most part positive, while 17–30 % reported moderate satisfaction. Their views of the skills they acquired relating to the incorporation of ICT in teaching activities were roughly similar, with certain differences.

Part VII: ICT for Specialized Uses

Gelastopoulou and Kourbetis present a methodological approach for the design and the development of accessible educational materials and software for students with disabilities utilizing ICT. The material developed is fully accessible to students with intellectual disability, deafness, blindness, autism, attention-deficit hyperactivity disorder and motor disabilities. The content is accessible through the use of alternative communication systems (pictograms, drawings, pictures) and easy to read texts. Access is ensured through the incorporation of the Greek Sign Language and Braille via multimedia resources.

Chanioti investigates dyslexia in primary school and focus on a new platform for identifying reading errors and improving reading skills. The educational application "Evglotton" is designed by the Institute for Language and Speech Processing to improve the reading ability of children with dyslexia aged 8–13. This pilot programme was tested with 6 children in the inclusion class of the 5th Primary School of Kifissia during the period 2013–2014. The initial results were very encouraging, showing that the learners were highly motivated with a gradual improvement in their reading capacity. In addition, it allows the special educator to better organize his work. Consequently, he saves time and gains a better understanding of the learner's reading capacity.

Part VIII: European Education Policy and ICT

Kalerante and Eleftherakis discuss the parallel association between the European educational policy on lifelong education and the introduction to information society. From 1995 until 2010, a developing programme was put into practice as part of the broader educational training plan along with the learning culture transformation to align the knowledge society with the information society. The major pillars were determined by the European educational policy conducive to both teacher and student familiarization with new models of acquiring and disseminating knowledge. The new school, which is the European aim, was associated with broader changes in the connection of different educational areas based on reinforced information and knowledge networks.

Riviou and Sotiriou present the impact of a teachers' Continuing Professional Development Programme and professional development community in the theme of competence-based learning. Most of the European Union Member States are formulating and at least beginning to implement policies that move their school systems from being predominantly input led and subject-oriented towards curricula which include competences, cross-curricular activities, active and individual learning, as well as a focus on learning outcomes. This chapter presents the outcomes from the needs analysis survey on key competence acquisition in Greece, as well as the design and localization of the training framework and environment based on the collected responses and the specifications set from the Greek Curriculum, the community support mechanisms that have been developed. These results highlight the characteristics of effective and useful teacher training practices and provide suggestions for improvement, which may inform training programmes and policies aiming to support competency-based teaching.

We would like acknowledge the large number of people who assisted us throughout the process of publicizing of this volume: first and foremost to the Hellenic ICT in Education Society who entrusted us with the organization of the HCICTE 2014 Conference and the editing of this volume. We would like to thank all the book contributors for submitting their work and for collaborating closely with us during the course of a very long reviewing and revision process. We thank all the colleagues who have significantly assisted in evaluating and improving the chapters featured in the present volume through their review comments. Finally, we would like to express our gratitude to Melissa James and Brian Halm from Springer US for their help and excellent collaboration.

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Part I
ICT in Education

Chapter 1
An Instructional-Learning Model Applying Problem-Based Learning Enabled by ICTs

Vassilios Makrakis and Nelly Kostoulas-Makrakis

Introduction

We are increasingly confronted with complex, interconnected, social, economic and environmental problems locally and globally. Humanity is living a crisis of sustainability that includes not only environmental issues such as climate change, ozone depletion, biodiversity loss, but also economic and social issues, such as poverty, social inequalities, violation of human rights, gender inequalities, loss of indigenous knowledge, etc. (Makrakis and Kostoulas-Makrakis 2013). The sustainability crisis is not just our biggest environmental, economic and social challenge; it is also a cultural challenge, a personal and moral one due to its anthropogenic cause. There is, thus, need for a shift of consciousness that alters: our way of being in the world (learning to be), our way for discovering others by discovering ourselves (learning to live together), our way of learning how to learn as well as appreciating all sorts of knowing (learning to know) and our way of putting knowledge into action (learning to do). It is above all, learning to "transform problematic frames of references–sets of fixed assumptions and expectations (habits of mind, meaning perspectives, mindsets)–to make them more inclusive, open reflective and emotionally able to change" (Mezirow 2003: 58).

Such a transformation can be significantly promoted through instructional and learning methods that focus on reflection and action to generate problem solutions, such as problem-based learning (PBL). Problem-Based Learning is not solely regarded as an

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instructional technique, but as an educational philosophy or approach for designing curricula that "empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem" (Savery 2006 p. 12). Focusing on sustainability problems, PBL provides learners with opportunities to move beyond surface learning and content consumption and compartmentalised knowledge to critically and reflectively examine problems to generate change. PBL is confronting learners with problems of everyday life. The 'real-life' sustainability problems are often tackled or solvable within disciplinary frontiers and not through interdisciplinary and more holistic perceptions of knowledge and problems. Thus, the epistemology of PBL is based on critical constructivism, a postmodern view of knowledge and learning, which has influenced teaching, learning and curriculum significantly in the past two decades. It is also based on transformative pedagogical processes that help to develop critical consciousness and knowledge construction that in turn can lead to individual and societal transformation. Such PBL processes are inextricably connected with certain critical skills that can be enabled by ICTs (Buus 2015; Ravitz and Blazevski 2014; Liu et al. 2012).

From the 4Cs to the 10Cs Enabled by ICTs

In the second half of the 20th century, much of the discussion on skills needed was centred on the 3Rs—reading, writing and arithmetic. In the last decade, there is a shift to what has been termed as the 4Cs for workforce readiness in the 21st century —critical thinking & problem solving, communication, collaboration and team building, creativity and innovation (AT21CS 2012; Partnership for 21st C. Skills 2011; American Management Association 2010).

However, in a world of rapid change highly driven by ICTs and expansion of human knowledge, along with the current sustainability crisis that threatens the very existence of humankind, education must go beyond the focus on the 4Cs to what we term 10Cs enabled by ICTs (Fig. 1.1).

Although there is some overlap among the 10Cs, each one has its own role in teaching and learning for problem solving. For example, critical thinking and problem solving refers to the ability to make decisions, solve problems and take appropriate action, using learning processes such as conceptualizing, applying, analysing, synthesizing and/or evaluating information gathered by multiple means. Communication refers to the ability to synthesize and transmit ideas in both written, oral and virtual formats. Collaboration refers to the ability to work effectively with others using multiple communication means. Creativity and innovation refers to the ability to apply new ideas in developing innovative applications and solutions. Wikis, such as Wikispaces, WikiQuESD (Makrakis 2010, 2012), and the latest versions of Pixie, Frames and Share include collaboration options that allow synchronous collaborative learning. Blogging is another means for virtual communication (e.g. Edublogs, Blogger and WordPress).

Fig. 1.1 ICTS as enabling tools for the 10Cs

Mind-mapping and concept mapping tools can become a great collaborative way in reflecting, conceptualising, constructing and assessing knowledge (e.g. SpidrerScribe, Wise Mapping, ChartTool, Cmap, Creately). These tools can boost learners' creativity and provide them with different ways to interconnect their thoughts as well as to accomplish metacognitive reflection skills. Similarly, tools for creating infographics (e.g. Wordle, Tableau and Inkspace) engage students in actively discovering connections and develop creativity. Connectivity addresses the complexity of the human-society-nature interaction, that can be significantly enabled by ICT-driven networking means. Critical reflection refers to a complex process that strongly engages learners to critically reflect upon their reality, personal and social, and to transform it through action and reflection (Stanlick 2014). Cross/inter-cultural competence addresses learners' capacity to communicate, collaborate and work in multicultural and global environments. Co-responsibility refers to a culture of sharing that necessitates shifting to less ego-centric principles and practices. Critical consciousness or concientization in Freire's (2000) terms denotes the process of developing a critical awareness of one's social reality through reflection and action. Constructing knowledge represents an attempt to shift from consuming information to constructing knowledge. All these critical 21st century skills enabled by ICTs merged with the 21st century learning pillars are used to advance a new methodological approach to PBL that can lead to personal and social transformation.

21st Century Learning Pillars and PBL

In its 1996 report to UNESCO, Learning: The Treasure Within, the International Commission on Education for the 21st Century argued that education should be based on four fundamental pillars of learning–learning to know, learning to be, learning to do and learning to live together, which "provide maps of a complex world in constant turmoil" as well as "the compass that will enable people to find their way in it" (Delors et al. 1996, p. 85). At a later, stage, the 5th pillar of learning to transform oneself and society was added by UNESCO. We feel the need to add a 6th pillar of 'learning to give & share' in order to respond to the quest for merging volunteerism, social activism and learning (Fig. 1.2) as defined in Table 1.1.

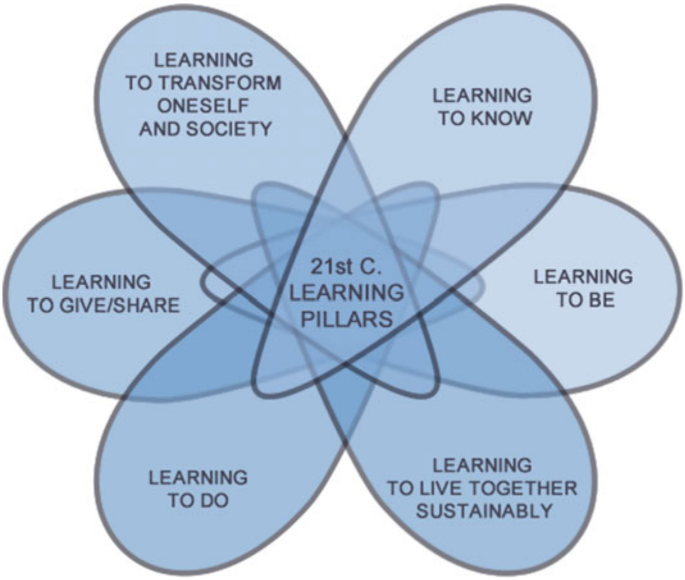

Fig. 1.2 21st century learning pillars

Table 1.1 Definition of the 21st century learning pillars

Learning to know	This type of learning concerns all the processes and practices that lead people to construct and transform knowledge to making sustainability a mode of life and being
Learning to be	This type of learning concerns all the processes and practices that lead to human self-actualisation, self-regulation and cultivating a sense of being versus a sense of having
Learning to live together	This type of learning concerns all the processes and practices that lead to a peaceful and non-discriminatory society and human co-existence with the natural world
Learning to do	This type of learning concerns all the processes and practices that lead to merging knowledge with action for building a sustainable future
Learning to give and share	This type of learning concerns all the processes and practices that promote solidarity, generosity and caring to meet human needs as learners gain a sense of purpose and meaning for their learning and civic engagement
Learning to transform oneself and society	This type of learning concerns all the processes and practices that lead people to transform their unsustainable values, behaviours and actions and collectively engage to change oneself and society towards sustainability

A Conceptual Framework of PBL Based on the 10Cs and the 6LPs

The proposed PBL framework consists of a number of key interacting processes which facilitate the theoretical and methodological clarification and understanding of the PBL as an instructional and curricular approach. Each interacting process integrates various skills drawn from the 10Cs (Fig. 1.3). Furthermore, it takes into consideration the contribution of the problem-solver and the potential impact that he/she brings to the outcome of problem solving process. It also gives primacy on a practical and emancipatory knowledge interest (Habermas 1971). The practical domain identifies human social interaction or 'communicative action' grounded on intersubjectivity (the understanding of meaning rather than causality) to determine what is appropriate action while the emancipatory domain goes further to identify 'self-reflection' leading to a transformed consciousness or 'perspective transformation'. The importance of the practical and critical reflective knowing is embedded in constructing knowledge and meaning merged with personal and social action.

The processes represented into the PBL model are re-conceptualised into a methodological framework depicted in Fig. 1.4. This framework functions as an organiser for designing, developing, applying and assessing a PBL approach contextualised in the area of education for sustainability. We expect that our approach provides a means towards building learning-based change that will ultimately contribute to building a more sustainable society.

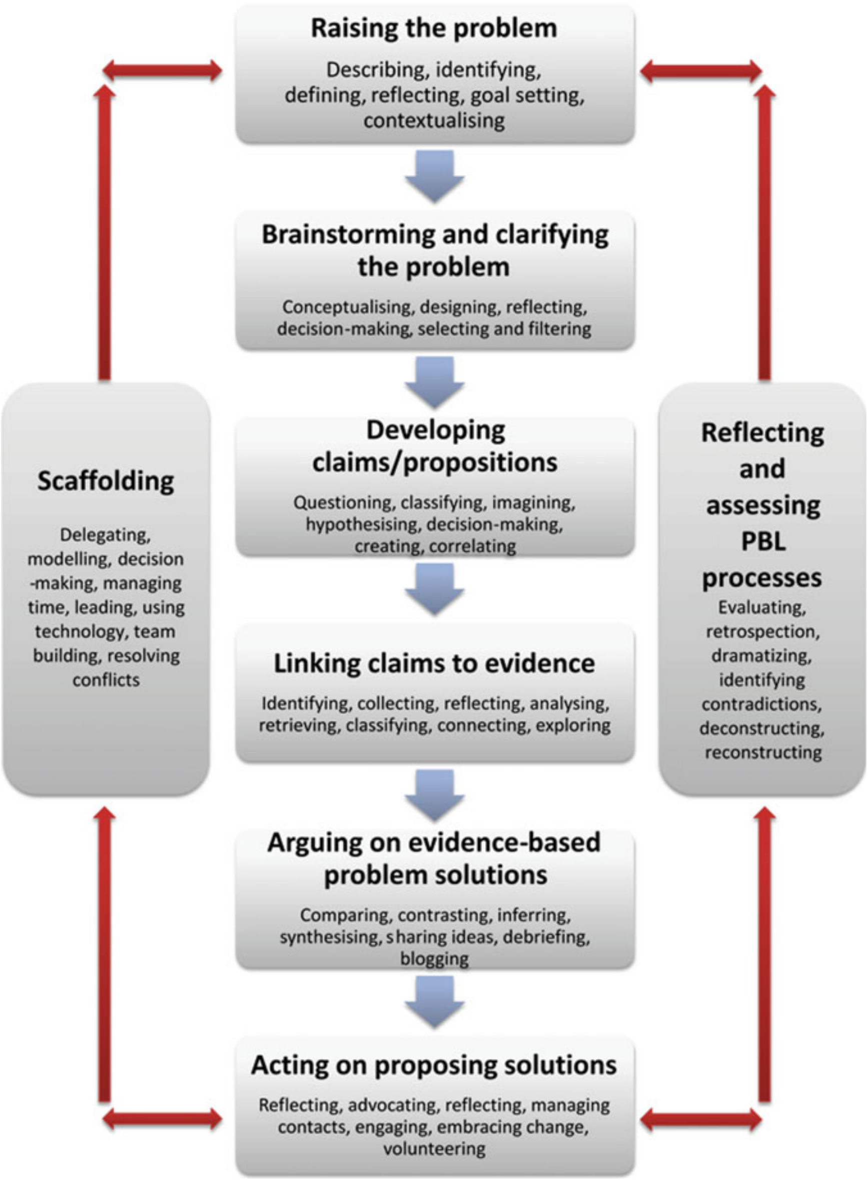

Fig. 1.3 The key skills integrated into the PBL processes

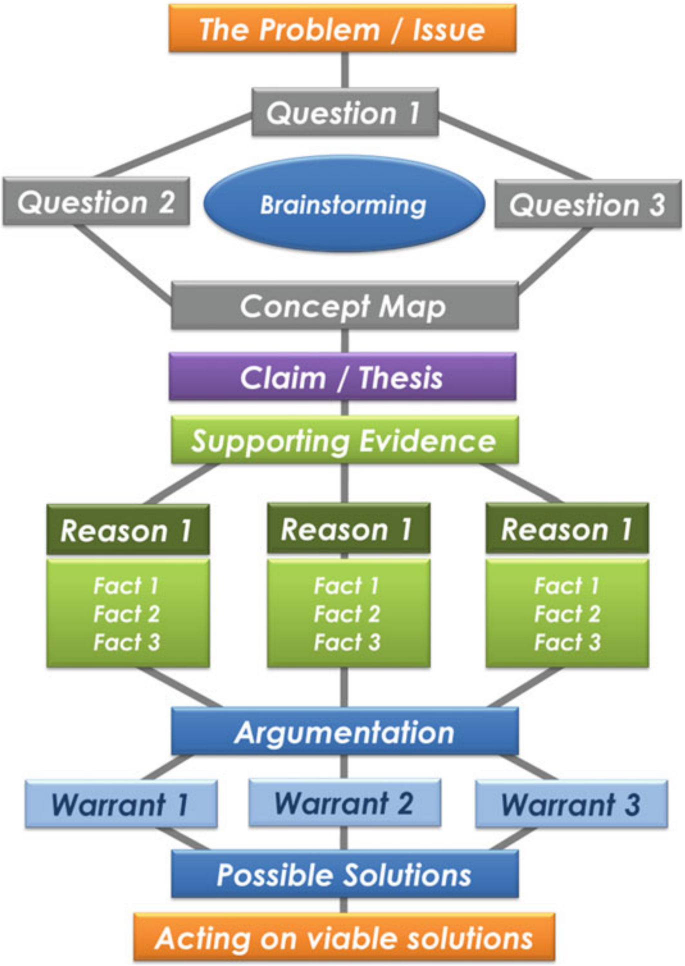

Fig. 1.4 The PBL organising framework

Raising a Problem

The focus of the PBL process is a real-life or authentic problem. Being able to craft good PBL questions becomes a critical skill for both learners and educators. The problem must be formulated in a way that motivates and challenges learners to think and reflect, to search and discover, to build on prior knowledge and promote transfer of what they have learned to other contexts. Problems raised through meaningful questions should motivate and challenge learners. To fully understand complex social problems, learners must also be able to account for and understand competing and multiple perspectives regarding a problem. For example, there has been an ongoing debate for years about whether or not to ban smoking in public places. Smoking is a social problem as it affects peoples' health. Introducing issues that convey controversial meaning such as smoking ban is expected to raise learners' interest in studying the issue and develop various skills and competencies related to PBL, besides raising awareness about the consequences of smoking to human health. This is an authentic ill-structured or controversial question since ban of smoking in public spaces could be interpreted from various perspectives. Ill-structured or controversial problems are presented as open or unresolved. Any problem-based issue raised requires a collaborative and communicative learning space that encourages learners to exchange ideas, search for evidence and apply multiple ways of thinking.

Brainstorming About the Problem Issue

Brainstorming is a creative thinking process that can help learners generate ideas, access prior knowledge, construct and reconstruct knowledge. Taking up the issue of smoking ban, the teacher, for example, can draw or show a picture of a no smoking sign on the board and ask students to contribute any related vocabulary to this picture. In other words, learners are motivated to brainstorm this key problem-based question using a concept mapping technique. To elicit learners' known vocabulary associated with the concept conveyed by the picture, the teacher could pose some question prompts, such as: "Is smoking healthy?", "Does everybody agree with banning smoking from public places?". Words that may come out could be: tobacco, smoke, ash, odor, inhale, breathe, cough, lung cancer, give up/quit, lighter, cigar, butt, etc. Concept mapping is a good technique to be used in eliciting prior knowledge in the issue, especially if an ICT-enabled concept mapping tool is used. Through the brainstorming process, learners also start defining learning objectives by means of identifying what they actually know about the problem and what they presumably need to know to formulate claims, link claims with evidence and develop effective argumentation on proposing solutions. Learning to know about the controversial issue of smoking ban is very critical at this process.

Developing Claims/Propositions

During this process, problem solvers elaborate the initial state of the problem and identify debatable claims. A claim or thesis/proposition is an expected opinion that conveys the problem solver's interpretations of or beliefs related to the problem. Claims are not facts but rather conclusions or assumptions that the problem solver draws from facts. In other words, a claim is characterized by its controversiality and challenge. If a claim conveys something that is generally agreed upon or accepted as fact, then there is no reason to try to persuade people. A disputable claim allows confrontation, which can be expressed as a counterclaim. In general, claims typically fall into one of four

Table 1.2 Types of claims and supportive evidence

Type of claim	Evidence supporting the claim
Factual	Cigarettes contain arsenic, formaldehyde, lead, hydrogen cyanide, nitrogen oxide, carbon monoxide, ammonia and 43 known carcinogens
Cause and effect	Cigarette smoke contains over 7,000 chemicals, 69 of which are known to cause cancer. Smoking is directly responsible for approximately 90 % of lung cancer deaths and approximately 80–90 % of COPD (emphysema and chronic bronchitis) deaths
Value-laden	Most smokers take up the habit in their mid teens, well before the legal age for purchasing them, and is seen as a right of passage towards adulthood
Policy claim	In 1970, President Nixon signed the law that placed warning labels on cigarettes and banned television advertisements for cigarettes

categories: (1) factual claims; (2) cause and effect claims; (3) value-laden claims and (4) policy claims (Weida and Stolley 2014). Bringing the controversial issue of smoking ban from public spaces, a factual claim might be expressed as "Cigarettes contain many and dangerous substances". A cause and effect claim might be expressed as "There is an association between smoking and lung cancer". A related value-laden claim might be expressed as "Youth start smoking to show a passage to adulthood". Lastly, a policy claim related to smoking ban is issuing regulations about smoking or imposing special or heavy taxes to smoking products in order to reduce smoking.

Linking Claims to Evidence

Claims have to be linked to supportive evidence, which is consisted mostly of objectified measured facts. In this process, learners decide about what data and information is needed to support, modify or even reject their initial claims. The amount of evidence needed depends on the claim. Usually, there are two types of evidence based on the source: (1) primary source evidence and (2) secondary source evidence. The first type may include data collection techniques, such as: interviews, experiments, surveys, or personal experience, while the second type of data collection may include books, periodicals and websites. Table 1.2 presents an example of linking claims to evidence based on the four categories identified through a web-based review.[1]

[1]http://www.cancerresearchuk.org/about-cancer/causes-of-cancer/smoking-and-cancer/smoking-facts-and-evidence. http://listverse.com/2009/01/11/30-fascinating-cigarette-smoking-facts/.

Arguing on Evidence-Based Problem Solutions

It is not enough to link claims with facts, it is also essential to develop sound and persuasive argumentation on the claims grounded on evidence and supportive facts or conjectures (Makrakis and Kostoulas-Makrakis 2014; Jonassen 1997). This is, in fact, the PBL process that synthesizes all the previous ones. In particular, it encourages learners to further explore and integrate knowledge and artifacts gathered through the previous PBL processes. Evidence-based arguments are discussions that present and provide support for claims with evidence and premises (Eemeren and Grootendorst 2004). Being able to produce convincing (i.e., logical and evidence-based) arguments is central to solving ill-structured problems (Cho and Jonassen 2002).

There are three major elements to persuasive argumentation: claims, evidence and warrants. Based on Toulmin model for analysing arguments (cited in Hitchcock and Verheij 2006), warrant is the logical connection between a claim and a supporting fact. Sometimes, the logical connection, the way in which a fact logically supports a claim, might be obvious. However, more often, there is need to explain how and why a particular piece of evidence is good support for a specific claim. In this case, a warrant is needed that will provide an underlying assumption which clarifies the evidence that supports the claim. For example, based on our web review we found that about 8.6 million people in the U.S. have at least one serious illness caused by smoking, which that for every person who dies of a smoking-related disease, there are 20 more people who suffer from at least one serious illness associated with smoking. Taking the issue of smoking ban, one can argue that as smoking is associated with significant health problems, documented with measured evidence depicted in Table 1.2, it has to be banned from public spaces. However, another could argue that "although smoking is associated with health problems, other measures than smoking ban should be applied". This counterclaim could be justified by reasons such as a general smoking ban restricts smokers' freedom and individual rights. Thus, instead of smoking ban from all public spaces, alternative policies such as smoking and non-smoking places should be established in public areas. The harm caused by smoking can be also reduced by educating smokers about safer options. Punishing smokers "for their own good" is repulsive to the basic libertarian principles that ought to limit the use of government force.[2] Effective and persuasive argumentation emphasizes logic and reason, which provide a rational link between the evidence and the claim. However, there is often a place for emotion as well. Emotional appeals can use subjective or inter-subjective sources such as interviews and individual stories that could illuminate objectified evidence or provide a more legitimate picture of reality. For example, presenting a video-clip that shows an individual story of a heavy smoker

[2]https://www.heartland.org/ideas/smokers-rights.

who died from lung cancer because of smoking may lead to a more persuasive argument than simply showing the percentage of deaths caused by smoking each year. Such examples could not only enrich persuasive argumentation, but possibly empower people towards direct action.[3]

Acting on Proposing Solutions

One of the key attributes of PBL, that has been misunderstood or ignored, is action competence (cf. Mogensen and Schnack 2010). This brings to the issue of turning problem solver's acquired and constructed knowledge, meaning, understandings and concerns into responsible action. There is, thus, need to merge knowledge with action and construct ways of thinking and acting that have an emancipatory knowledge interest. To this end, young learners should be encouraged to develop the capacity to envision sustainable futures, to think critically and reflectively of current unsustainable practices, to plan and evaluate alternative courses of actions, and to transform their attitudes, knowledge and concerns into individual and collective action for building a sustainable society. There is, thus, need to empower young learners to be seen as a resource in their communities with the potential to act as catalysts for and agents of change (Wallerstein et al. 2005; Holden et al. 2004). Finding solutions to reduce smoking is a very important process. However, one can propose that any smoking restricting regulation has to balance reducing risks with reducing potential benefits. Learning to transform oneself is a critical process that needs to be integrated into any learning process if we envision a change as a direct outcome of our instructional-learning intervention.

Scaffolding

Scaffolding is generally regarded as support for learners while they are engaged in activities just beyond their own capabilities. As learners become more autonomous, scaffolding is gradually withdrawing. Scaffolds may take many forms to guide students through the PBL task. Saye and Brush (2002) identified two types of scaffolds to illustrate the important role of the teacher in guiding students to solve ill-structured problems: (a) hard scaffolds and (b) soft scaffolds. Hard scaffolds refer to "static supports that can be anticipated and planned in advance based on typical student difficulties with a task" (p. 81). This type of scaffolds could be also referred to conceptual, metacognitive, or strategic hard scaffolds (Ge and Land 2004; Hannafin et al. 1999). In recent decades there has been a concurrent growth in the availability of online technologies for teaching and learning and interest in

[3]https://www.youtube.com/watch?v=CO0qwl5k9R4.

advancing project- and problem-based learning (Ravitz and Blazevski 2014). Hard scaffolds (computer or paper-based cognitive tools) can also serve the same scaffolding roles as soft scaffolds (Simons et al. 2004) and are meant to augment, not replace, soft scaffolding (Saye and Brush 2002). Examples of hard scaffolds include expert modelling, question prompts, computer-based tools, concept mapping etc. In contrast, soft scaffolds include human beings, such as teachers, students or adults, who can provide dynamic and situational support.

Reflecting and Assessing PBL Processes

Reflecting and assessing activities in authentic and ill-structured problem solving are important constituents of the PBL process. Giving students the opportunity to reflect on their own learning is a key element in PBL. Student reflections should be more than just commentary on what the students have done–they should used by students to highlight what they have learned, explain important decisions they have made, and articulate plans for incorporating feedback and moving forward. Traditional assessment techniques such as multiple-choice and true-false examinations do little to assess such processes. The PBL framework advanced here emphasizes that assessments should be a continuous and integral part of the learning process and not be viewed as a compartmentalized activity. Whatever assessment technique is used, it must be viewed by learners as an active part of the learning process.

Concluding Remarks

As pointed in the introduction, there is need of an instructional design framework that helps teachers at any education level better understand the theory and methodology of PBL and enable them to adapt it as needed for their own teaching and learning environments. There is need to help learners realize that it is critical to their lives to be self-reflective and critical, be able to question their own and others' beliefs, the knowledge presented to them as an "objective reality", as well as societal structures and conditions. In other words, PBL entails developing young learners as critical thinkers and active citizens.

The proposed PBL model is aimed to fill this gap. In such kind of learning environment, learners tackle authentic problems, develop debatable claims and linked them with supportive evidence, interacting with a wide variety of learning resources, and develop argument-based solutions to those problems. Further, they develop action competence as a means for engaging learners in problem solving and provide with a framework that enables learners to take individual or collective action to the proposed solutions. Learners in the 21st century live in a technology and media rich environment where they have access to a plethora of ICTs that can function as enabling tools across all 10Cs to facilitate the PBL processes (Stanlick 2014; Mayo 2012; Makrakis 2010). However, simply providing learners with new powerful and interactive ICTs will not develop these skills and enhance their learning. What it matters is not how to use technology or even teaching with ICT tools, but more using ICTs as enabling tools to support communication, reflection and knowledge construction related to real-life problems (Makrakis 2014). Accordingly, the proposed PBL model driven by critical, reflective and transformative theories to teaching, learning and curriculum envisions learners as active participants both in the learning process and in the construction of social reality. In such a process, reflecting on the six pillars of 21st learning and properly contextualised in the learning process is of critical importance for transformation.

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Chapter 2
ICT and Collaborative Creativity in Modern School Towards Knowledge Society

Panagiotes Anastasiades

Introduction

Nowadays, teachers and students face a major challenge, as they are called to cover a great distance that separates knowledge and skills, given by the school of today, from the knowledge and skills, which are necessary for the future citizen of the emerging Knowledge Society. If we really believe that resignation and sterile negation are the other side of the same coin, then we should look for new, original and innovative ideas that could lay the foundations of an alternative—creative approach to educational issues. ICT, under pedagogical conditions, may be one of the most important tools for teachers and students to develop crucial skills (cognitive, social, and technological) so as to be able to respond, critically and creatively, to the needs of the new social and economic reality that is, constantly, changing.

First of all, the purpose of this paper was to highlight the collaborative creativity (CC) as one of the most important issues for the critically thinking teacher of today, and, second of all, is to explore ways through which ICT can support him in this effort. The structure of this paper is as follows: In the first section, there is an attempt of, initially, mapping the features of the emerging social reality. The second section clarifies the concept of creativity and emerges the importance of it in today's era of intense change and uncertainty. The third section focuses on the role of ICT as a critical factor for encouraging the collaborative creativity. The forth section is a brief reference of the ODYSSEUS Program 2012–13, in which ICTs were used in order by students and teachers to design and implement creative activities, collaboratively and remotely.

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What Changes in Our Days?

In the era of globalization and internet, knowledge is the main productive factor of the new form of the social and economic organization (Tapscott 1995; Anderson 2008). The aim of societies must be the strengthening of social capital, meaning all the actual and potential resources, that are incorporated, are available and come through the network of relationships, which an individual or a group keeps (Nahapiet and Ghoshal 1998). Furthermore, the role of creativity is important to achieve this goal (Walberg 1988, p. 342). Knowledge is one of the goods moving through this network and ICT plays an important role (Van Bavel et al. 2004), by reducing the distance between the urban centers and rural areas (Westlund and Kobayashi 2013), but by creating new kinds of social inequalities based on age and internet access (Brandtzæg et al. 2011).

In today's school, we educate the future citizens of a society for which we do not have the slightest idea of how it will be after a few years.

Rapid social and economic changes contribute to the emergence of a new reality, which includes these features:

a. *Shock of Information overload*: the increasing amount of information, available, now, on the web, results in creating the shock of Information overload phenomenon (Brown and Duguid 2000; Bawden and Robinson 2008; Murayama et al. 2015; Lee et al. 2016).
   Today, the challenge is to gain the ability of:
   - focusing on information literacy: The ability to recognize, search, assess, organize and create synthesis and utilization of information disseminated in order to process a subject or to give a solution to a problem (UNESCO 2003), taking validity and timeliness into consideration (Anastasiades 2007). This requires the cultivation of information search skills, imagination, and originality.
   - Cultivating the capacity of assessing and identifying significant or authentic information (c), that is to cultivate critical thinking.

b. *The Rapid Devaluation of Knowledge:* in the so-called society of knowledge and uncertainty(Hargreaves 2003) knowledge devaluates rapidly(Kaufman 2006), a fact that requires us to rethink the way we deal with the concept of teaching and learning, focusing on how our students learn (Laurillard 2002; Anderson 2008).
c. *The multiplicity of information*: today's era urges us to (Johnston 1998):
   - seek new knowledge from different sources,
   - to realize that there are different kinds of knowledge and multiple ways of looking, interpreting and solving problems,
   - focus on new forms of perception and meaning acquisition, concerning the world around us (Makrakis 2000, p. 247).

In order to achieve the above, we have to encourage the release of thinking from its reveling standardization, nurturing, in teachers and students, the alternative viewing of things and multiple ways of solving problems.

d. *Global networking-cooperation:* the possibility of global networking among researchers, teachers, and students creates the conditions for a new, participatory culture (Jenkins 2006), respecting individual social and cultural environments. In this context:

- we strive for constant contact and cooperation with others who have common interests and worthwhile practices (Smith and Lovat 2003)
- we cultivate the culture of sharing knowledge, experience and life experience, with the help of social networking environments and web 2.0 (Anastasiades and Kotsidis 2013).

Summarizing, based on the above four features of the new social, emerging reality, teachers and students should focus their interest in the cultivation of critical thinking: (a) on highlighting originality, imagination, and innovation, (b) on the encouragement of alternative viewing of things, (c) on the pedagogical use of making mistakes, aiming at building collaborative, learning environments and creative expression.

Meaning and Importance of Creativity in Modern School

As understood, the concept of creativity gets a special added value for educational systems, in this era of constant change and structural realignment (Hargreaves 2003; Ball 2008, p. 39). This reflects at both European (Work Programme Education & Training 2010; Commission of the European Communities 2008) and national level (Leonidou 2006; Xanthakou 1998; DCMS 2001).

Overviewing international literature, the concept of creativity could be traced through four conceptual, tangent circles (Fig. 2.1).

1st circle: a large number of researchers focus on imagination, originality, and innovation, as the characteristics of creative thinking (Bruner 1962; Getzels and Jackson 1962; Torrance 1966; Lytton 1971, Reber 1985; Vernon 1989; Savoie 2015; Brand 2013; Fraser 2007; Plsek 1997; Wimmer 2007).

2nd circle: an important prerequisite for the cultivation of creativity is to encourage different viewing of things (Lee et al. 1987; De Bono 1967; Trilianos 1997; Savoie 2015; Bailey et al. 2016), the development of divergent thinking and the formation of new relationships (Salla-Diakoumengidi 1996). Different kinds of expression (in metaphor: such as…, pro rata: it is not/it is, symbolically: poetry/art, practically: solving a problem, schematically: Shape, etc.), combined with the active participation of students in building knowledge (Makrakis 2000: 247), are important factors for developing creativity in education.

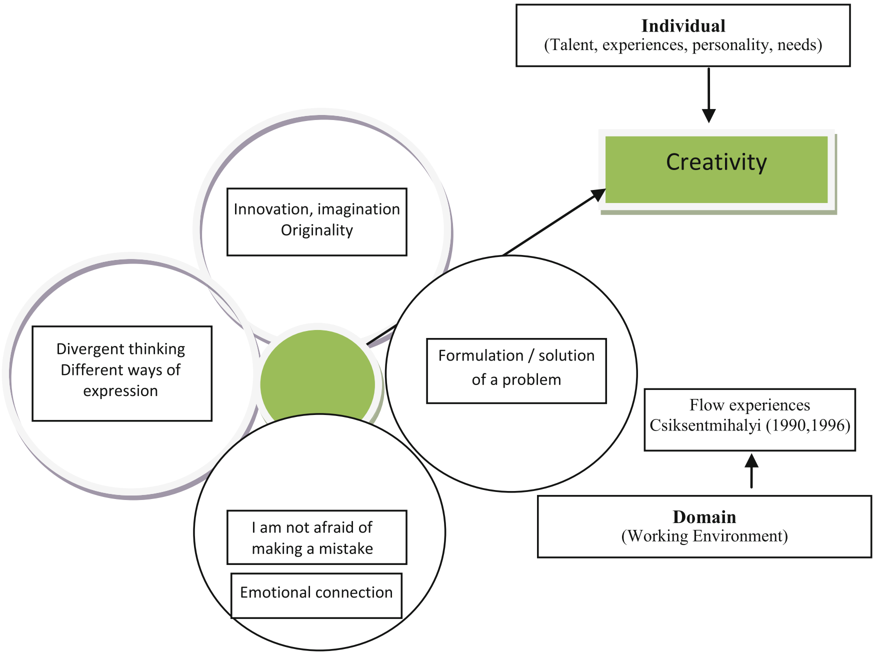


Fig. 2.1 Conceptual depiction of creativity

3rd circle: according to several researchers, formulating a problem is a much more important process than solving it (Piaget 1960) and contributes to the development of creative thinking (Kaila and Xanthakou 2002; Morris 2006).

4th circle: pedagogical use of making a mistake, emotional climate:

The standardization of thinking, the absolute sovereignty of logic, the lack of confidence in our creative abilities, the fear of error and ridicule, the social frame that presses for compliance and, finally, the psychological insecurity for the new and the unknown are the most important barriers, relating to creativity, according to Paraskevopoulos (2004).

According to Kampylis (2010), the Greek teachers of primary education have no clear picture, with regard to creativity, and often have such perceptions that do not help in further development of it. This fact is due to both their initial education and the content-methodology of their training. This conclusion is consistent with the corresponding research of Loveless et al. (2006), which highlights the importance of teacher training, while Webster et al. (2006) point to the need for a good preparation period for the teachers.

Collaborative Creativity (CC) and the Role of IST

According to socio-cultural approaches, creativity has a special added value, when it takes place in collaborative environments (Littleton and Miell 2004; Sawyer 2007), without invalidating the fact that individual, creative activities have a strong, social dimension (Ivinson 2004).

Under CC, interest focuses on the following: (a) the mutuality between the team members, (b) exchanging ideas, experiences, and life experiences, (c) exploring a common vision, (d) negotiating a collective sense (Glăveanu 2011). On the other hand, research does not focus, only, on the content of creativity (what and how), but also, on the sociocultural frame, in which it is carried out (De Laat and Lally 2004).

In particular, within the school environment, nowadays CC is one of the most important requirements for the critical integration of students in the society of knowledge (Craft 2008; Daskolia et al. 2009; Cachia et al 2010), as it contributes to their socio-emotional development and the emergence of strong, internal motivation (Littleton and Miell 2004).

In pedagogical conditions, ICT can support the development of CC in modern school through three interrelated practices (Loveless 2003, 2011), which are depicted in Fig. 2.2:

According to Wheeler et al. (2002), ICT can contribute to the development of creative thinking, through three interrelated dimensions: problem solving, creative knowledge, and social interaction. Howell (2012) argues that creative activities, combined with the exploration of knowledge, maximize the expected results, both in terms of knowledge and skills of students.

In recent years, the development of web 2.0 pushes the support of creativity, as these applications allow ordinary users to create, publish, and share content (i.e., text, picture, and video) (Bush and Hall 2011; Daud and Zakaria 2012; Kurtz et al. 2012).

The important feature of web 2.0 is that it encourages and supports the simple user to create content with others (collaborative creation), promoting interaction and communication between them (O'Reilly 2005). Indeed, Jenkins (2006) states that web 2.0 marks the participatory culture, in which there are many opportunities for

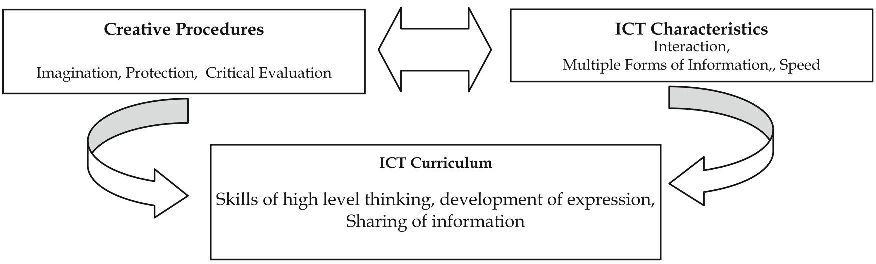


Fig. 2.2 ICT framework to support creativity

someone to create and participate in collaborative learning, thus becoming a global citizen (citizen of the whole world), capable of communicating and working in different frames.

In conclusion, ICT contributes to encouraging participatory culture, by creating and sharing content in different social and cultural contexts. Therefore, under pedagogical conditions, it can contribute to the development of collaborative creativity in the classroom.

From Theory to Practice: Encouraging Collaborative Creativity for Primary Students by Using Advanced Learning Technologies

According to Ripple (1999), we can distinguish two basic strategies to enhance creative thinking. The first one focuses on teaching techniques and the use of specially designed activities, such as open questions and vaguely formulated problems. The second one focuses on innate creativity, which can be highlighted, by removing barriers and realizing our creative capabilities. An important prerequisite for encouraging it is to create the right emotional climate in order teachers and students not to be afraid of making mistakes (Robinson 2008). To achieve this, it is important that the student is encouraged to express emotions in comfort (Russ 1993: 12–16), open to experiential situations, which will give him the ability to recognize and process them (Russ 1993: 38–42).

The design, development, and implementation of collaborative, creative activities via advanced learning technologies (videoconferencing, web 2.0 etc.) are the core of the ODYSSEUS Program, which is implemented by the Department of Primary Education of the University of Crete. It began its exciting route in 2000 in Cyprus and until 2013, 1800 students, 50 teachers from 20 primary schools in Greece and Cyprus (www.edc.uoc.gr/~odysseas/).

Under the term of “Videoconferencing” we refer to the communication in real time through audio, live video, and data, between two or more remote places. (Anastasiades 2003; Alexander et al. 1999; Chandler and Hanrahan 2000). Interactive Videoconferencing (IVC) allows trainees and trainers, who are in two or more remote places, not just to communicate, exchanging opinions, or to share data between them, but also to actively participate in a dynamic environment of interaction, which is mainly characterized by the collaborative building of knowledge from distance, in a real time (Anastasiades 2009). IVC is an important technological tool, which, under pedagogical and social conditions, can contribute, significantly, to the school opening to wider social and learning environments. Furthermore, it can encourage social negotiation and critical view of contemporary, local biographies of the microworld, surrounding the classroom, and it can also cultivate the spirit of cooperation, the necessity of empathy, and the culture of everyday consultation with other mentalities, attitudes, behaviors, and perceptions (Anastasiades et al. 2010).

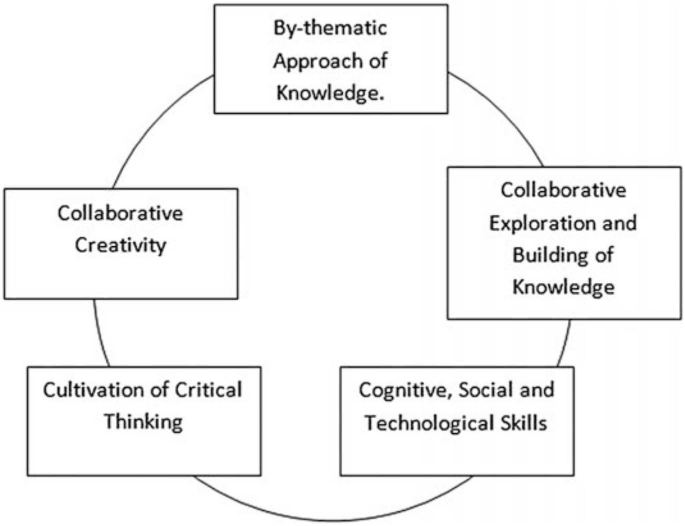


Fig. 2.3 Components of pedagogical approach of the ODYSSEUS Progam

The pedagogical approach of the ODYSSEUS Program (Anastasiades 2003; Anastasiades et al. 2010) is based on the by-thematic approach of knowledge, which is explored and built collaboratively, aiming to: (a) cultivating crucial, cognitive, social, and technological skills, (b) highlighting critical thinking, (c) encouraging CC, in order to prepare the future citizens for their creative and critical inclusion in the emerging society of knowledge, in the twenty-first century (Fig. 2.3).

The "ODYSSEUS 2013" Program framework, in relation to the encouragement of CC, is based on three pillars:

1. "Democratic Endorsement" is adopted (NACCCE 1999), according to which creativity does not concern some gifted and talented people, but it refers to the creative aspects that each person has (Finke et al. 1992; Craft 2010; Xanthakou 1998; Koulaidis 2007; Weisberg 1993).
2. Creative aspects of students can emerge through realizing and unleashing their skills, while the role of the teacher is to contribute to the elimination of related barriers with the help of techniques and methods, in an understanding and trusting environment.
3. The theoretical framework of social constructivism is considered the most appropriate for the encouragement and promotion of CC (Mamykina et al. 2002), since a significant number of researchers believes that theories of social constructivism contribute, significantly, to enhancing the creativity of students (Csiksentmihalyi 1996; Plucker et al. 2004; Sawyer 2004; Craft 2005).

Based on the approach of the pedagogical use of videoconferencing (Anastasiades 2003, 2010) in combination with the revised taxonomy (Bloom, Anderson et al. 2001) and the use of web 2.0 applications (Anastasiades and Kotsidis 2013), four main stages are recommended (Fig. 2.4):

During the “Odysseus 2012–13” program, from February to June, there were made a total of 16 videoconferences, involving almost 200 students from 8 primary schools in Athens, Crete, and Aegina. Students and their teachers took advantage of the IVC methodology (Anastasiades 2003, 2010). Furthermore, with the help of web 2.0 applications, they designed and implemented creative activities remotely (Picture 2.1a, b).

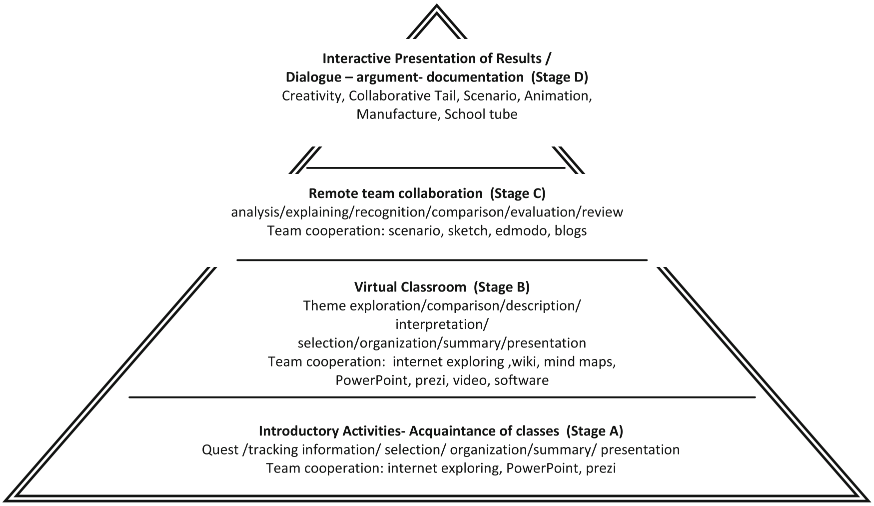
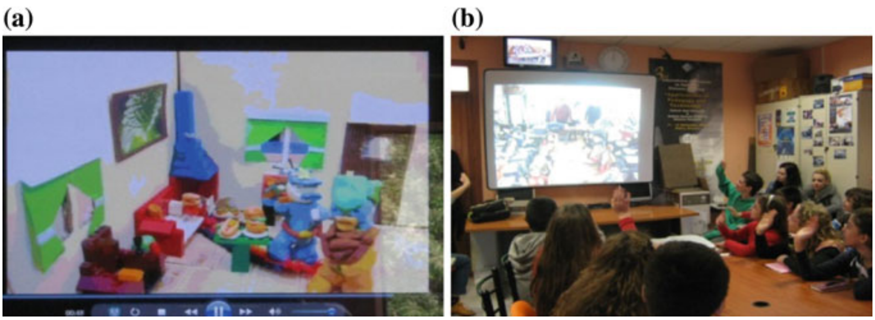


Fig. 2.4 The pyramid of IVC



Picture 2.1 **a**, **b** Snapshots from students’ creative activities by distance

Conclusions

In these times of uncertainty and rapid change at all levels, the educational system, the universities, and the educational policy designers owe to bear on their shoulders a historic weight: to regenerate, from its ashes, what, for years and systematically, they delegitimize: the creativity of students and teachers, which was degraded, in the name of positivist and mechanistic approach to serving the needs of industrial society and its structures.

Prerequisite for encouraging collaborative creativity is to redefine the pedagogical dimension of ICT in order to support teachers and students in building a new participatory culture. This will contribute to the necessary transition from the school of standardization, sterile rationality, error and uniformity “criminalization,” to environments, which will encourage originality and innovation, build collaborative knowledge with the use of alternative approaches based on the pedagogical use of the error. This paper argues that the pedagogical approach, within “ODYSSEUS” program, is a first step in this exciting journey.

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Chapter 3
Contextualized Educators' Training: The Case of Digital Storytelling

Tharrenos Bratitsis

Introduction

Currently, the need for the education system to serve the cultivation of the twenty-first-century skills is being discussed (Mishra and Kereluik 2011). The latter refer to "a set of skills, work habits and character traits that are believed—by educators, school reformers, college professors, employers, and others—to be critically important to success in today's world" (Hidden Curriculum 2014). Although the term is rather vague and several approaches and frameworks for describing these skills exist, it is a fact that "…schooling needs to be fundamentally reconfigured to emphasize higher order cognitive processes…" (Mishra and Kereluik 2011) which derive from the emergence of Information and Communication Technologies (ICT). Nowadays, it seems to be more important for students to learn how to be able to communicate, share, use information to solve complex problems, adapt, and innovate, rather than conduct manual labor or use routine skills (PPRC 2010). Hence, new standards for what students should be able to do are replacing the basic skill competencies and knowledge expectations of the past.

A transformation in education seems necessary in order for the students to be able to acquire such skills. The basic idea is that students, who will come of age in the twenty-first century, need to be taught different skills than those learned by students in the twentieth century and that the skills they learn should reflect the specific demands that will be placed upon them in a complex, competitive, knowledge-based, information age, technology-driven economy and society (Hidden Curriculum 2014).

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Several researchers attempted to record and categorize the twenty-first-century skills (Mishra and Kereluik 2011). Most of them conclude to 3 large categories, namely the following: (a) learning and innovation skills, (b) literacy skills (information, media, and technology), and (c) life and career skills. These include several subcategories (P21 2009). Although many of these skills are not unique to learning in the twenty-first century, two subcategories seem to be. These are information literacy and cultural competence and awareness, which are directly related to the emergence of ICT and the digital era (Mishra and Kereluik 2011). Considering Prensky's (2001) description of today's youngsters as "digital natives", as opposed to the previous generation which is characterized as "digital immigrants", the need for educators' training both on a professional level as well as that of teaching competence.

Taking into account that educators are considered to be adult learners when engaged in professional training, this chapter argues about designing training programs, utilizing the contextualized teaching and learning approach in a work context. The case of digital storytelling as a teaching methodology/approach is exploited in order to highlight the effectiveness of this approach.

This chapter is structured as follows: Initially, the theoretical background is discussed, focusing on contextualized teaching and learning and digital storytelling in education. Then, the contextualization of educators' training is discussed via a case study of seminars about digital storytelling as a teaching tool in which in-service and future teachers participated, before the concluding discussion.

Theoretical Background

In this section, the elements of the theoretical background of this chapter are presented. The first regards the contextualization of teaching and learning in a work context and its significance, while the second discusses digital storytelling as a teaching tool. This presentation aims at identifying the convergence points of the two elements, as discussed in the next section.

Contextualized Teaching and Learning

Contextualized teaching and learning (CTL) is identified as a promising strategy that actively engages students and promotes improved learning and skills' development (DeLottBaker et al. 2009). Several definitions are available in the literature. Perin (2011) refers with this term to "the practice of systematically connecting basic skills' instruction to a specific content that is meaningful and useful to the students."

This approach relies on the constructivistic perception of learning, according to which individuals learn by constructing meaning through the interaction with and interpretation of their environments (Brown 1998). This meaning is related to their personal experiences and contextualized by real-life situations and problems. According to Imel (2000), among the contextualized perspectives of learning are situated cognition, social cognition, and distributed cognition.

Perin (2011) defines two practices of contextualization, contextualized and integrated instruction. Contextualized instruction serves the objective of teaching basic skills in the context of a specific subject area in order to provide the opportunity of meaningful skills' application. It can be provided by corresponding instructors (language, math, etc.) with the primary objective to teach academic skills, although some implicit content learning may occur. For example, a course of scientific writing can incorporate language learning.

Integrated instruction on the other and is the incorporation of basic skills into the teaching of content. For example, writing and math skills can be incorporated in a science lesson (Tilson et al. 2010) or in complex problem-solving approaches which follow the Content and Language Integrated Learning (CLIL) approach (Dourda et al. 2014). Integrated instruction is found in discipline-area classrooms, with the academic skills serving as a means of developing critical thinking about disciplinary content (Pearson et al. 2010).

In general, contextualized learning is utilized in order to create conditions for more effective learning. The underlying mechanisms include the promotion of learning transfer and improvement of information retention (Boroch et al. 2007; Stone et al. 2006). When information is processed and knowledge is acquired in a context similar to that in which they will actually be needed, the application of learning to the new context may be more likely (Perin 2011).

When addressing adult learning, learners consider the benefits of contextualization to be flexibility and adaptability, enhancement of engagement and motivation by providing relevancy to workforce skills, facilitation of pace acceleration to courses' access and addressing of challenges in the design of traditional developmental and basic skills' education (EDC 2012). The concept of contextualized learning in adult education is not new. It emerged in the early 1940s within military training (Sticht 1997). Since the 1970s, it has been connected to functional content instruction (Sticht et al. 1974), instruction based on learners' immediate needs and "life skills" (Knowles 1980), and the importance of teaching for transfer (Mikulecky et al. 1994).

In this chapter, contextualized adult learning is examined under the scope of training educators in innovative teaching approaches and learning design. Focusing on digital storytelling as a teaching methodology, it is exploited as an approach to teach educators how to teach using it. Thus, contextualization occurs by demonstrating the method to be taught by actually teaching (or learning by the trainees' side) through it. Moreover, additional skills are cultivated, related to ICT, writing, thinking, and more.

Digital Storytelling as an Approach for Teaching and Training

Storytelling is one of the oldest methods of communication and learning, comprising of two constituents, story and telling. According to the Oxford Dictionary, the former is defined as “a narrative, true or presumed to be true, relating to important events and celebrated persons of a more or less remote past; a historical relation or anecdote” and the latter is “the act of communicating information, facts or news to someone in spoken or written words.” For thousands of years, societies have taught key principles through storytelling (MacDonald 1998), such as culture, values, and history (Egan 1989). Great leaders of all types have used stories as instructional tools in the form of parables, legends, myths, fables, and real-life examples to convey important information (Brown and Duguid 1998; Leonard-Barton 1990).

Digital storytelling is the combination of traditional, oral narration with multimedia and communication tools (Lathem 2005). It is a form of art which combines different types of multimedia material, including images, text, video clips, audio narration, and music to tell a short story on a particular topic or theme (Robin and McNeil 2012). Digital stories can be stored or published on the Internet, allowing people to review, critique, and discuss upon them, thus enhancing their educational value and their life span (Lathem 2005).

Since the tools needed for digital storytelling, such as computers, scanners, and digital cameras have become more affordable and accessible, educators’ interest for its application has lately increased. Besides, even novice computer users can become digital media producers and editors, because of the powerful and yet inexpensive software and Web 2.0 applications.

Some learning theorists believe that as a pedagogical technique, storytelling can be effectively applied to nearly any subject. Constructing a narrative and communicating it effectively requires one to think carefully about the topic and the audience’s perspective. Both listeners and narrators have the opportunity to develop their personal and narrative speech, to represent their knowledge, to present their story and receive feedback (Coventry 2008).

Growing up with unprecedented access to technology has changed the way young people, “digital natives”, communicate, interact, process information, and learn (Oblinger and Oblinger 2005). Technological progress is such that communication and interactivity are easier to facilitate (Jenkins 2006), high fidelity and media-rich learning environments are becoming more and more common (Gee 2007), and this contributes to the belief that life and learning in the information age will differ significantly from that of the industrial age (Reigeluth 1999).

When combined with the latest technologies, storytelling has the potential to be used in all settings, including formal, non-formal, and informal education settings as well as work environment, such as medical practice (Heiney 1995; Chelf et al. 2000) or human resources and knowledge management (Swap et al. 2001).

It is considered by many to be a powerful teaching tool (Pedersen 1995), which can be effectively applied in all levels, from kindergarten to university. Digital stories can be created by teachers or students. As educational tools, they can serve as a way to present new material and capture students' attention (Robin 2008).

Also, they can facilitate students' interaction and help make content more understandable (Burmark 2004). Students can express their thoughts, ideas, and opinions and share them with a larger audience, while at the same time, they improve their writing skills by creating their own stories (Gakhar and Thompson 2007). They also become more active and productive in individual or collaborative communication activities (Bratitsis et al. 2012). The most important, however, benefits of the use of digital storytelling regard the development of twenty-first-century skills, such as critical thinking, problem-solving and decision making, collaboration, creativity, innovation, and development of digital literacy (Microsoft 2010). It is a fact that nowadays, children's access to technology has changed the way they communicate, interact, process information, and learn (Obliger and Obliger 2005). Communication and interaction are easier to occur (Jenkins 2006); high fidelity and rich multimedia learning environments are available more and more (Gee 2007), significantly altering the teaching approaches which are used.

There is evidence in the literature of exploiting digital storytelling as an education/training medium in a great number of fields, including mandatory education, adult education, health (narrative medicine), entrepreneurship, and many more. A collective presentation can be found in the products of the T-Story project (http://tstory.eu/). Digital stories act as an educational medium through which also the narrator/storyteller learns, as in his/her effort to deploy the narration and communicate it to the target audience through technology, he/she learns how to incorporate the audience's perspectives, beliefs and needs, in order to better present the story. Under this scope, digital storytelling can be an individual, but also a collaborative process (Bratitsis 2014).

Contextualizing Educators' Training: The Case of Digital Storytelling

It becomes obvious that digital storytelling can be exploited also for training educators within their professional development. Not only it constitutes an innovative teaching approach for them to be trained on how to utilize it, but it can also incorporate the development of several skills, basic and/or advanced. For example, writing skills are enhanced through the deployment of a narration. ICT skills are improved through the process of collecting and creating digital material in order to digitize a story, but also through the process of understanding video creation and online sharing/distribution techniques. Other significant issues are addressed, as discussed in the remaining part of this section.

The case of a training program for educators regarding digital storytelling as a tool or method for educating/training is discussed in this section. Based on its design and implementation, but also through the qualitative assessment via the trainer's observations and contextualization of educator's training, it is discussed on another level. Proceeding further than the incorporated cultivation of skills through implicit learning, this approach proposes the contextualization of training by implementing the actual program, exploiting the teaching method which constitutes the core aim of the program. Thus, in this case, digital storytelling as a teaching method was taught through a training program, completely designed and implemented with the digital storytelling method.

This training program was designed within the T-Story, an EC funded program (project no. 530860-LLP-1-2013-1-IT-KA3-KA3MP) which was realized from November 2012 to October 2014 (24-month duration) by 7 partners in an equal number of countries. The core aim was to train teachers/educators/trainers how to incorporate the digital storytelling methodology. The learner participated in a fictional world with other classmates, following the narration of Dan, the main character of the course's digital story. The handbook and the course were tightly interconnected and complementary. Dan paused his narration occasionally, asking from the learners to consult the handbook and elaborate on the provided material. The handbook contained examples and exercises, but it also provides interactive links, utilizing the Quick Response Codes (QR Codes) for the learners who wished to study even more resources and expand their knowledge.

Guided by Dan and his colleagues, the learner was aided throughout the process of building his/her own digital story, by the end of the course. Thus, by completing the course, the learner did not only familiarize him/herself with digital storytelling techniques and tools, but would have also produced a tangible outcome which would facilitate the deep understanding of the method. The important aspect of this approach was that this product was based on the actual teaching ideas of the learner, thus constituting an indicative case study for him/her.

The training was realized in various manners. The first followed a blended learning approach, combining video lessons, under the scope of digital storytelling, and three 4-h face-to-face workshops. The second was completely online in a self-learning manner. Several combinations were also realized, with less face-to-face sessions with a longer duration.

Based on all these realization cases, contextualization is to be discussed hereinafter, focusing on efficiency of the training and acceptance by the trainees. Contextualization occurred in various manners. The first level of contextualization is that of cultivating several skills through training on digital storytelling, namely ICT-related and writing skills, along with skills related to educational design. Elaborating on this claim, data from a survey conducted prior to the design of the program in order to record training needs is invoked (Bratitsis et al. 2014). Overall, when the respondents of the survey were asked to grade their skills and digital material creation skills, their answers revealed that significant improvement was necessary. Thus, the designed program addressed this issue not by demonstrating specific ICT tools but by requesting from the trainees to actually create material, using any digital tool (online or not) they wished. A theoretical basis and specific examples were only provided. For instance, the results of cropping a digital image were discussed and explained, examples were provided, and types of tools were demonstrated for accomplishing proper training. Then, the trainees were able to select any tool they preferred in order to complete the assigned tasks.

In this manner, the training program was not tool-centered as most of the related programs available worldwide, but approach specific. The trainees were able to complete the assigned tasks with any tool they felt attracted to or by deepening their knowledge regarding tools they were already familiar with. Consequently, their ICT skills were significantly enriched in a way that they could exploit them in the future, considering that they chose freely tools to fit their own comfort. The latter is a significant element of informal computer skills' acquisition (Desjarlais and Willoughby 2010; DeLay et al. 2014). Observations from all the implemented training programs revealed that this approach was efficient, as the final products were rather sophisticated, although many of the trainees were not very confident about their ICT skills at the beginning, expressing their doubts about being able to successfully create digital stories. Opposed to this approach are many of the offered seminars and workshop on digital storytelling which can be found all over the Web, which are mainly tool-specific.

Another level of contextualization was achieved by the actual structure of the training program. Based on questionnaires, filled during the registration process by the trainees (Bratitsis 2014), teachers, especially those serving in the lower grades, were familiar with storytelling as a teaching methodology (over 75 %), and almost all of them were rather confident about their ICT skills, having participated in a nationwide training program about basic ICT skills. Nevertheless, they did not exploit digital storytelling as a teaching methodology at all, although many of them practiced storytelling in various ways (e.g., participating in extracurricular activities about the literature and storytelling or even hosting radio broadcasts about the matter). The main conclusion of the questionnaires' analysis (Bratitsis 2014), aligned with the initial program survey (Bratitsis et al. 2014), was that teachers mainly connected storytelling with amusement and not teaching or it is restricted only to language skills' teaching.

This observation is significant when examining the teachers' initial attempt to design a draft of their own teaching stories for the needs of the training program. They were asked to freely select a topic from their own experience and close to their teaching practices and attempt to create a story, through which they would attempt to teach this topic. Divided into groups of four, they presented their story to their partners in order to receive feedback regarding the clarity of their teaching goals, the conformity with the proper narrative structure, and any possible extensions or improvements. During this process, they were asked to reflect upon their stories and proceed to any possible modifications.

The most important observation from the conduction of these collaborative meetings regards the proper application of the narrative structure (Bratitsis 2014). The trainees were careful enough to formulate the opening statement of their stories, by following the lessons they had participated in, thus answering to the questions: Who, When, Where, and How. This technique is used in order to initiate stories and succeed in positioning the audience in the core of the story, facilitating their own "participation" in the story and its evolvement. Furthermore, the formulated teaching goal was clear in the teachers' presentations, as well as the dramatic question which led to the evolution of the story plot. After this section, most of the stories appeared to have drawbacks. For example, most of them were just making statements instead of highlighting them through a big contrast, for example. The way the teachers approached the issue they wanted to negotiate through their stories resembled traditional, straightforward teaching which is common in real classroom settings. Thus, they were trying to "show" and not facilitate "participation and experience" through their stories, which could lead to comprehension. What became evident was that their perception was rather biased from in-class attitudes and the constraints of the official curriculum which often leads them to adopt a straight forward, teacher-centric approach.

In one of the training programs, a variation of this approach was applied. Due to the large number of participants (about 400) and having a focus on how the process of creating digital stories for teaching can facilitate the cultivation of alternative points of view, the teachers were requested to bring one piece of fruit. Then, they were asked to write its story in a few lines. As expected, most of them described the basic characteristics of the fruit, such as color, shape, and nutritive value. Through a set of questions, they were asked to expand or rewrite their stories, examining the origin of the fruit, its "journey" until the consumption or even the story of its creation and all the creatures related to it. In most cases, instead of extending their point of view, the teachers tried to answer to the indicative questions which were used to explain the corresponding level of examination of the fruit's life cycle. For example, they were asked: "Where did you buy it from? How did it get there? How many hands touched it before you acquired it? What might have happened to one of these people that day?". The answers followed the pattern: "I bought it from the grocery store. Hundreds of hands touched it that day. It arrived there on a truck." Through this approach, what was demonstrated to the teachers was that their point of view was significantly biased by their teaching practice and their initial perception of the fruit. They focused on those qualities of the fruit that are included in nutrition and well-being training programs which are nowadays integrated in the official curriculum, especially in the lower grades.

One could wonder where does training contextualization fit in the discussion of the above paragraphs. The answer lies within the actual structuring of the teachers' participation in the training program. They were asked to work, step-by-step on a topic of their choice, selecting one from their everyday teaching practice. This is very close to the real teaching settings, as the teachers usually prepare themselves and their teaching approach, before entering the classrooms. On the other hand, they were provided with the opportunity to discuss their story designs with peers and experts. This type of feedback is not possible in everyday school life. Following a mentoring–advisory approach, they were confronted with the limitations of their perceptions and attitudes, reflecting upon them and assisted in understanding their handicaps and misconceptions in order to address these issues. Consequently, in a way the trainees were working in real, professional conditions but with an added value; that of expert and peer feedback in order to improve their self-efficacy, challenge their confidence and teaching strategy effectiveness. In this vein, the training programs were carried out in the context of real-life, professional experience, allowing the trainees to better reflect on the efficiency of their teaching strategies and their learning design. The most important aspect was that they were asked to work on a topic which they had approached with another method in class. Thus, they were able to reflect by comparing the different approaches, also by discussing them with peers and experts.

The most important contextualization aspect was that the teachers were trained using the same method as the one they were being trained for. The whole training program was designed and realized under the digital storytelling method. This allowed the teachers to observe, first hand, the efficiency of the method and many details of the design and implementation process. Throughout the training, techniques that were integrated in the program were explained and demonstrated. It is worthy to mention that regarding the multimedia-video design of the training program, several video editing and creation techniques were exploited with a gradual complexity. Thus, there was a transition from faceless sketches to fully detailed video recordings, from camera panning to full motion picture, from comic strips to video scribing, stop motion video, and many more. The trainers were able to explain the aim of using each technique and discuss the efficiency but also the complexity of the technique.

Lastly, a significant portion of the training program regarded the construction of the storyboard of a digital story. A storyboard is a structured description of the elements that constitute the digital story, with details for every scene of the final product. The storyboard can be very abstract or extremely professional and detailed. It is the phase of a digital story design in which all the important decisions are made, and after its completion, implementation with the selected digital tool follows, with no more setbacks. All the audiovisual effects, the audio carpets, the voice recordings, and the required elements are chosen and placed together in this stage. An issue that emerged in this section was that the trainees faced certain difficulties while designing their storyboards. Most of them tried to transcribe their stories upon a series of images which corresponded to the different scenes. Moreover, most of them restricted the use of audio elements to a music carpet throughout the whole story. Eventually, they simply rewrote their stories in a more visual manner. Of course, under the scope of designing a digital story, these actions provide no value to the final product and make this stage obsolete, leading to a more complex implementation process with many drawbacks. For inexperienced designers, this is more or less expected and partially the training programs aim at addressing this issue.

Consequently, these issues needed to be discussed and resolved. In the case of face-to-face sessions, the flaws and the missing elements of the storyboards were discussed in detail by the trainer. In the case one decided to follow the program individually and online, these issues were required to be addressed through the program itself. This was done in a twofold manner; examples of converting small stories to complete storyboards were provided, but also parts of the storyboard of the story which constituted the training program were presented and explained. The latter allowed the trainees to better comprehend the significance of the storyboard but also the connection of the audiovisual effects with the intention of the creator and the actual result. Concluding, this paradigm constitutes another level of contextualization on which the trainees were required to work with tangible artifacts (their own stories, the examples but also the story of the main program) and discover on their own all the requirements and the details. The differentiation from other more traditional training programs is that not only the elements are presented in an abstract and theoretical manner nor collaborative activities are designed, but also the trainees participate in hands-on activities with tangible artifacts, able to connect decisions and results, theory with practice and design with implementation and constructive feedback.

Discussion

In this chapter, the issue of adult training contextualization, educators' training in particular, is discussed. The more wide definition provided by Perin (2011) places contextualization under a constructivist-driven scope, by forming it to be context-specific, meaningful, and useful for the learners. Several frameworks for CTL exist in the literature, with Perin (2011) providing a comprehensive review of them.

Overall, contextualized learning aims at creating conditions for more effective learning by promoting learning transfer and improving information retention Boroch et al. 2007; Stone et al. 2006).

In this chapter, a different form of contextualization in multiple levels was discussed. Examining a training program about digital storytelling as a case study, aspects of contextualizing in-service teachers' professional training were discussed. The success for the training program is not discussed in this chapter, since that is out of its scope, although the program was indeed successful (Bratitsis 2014). The first level of contextualization in the described approach was the most common in the literature, that of incorporating skills in a content-specific program. These skills were ICT-related, which under the scope of the twenty-first-century skills are nowadays considered rather basic ones. The trainees were required to acquire those skills at a certain level in order to complete the assigned tasks. Moreover, the whole approach was meaningful, as all the skills were to be utilized for implementing the final product. Thus, the tangible outcome of the training program elevated meaningfulness and engagement of the trainees.

The second level of contextualization occurred by asking the teachers to work throughout the training on a topic of their choice, directly related to their professional interests. Ideally, this topic should have been something they previously work on within their everyday teaching, using other methodologies. This type of contextualization made the training more meaningful, as it provides a concrete context for comparing elements of digital storytelling with the methodologies the teachers were already familiar with, regardless of which ones those were. Teaching a topic was already a meaningful task. Thus, as discussed earlier, when information is processed and knowledge is acquired in a context similar to that in which they will actually be needed, the application of learning to the new context may be more likely (Perin 2011).

The final and probably most significant level of contextualization is that of implementing the whole training program with the methodology which constituted the actual training material. This way the trainees were able to comprehend in a very straightforward manner the efficiency of the methodology they were taught, but also to examine and elaborate on the design aspects and details of it. They were able to directly connect theory with practice in realistic conditions. Moreover, they were engaged in a learning process which included expert and peer feedback, as opposed to traditional training programs in which feedback is minimal or impossible to be provided when the educator attempts to later exploit the acquired knowledge in his/her class.

This contextualization approach seems to have worked very well. Partially, the success relied to aspect of digital storytelling, such as engagement. On the other hand, this multilevel approach seems interesting to be tested with other training contexts in order to compare observations and findings. In the case of educators' training, direct connection to their teaching practice is always a goal and having them serving as both teachers and students within a training program seems to be the ideal case. More studies should be conducted in order to create a concrete theoretical framework on this matter.

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Part II
ICT in Preschool and Primary Education

Chapter 4
Investigating Young Children's Engagement with Computer Use as a School Activity: A Pilot Study

Kleopatra Nikolopoulou and Vasilis Gialamas

Introduction

Researchers (e.g., Clements and Sarama 2003; Siraj-Blatchford and Siraj-Blatchford 2006; McCarrick and Li 2007; McKenney and Voogt 2012; Howard et al. 2012) agree that the computer can be used as a tool to support learning and assist communication, collaboration, creativity, and language development in young children. The active, appropriate use of technology/ICT can support and extend traditional materials in valuable ways. The teaching and learning research program (Plowman and Stephen 2006) reported that encounters with ICT can enhance key areas of young children's learning, such as dispositions to learn (e.g., by increasing confidence, by supporting independence, and persistence in the face of initial difficulties), knowledge of the world (e.g., learning about mathematics, language), and operational skills (e.g., using a mouse, physical dexterity, or developing hand–eye coordination). Research studies point to the positive effects of technology in children's learning and development, both cognitive (e.g., Kalogiannakis and Zaranis 2012; Binder and Kotsopoulos 2011) and social (e.g., Kumtepe 2006). Regarding the socioemotional domain, children have shown interest in using the computer and improvement in their self-esteem (Hatzigianni and Margetts 2012), while regarding the development of children's fine motor skills research refers to mouse control and

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hand–eye coordination (Parette and Blum 2013; Saçkes et al. 2011). Brooker and Siraj-Blatchford (2002) reported that computer use in kindergarten classroom increased young children's confidence and self-efficacy, and it was also an enjoyment.

In parallel, the role of kindergarten teachers is essential in supporting and improving young children's computer/ICT experiences in kindergarten class (Stephen and Plowman 2008). Maximizing the learning benefits of ICT requires a pedagogy which values pleasure and engagement as well as operational skills. Play and ICT use in kindergarten are often linked, and kindergarten teachers often believe that playing with ICT is an effective mode of learning and developing children's technological competence (Nikolopoulou and Gialamas 2015). Using the computer is now a reality for several kindergartens in Greece (see Chronaki and Stergiou 2005; Fesakis and Kafousi 2008; Nikolopoulou 2014), while the National Curriculum for ICT in preschool and primary education states: "(children) use software and internet services… integrating ICT in kindergarten's daily activities as teaching aids, as investigative and problem-solving tools, as well as for digital literacy, expression, creation, communication, and collaboration" (YPEPTH-PI 2012). Indicatively, the section "I familiarize myself with ICT and I create" refers to the acquaintance, familiarity, understanding of the basic functions, and the progressive autonomy in the use of the computer system, the section "I explore, I experiment, and I discover with ICT" refers to the use of educational software (open ended problem-solving activities software as well as closed problem-solving software), while the section "ICT in society and culture" refers to the development of attitudes and social skills. The USA National Association for the Education of Young Children and the Fred Rogers Center reported that technology/ICT are tools that can promote effective learning and development when they are used intentionally by early childhood educators, within the framework of developmentally appropriate practice (to support learning goals) and they also reported principles to guide technology use in early childhood programs (NAEYC and FRC 2012). They stated that when technology is used appropriately, it can enhance children's cognitive and social abilities. Due to the above, both the empirical evidence and the curricula requirements associate computer use in kindergarten with different domains such as cognitive, socioemotional, and fine motor skills domain.

In Greece, although there some research studies regarding computer use/integration in kindergarten classes, this use has hardly been assessed in relation to different domains. Children's assessment by their teachers may assist, among others, in providing feedback and in improving the learning process. This paper is a pilot study aiming to investigate children's engagement in computer use as a school activity. In particular, it aims to investigate their engagement in different domains identified in the literature such as knowledge, skills, and socioemotional. For the purpose of this paper, specific terms used are briefly explained. Initially, the term *computers* is used as synonymous and as more preferable to the terms *ICT* (Information and Communication Technology) and *technology*. Apart from computer software, a number of products that incorporate some aspects of ICT are available to young children such as electronic-musical keyboards, programmable interactive toys, and digital cameras. However, practitioners define ICT more narrowly as computers and printers and this view is very influential (Stephen and Plowman 2008) till now. The term *kindergarten* is used as synonymous to the terms *early childhood setting* and *preschool*. This term refers to kindergarten classrooms (formal educational settings) that attend children above 3 years old. The aim of this study was to investigate young children's engagement in computer use in kindergarten (knowledge, skills, dispositions, and feelings displayed around the classroom computer).

Methodology

Research Objectives

The objectives of the pilot study were the following:

- To investigate the degree of children's engagement with the computer in kindergarten class.
- To determine the relationship between children's engagement with the computer and specific characteristics (gender, age, access to computer at home, frequency of computer use in class).

Furthermore, a specific objective was to determine the limitations of the pilot study in order to design better the main study. The investigation of other factors, such as the effect of the type of software and class organization, was beyond the scope of this study.

Sample

Twenty-nine children from twelve different state kindergartens in Athens, Greece, participated in this study. Ten kindergartens had only one computer, and the rest (two kindergartens) had two computers. The age range of children in Greek kindergartens is between 4 and 6, 5 years old. Table 1 shows the distribution of children by age group and gender. The majority of children were 5–5.5 years old, as the attendance is obligatory for this age group. The degree of each child's engagement/involvement in computer use was recorded by his/her teacher (the data collection instrument is described below). The teachers were all women, they were

Table 1 Number of children by gender and age group

		Girl count	Boy count
Age group	4–4.5	2	1
	5–5.5	8	16
	6–6.5	1	1
	Total	11	18

working in different kindergartens, and during autumn 2013, they were doing their practice—as part of B-level teacher training in ICT (YPEPTH 2014). Their participation in the pilot study was voluntary. The teachers were asked to select children who would have their first contact with the computer in kindergarten (preferably not to have a computer at home). Regarding ethical research practice, permission was gained from the gatekeepers–teachers.

Research Instrument and Procedure

A questionnaire was used for children's assessment, which was taken from the relevant literature (Brooker and Siraj-Blatchford 2002). According to these researchers, all statements of the questionnaire (a) were based on evidence from classroom observations in preschools and (b) they were in line with Katz's (1995) suggestion that all of early childhood education should be assessed in terms of knowledge, skills, dispositions, and feelings. The questionnaire was selected because it explores children's engagement with the school computer, holistically, i.e., apart from knowledge and skills, it investigates children's feelings, dispositions, and social behavior displayed around the classroom computer. The questionnaire included 10 statements/items (S1–S10) corresponding to five categories: The items S1 and S2 correspond to the category "knowledge (hardware and software)," the statements S3 and S4 to the category "skills (mouse control, coordination)," the statements S5 and S6 to the category "dispositions (exploration, resilience)," the statements S7 and S8 to the category "feelings (enthusiasm, enjoyment)," and the items S9 and S10 to the category "social behavior." For example, the item S3 regards the child's skill to control the mouse ("Handles mouse appropriately and can use it to point and click"), the item S7 regards the feeling of "enthusiasm" ("Enthusiastic and eager to work at computer"), while the item S9 regards an aspect of social behavior ("Enjoys sharing computer experience with peers, in operating or supporting role"). For each of the 10 items of the questionnaire, the answer had to be given in a scale of 1–5: number 5 (strong statement) expresses the highest degree of conquering the content of the item, while number 1 (weak statement) expresses its complete absence. The items of the questionnaire were in line with the axes of the Greek ICT curriculum for kindergarten. As the second part of the questionnaire, we added some questions regarding specific characteristics of the children (age, gender, access to computer at home) and the kindergartens (number of computers, ways of computer use from September to November 2013, type of software, frequency of computer use in class).

The questionnaires were distributed to the twelve kindergarten teachers mid-September 2013, and they were returned back in November 2013. They were anonymous, and each questionnaire was completed by the class teacher for each child separately. Each kindergarten teacher returned one to four questionnaires, i.e., she assessed one to four children in her class. The selection of children was made by the teachers. The condition set by the researchers was, for the participant children, to use the computer for first time within the class environment (and preferably not to have a computer at home). For this reason, the study was conducted at the beginning of the academic year (early autumn), when children begin to use the computer in kindergarten class as a school activity.

Results and Discussion

Degree of Children's Engagement in Computer Use in Kindergarten class

Table 2 shows the frequency responses (n = 29 children) by scale (1–5) on the 10 statements of the questionnaire. Regarding the category "knowledge," most children were assessed within the scale numbers 1 and 2 (minimum conquest of statement content). Out of 29 children, 22 and 23 children had minimal prior knowledge for items S1 and S2, respectively; they had little initial knowledge in tracking programs/applications and in navigating around programs. This means that

Table 2 Frequency responses (n = 29 children) by scale (1–5) on the 10 statements of the questionnaire

10 (strong) statements (and their correspondence to the categories: knowledge, skills, dispositions, feelings, social behavior)	1*	2	3	4	5*
S1 (knowledge 1: hardware). Knows how to set up the computer and locate programs	11	11	4	3	0
S2 (knowledge 2: software). Knows how to navigate routes through one or more programs	16	7	3	3	0
S3 (skills 1: mouse control). Handles mouse appropriately and can use it to point and click	0	11	10	6	2
S4 (skills 2: coordination). Handles mouse successfully and can use it to drag and drop objects on screen	4	9	7	7	2
S5 (dispositions 1: exploration). Keen to experiment with computer and with unfamiliar software and techniques	4	2	11	9	3
S6 (dispositions 2: resilience). When experiencing difficulty, error or failure, is spurred to keep trying or make more effort	3	4	15	5	2
S7 (feelings 1: enthusiasm). Enthusiastic and eager to work at computer	1	2	10	12	4
S8 (feelings 2: enjoyment). Appears relaxed and happy while working at the computer	1	2	13	8	5
S9 (social behavior 1). Enjoys sharing computer experience with peers, in operating or supporting role	2	3	4	14	6
S10 (social behavior 2). Takes turns without difficulty and surrenders to another child cheerfully	2	9	3	11	4

*Number 5 in the scale expresses the highest grade of conquering the content of the item (strong statement), in contrast to number 1 which expresses its complete absence (weak statement) children did not have the specific knowledge before using the computer in class, an issue which highlights the essential role of the school in the whole process of learning with/about ICT. The assessment of children appeared higher in the category "skills," where the majority of the children (27 and 23 children for statements S3 and S4, respectively) were assessed within the scale numbers 2 (a little), 3 (moderate), and 4 (good). Interestingly, the highest assessment results appeared for the categories "dispositions" and "feelings." Most of the children (22 or more, out of 29 children) were assessed within the scale numbers 3 (moderate), 4 (good), and 5 (very good), and in particular within the middle scale (3 and 4). This means that although the children lacked knowledge of how to navigate around a program or their mouse skills were still low, they did show interest in experimenting with the computer and they were happy when they were working at the computer corner. This finding is in agreement with earlier research which revealed young children's interest in technology (Parette and Blum 2013). Additionally, there is an agreement in that computer use in kindergarten facilitates the socioemotional development of children (see Howard et al. 2012; Hatzigianni and Margetts 2012); for example, it improves children's self-esteem, cooperation, and communication skills.

With regard to the categories "dispositions" and "feelings," some excerpts from teachers are presented here: "Computer use helps him in strengthening his self-esteem—he feels he has grown up and in this school he deals with something important… he becomes increasingly better" (child 1); "He had no contact with the computer at home, only with the play-station. He is willing to use the computer but he will not choose it by himself—unless his friend selects it or I ask him" (child 6); "Acceptance of the computer with enthusiasm but with little uncertainty as to its operation" (child 15); "While initially he had no contact with the computer, later, he changed his attitude and he was looking for it more often during the free activities" (child 23).

Provided that the frequency of computer use per child was once a week and that the questionnaires were completed within the first months of the academic year, the children had used the computer in class for a few times (5–7 times). Regarding the way of computer use in kindergarten class, the teachers reported that it was mainly used during the hour of free activities, at the computer corner. This confirms an earlier study (Nikolopoulou 2014) carried out in 17 state kindergartens in Athens, which revealed the computer to be predominantly used during the hour of free activities. In this study, the teachers stated that the computer was used as an empowerment tool in their daily teaching practice, as an entertainment tool and for searching information in the web. For example, it was reported that it was used for acquaintance with the parts of the computer, for familiarization with the use of the mouse, for exercising the drag-and-drop technique, and for saving and printing files. All the ways mentioned by the teachers are in accordance with those suggested by the Greek kindergarten curriculum. The software programs used were mostly, those proposed/exercised in B-level teacher training in ICT course (such as Tuxpaint, Revelation Natural Art, Kidspiration, and Puzzle programs).

The questionnaire is useful because it contains statements related to different domains: cognitive, socioemotional, and fine motor skills domain. However, it is more useful to be combined with qualitative data such as classroom observations and interviews with kindergarten teachers. The lack of qualitative data was a limitation of the pilot study, and it is discussed in the last section. The questionnaire was completed at the beginning of the academic year, when children begin to use the computer at school. The interdisciplinary curriculum framework (D.E.P.P.S) for kindergarten (YPEPTH-PI 2003) reports that children's assessment—as a pedagogical act—is a continuous process, is being spread during the daily teaching practice, and is formative as to the ways and techniques. This questionnaire is proposed to be used throughout the academic year, in order to become a part of the individual child's portfolio, associated with the section "familiarization and use of a computer."

Relationship Between Children's Engagement in Computer Use and Specific Characteristics

It was found that none of the five categories (knowledge, skills, dispositions, feelings, and social behavior) was statistically significant associated with the individual characteristics "age," "gender," and "computer use in kindergarten." The frequency of computer use was mainly once a week or several times a week. The absence of significant correlation with the frequency of computer use (by the child) may be due to the homogeneity of the frequency of use, among different children. The only significant correlation was between each of the categories "knowledge," "skills," and "social behavior" with the characteristic "access to a computer at home." Sixteen out of 29 children had a computer at home. Table 3 and Fig. 1 show the relationship with this characteristic. Those children who had a computer at

Table 3 Mean values on categories for the characteristic "access to a computer at home"

5 categories	Children's access to a computer at home			
	Yes (n = 16)		No (n = 13)	
	Mean value	Standard deviation	Mean value	Standard deviation
Knowledge (hardware and software)	2.31_a	1.05	1.31_b	0.43
Skills (mouse control, coordination)	3.25_a	1.08	2.42_b	0.73
Dispositions (exploration, resilience)	3.06_a	1.08	3.08_a	0.93
Feelings (enthusiasm, enjoyment)	3.66_a	0.77	3.35_a	0.97
Social behavior	3.84_a	0.87	2.92_b	1.10

Note Mean values of the same row with different indices differ significantly ($p < 0.05$) in the 2-sided test

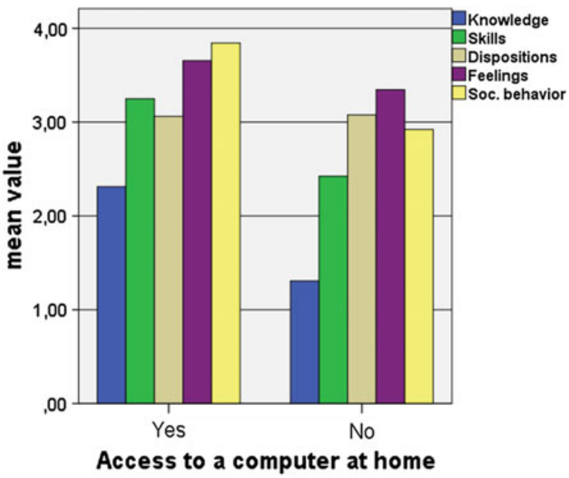

Fig. 1 Mean values on categories and children's access to a computer at home

home had higher mean values for the categories "knowledge" (2.31 vs. 1.31 for those not having a computer), "skills" (3.25 vs. 2.42), and "social behavior" (3.84 vs. 2.92). This finding is consistent with earlier research which showed that access to and use of a computer at home affected children's performance in class (Espinosa et al. 2006). According to Saçkes et al. (2011), availability of a computer at home was a statistically significant predictor of children's baseline computer skills in kindergarten. Of course, access by itself is not enough to favor young children; thus, more qualitative data is needed.

Conclusions

This paper regarded a pilot study. Although the findings cannot be generalized, they contribute to the ongoing debate regarding computer/ICT use in kindergarten class. The questionnaire used investigates young children's engagement in computer use holistically: Besides knowledge and skills, it investigates children's feelings, dispositions, and social behavior. This study adds to the body of evidence regarding children's overall development when using a computer in the classroom. Taken into account that computer is typically used during the free play activities of kindergarten classroom (Ljung-Djärf 2008), it is also important to know children's feelings and dispositions around the computer corner. The questionnaire is proposed to be completed by the teachers at the end of the different academic semesters, so as to become part of each child's portfolio (e.g., in relation to the child's familiarization and use of a computer). Each child's assessment could be continued by recording his/her participation and behavior at the computer corner. Regarding the questionnaire, it could be enhanced, maintaining the same five categories, by adding statements associated with (i) other aspects (sections) of different countries' curricula for ICT in kindergarten and (ii) the educational material for B-level kindergarten teacher training in ICT (Komis 2010). For these to happen, the role of early childhood educators is very important.

To make informed decisions regarding the use of ICT in ways that support children's learning and development, early childhood educators need information and resources on the nature of these tools and the implications of their use with young children (NAEYC and FRC 2012). For example, early childhood teachers need guidance to make decisions about how to support learning through ICT, when and how to integrate appropriate digital technology in kindergarten classroom. This has implications for early childhood teacher training and their professional development. Quality professional development provides, for example, opportunities for hands-on technology training, a balance of appropriate activities, and ongoing support. Also, effective early childhood teachers recognize their roles in strengthening desirable dispositions in children. According to Bertram and Pascal (2002), dispositions (such as resilience, social competence, and self-concept) are linked to effective learning.

The pilot study revealed some limitations which must be considered in further research. The limitations include the small sample of children, the use of only a quantitative instrument, and the lack of data on how children use the computer in the home. The completion of this questionnaire should be combined with classroom observations and interviews with the teachers, because the combination of qualitative and quantitative data leads to a more complete investigation and interpretation of a situation. For example, the effect of the type of software and the organization of activities could be revealed via the use of qualitative data/techniques. It would also be useful to collect data regarding children's computer use at home, as this characteristic seems to affect specific knowledge (for hardware and software), skills (mouse control, coordination), and social behavior, during the process of computer use in class. This finding warrants further consideration as researchers showed that those children who have access to ICT outside the school have already acquired some technological/digital experiences before they attend kindergarten (Zevenbergen and Logan 2008). Future research is suggested to take into account previous ICT experiences of children, experiences mainly acquired at home. This process could, in combination with other activities, strengthen the link between kindergarten and home. This questionnaire is proposed to be used with other preschool populations, as well as in other countries in order to identify possible similarities and differences.

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Chapter 5
Using a Research-Based Learning Environment's Appropriation, as the Context for a Professional Development Intervention in ICT Integration in the Classroom

Vassilis Kollias, Athanasios Davaris, Apostolos Daropoulos and Konstantinos Zaganas

Introduction

Concerns are often voiced in the literature about the limits of ICT implementation in classrooms, and different kinds of barriers obstructing high-quality ICT implementations have been pointed out (Bekcer 2000; Ertmer 2005). The point here is that even when teachers embrace technology, their current practices, their beliefs, or the context of their work become obstacles toward achieving the potential that technology can offer (Cuban 2001; Eteokleous 2008; Player-Koro 2012). Professional Development Training Programs have been the main means to address challenging aspects of ICT implementation that pertain to teachers, but their design is still a challenging problem. Even under quite favorable conditions, teachers' practices turn to be very recalcitrant and the quality of ICT implementations to be

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limited (Karasavvidis and Kollias 2014). That motivated us toward experimenting with teacher professional development work that explores new designs.

Research in teacher professional development has brought forth important dimensions and best practices (Avalos 2011; Desimone and Garet 2016; Postholm 2012). In a recent review, Desimone and Garet (Desimone and Garet 2016), based on research data from US schools, reaffirm (Desimone 2009) minimum features that teacher professional development should secure: "activities that are focused on subject matter content and how students learn that content," "opportunities for teachers to observe, receive feedback, analyze student work, or make presentations, as opposed to passively listening to lectures," "content, goals, and activities that are consistent with the school curriculum and goals, teacher knowledge and beliefs, the needs of students, and school, district, and state reforms and policies," "activities that are ongoing throughout the school year and include 20 h or more of contact time," and "groups of teachers from the same grade, subject, or school participate in PD activities together to build an interactive learning community." However, they point the difficulty in supporting teachers to master inquiry-oriented instructional techniques (or to improve their skills in reflective practice). In her overview of ten years of research in professional development in "Teaching and Teacher Education," Avalos (2011) points to the importance of reflection processes, often through involvement in research, for teacher professional development and the power of teacher colearning culminating in workshops that support collaboration and joint projects. Moreover, "to move from colearning through talk to colearning through observation and feedback is necessary as well as effective." Finally, she points to the revision of the "master role" of the teacher educators in various studies toward more egalitarian patterns of participation. Finally, Postholm (2012), reviewing studies in teacher professional development, points to the importance of formal continuing education courses and lectures but also the importance of learning at school. With respect to learning at school, organizational support should include support of professional learning, teacher involvement in cooperating activities, and cooperation with external resource persons, space for teacher autonomy, while individual teacher involvement should lead into thus becoming self-regulated in their own learning process. Moreover, teacher trainers should contribute their knowledge while interacting in the teachers' arenas.

The above review of the teacher professional development literature gives helpful guidelines toward designing professional development interventions. In the current research, we focused on these aspects of professional development that emphasize teacher autonomy, teacher reflection, and teacher development into self-regulation. For this reason, we turned to the theoretical formulation of transformative learning provided by the work of Mezirow (1997a, 1997b, 2003, 2009) and his guidelines with respect to effecting transformative learning.

"Transformative learning is the process of effecting change in a frame of reference" (Mezirow 1997b). Frames of reference (or meaning perspectives) are the structures of assumptions through which we understand our experiences. Mezirow (1997b), and they are comprised by habits of mind (or meaning perspectives) and points of view (or meaning schemes) (Kitchenham 2008). Habits of mind work as entrenched presuppositions that filter the way the learners interpret the meaning of experience and are difficult to change while points of view are feelings, attitudes, and value judgements referring to particular situations of which we have conscious awareness and are easier to change. There are distinguished (Baumgartner 2001; Mezirow 1997b) four components in the learning process suggested by transformative learning: experience (a challenge that sets the process going), critical reflection (the learner faces assumptions and beliefs that are brought up in the process and examines them), reflective discourse (the learner constructs the new meaning through discussions with others about the assumptions or beliefs), and action (where learner makes further decisions about necessary changes). Mezirow (2009) has also proposed a sequence of steps that to a certain degree describe the path of transformative learning

- "a disorienting dilemma;
- self-examination with feelings of fear, anger, guilt, or shame;
- a critical assessment of assumptions;
- recognition that one's discontent and the process of transformation are shared;
- exploration of options for new roles, relationships, and action;
- planning a course of action;
- acquiring knowledge and skills for implementing one's plans;
- provisional trying of new roles;
- building competence and self-confidence in new roles and relationships; and
- a reintegration into one's life on the basis of conditions dictated by one's new perspective."

Therefore, the goal of this research has been to design, implement, and assess a professional development intervention that would combine Mezirow's steps of transformative learning with good practices provided by the review of the literature in teacher professional development. With respect to the participants of the intervention, the goal was to bring forth and reflect on habits of mind that have not previously been open to reflection. Mezirow (Kitchenham 2008) distinguishes three types of reflection: content reflection, process reflection, and premise reflection. Since premise reflection (the reflection on hidden assumptions) is the kind of reflection related to changes of frame of reference, our design aimed toward supporting this kind of reflection.

In our design, a primary school teacher, a primary school teacher consultant, a junior researcher and a senior researcher formed a working group (WG) that adapted, implemented, and assessed a research-based learning environment (RBLE). The RBLE was a science education environment supported by ICT and produced by a foreign research team (it is described in what follows as a Foreign Research-Based Learning Environment or FRBLE). A learning environment, like a literature text, is embedded in a system of similar artifacts in its own cultural environment. Actually, the moves that translation theorists describe relative to the process of translation (Steiner 1998) are similar to the ones experienced in learning environment adaptation in a new cultural context. After the first moves that refer to the translator been attracted by and then aggressively approaching the artifact, there comes the third move where "there are innumerable shadings of assimilation and placement of the newly acquired ranging from the complete domestication… to the permanent strangeness and marginality of an artifact such as Nabokov'v 'English language' Onegin" (Steiner 1998 pp. 314–315).

In our case, it is this extreme pole of "permanent strangeness and marginality" that we tried to realize by insisting to appropriate the FRBLE—although coming from a different tradition in science education—staying as faithful as possible to both the form and the content of the initial FRBLE. The challenge of implementing the FRBLE consisted the extended "experience," the disorienting dilemma in Mezirow's terminology, that prompted critical reflection and reflective discourse from the part of the members of the WG. Since what was to be done (content reflection) was already specified in the FRBLE and the way to be done (process reflection) was open just to the questions of clarification, the main reflective activity referred to seeing the larger view of what is operating within the WG's value system (premise reflection) which according to Mezirow is conductive to transformation in the meaning perspective (habit of mind) (Kitchenham 2008).

Our design combined also good practices found in the professional development literature with good practices on how to create conditions for transformative learning. There was a small group setting, and in particular, the WG was comprised by both researchers and teachers who had previously worked together, creating curricular material according to the participatory design paradigm (Kensing and Blomberg 1998) in the CoReflect Project. This feature is in accordance with creating a "safe, open, and trusting environment" (Baumgartner 2001). Moreover, the fact that the FRBLE was designed according to a different science education tradition than the one espoused by the researchers in the WG helped in relinquishing authority and position power from the side of researchers (Baumgartner 2001).

Method

The research reported here was possible thanks to the authors' participation in the European collaboration project "Digital Support for Inquiry, Collaboration, and Reflection on Socio-scientific Debates" (CoReflect www.coreflect.org). During this project, the participating mixed teams of researchers and teachers had to design and implement inquiry learning environments centered around socioscientific issues. The environments were supported by STOCHASMOS (www.stochasmos.org), an authoring tool for the creation of web-based learning environments supporting students' scientific reasoning through scientifically authentic investigations. Part of the project work included the translation and adaptation of each learning environment in a different language and educational system and its subsequent implementation and assessment (Kyza et al. 2014).

Participants and Setting

The participants in this research were a senior researcher, a junior researcher, a primary school teacher, and a primary school teacher consultant. They comprised the working group (WG). They interacted with the foreign working group (FWG) who authored the FRBLE (the FWG was comprised by a senior researcher, a Ph.D. student, and a school principal). The WG's main theoretical influence in science education was the conceptual change paradigm (Vosniadou and Maison 2012) and the consequent directions with respect to science teaching (Duit and Treagust 2012).

The WG organized its work along the following phases. These phases were on the one hand dictated by the flow of work in the international collaboration and on the other hand by the steps of transformative process described by Mezirow (2009):

1. The WG interacted with the FWG about the FRBLE, while the FWG was designing it—the FRBLE was not yet available to the WG. There have being two face-to-face meetings as part of the Coreflect collaboration meetings. Notes were taken during these meetings and e-mail exchanged after the meetings. At this time, we expected a mild disorienting dilemma
2. The WG got the FRBLE (implemented in STOCHASMOS) and the teacher guide for the FRBLE. In this phase, the "disorienting dilemma" took new intensity leading to the registration of negative feelings and the realization of a clash of assumptions between the FWG and the WG. The WG collected questions to be addressed to the FWG from all its members, through e-mail exchange and an f2f meeting where notes were kept. These were sent to the FWG, and feedback was provided by the FWG (acquiring knowledge and skills for implementing one's plans)
3. Subsequently, there has been a virtual meeting of the WG in which the main open issues were discussed and decisions were taken about the final form of the adapted environment. This meeting was recorded. This was a very important event. Not only emotions and frustrations could once more been aired, but there could take place recognition that one's discontent and the process of transformation are shared, critical reflection on assumptions and exploration of new roles and relationships in the group.
4. Once the translated and adapted FRBLE was ready—through the work of the WG—the FRBLE was implemented in a fifth-grade classroom and the intervention was assessed using the tools provided by the FRBLE. Moreover, the lessons were also observed by the junior researcher, and e-mails reflecting on the implementation were exchanged. Finally, after the implementation, the members of the WG exchanged mails referring to their observations from the implementation of the FRBLE and their reflections (assessment of assumptions; explorations of options for new roles; relationships; and action)
5. While the project was still going on, there was discussion among the members of the international collaboration about producing a collaborative article on the process of adaptation of FRBLEs. The process of writing the successive drafts of the current article was extended in time (more than 3 years), and during this

time, many issues came forth and were recorded in the exchanged e-mails (critical assessment of assumptions; exploration of options for new roles, relationships, and action; and provisional trying of new roles).

Research Questions

The goal of this research has been to design, implement, and assess a professional development intervention that would combine Mezirow's steps of transformative learning with good practices provided by the review of the literature in professional development. With respect to the participants of the intervention, the goal was to bring forth habits of mind that have not previously been open to reflection. We therefore were interested in recording habits of mind that referred to both teaching with ICT and teaching in general that surfaced in the reflective discourse of the group and in assessing limitations in our professional development design measured by means of Mezirow's theory.

The research questions that we posed were as follows:

What points of view and habits of mind related to the implementation of inquiry environments supported by ICT in the WG's local context were brought forth through critical thinking and reflective dialogue?

Did the particular process of FRBLE adaptation bring forth new opportunities and capacities for learning for the participating members?

What signs of inefficiency of this process of teacher professional development have been recorded?

Data Sources and Analysis

Data sources included notes (from the meetings between the WG and the FWG and the f2f meeting of the WG), e-mail exchanged between the members of the WG, and the transcripts of the virtual WG meeting.

The questions of Phase 2, which came both from e-mail exchanges and notes from f2f meetings of the WG, were categorized according to what was the type of information request (clarification, questions about the rational, questions about the context, indirect suggestions of change) addressed to the FWG and then they were assigned to steps in the sequence of transformative learning provided by Mezirow. They were also assessed according to the type of critical reflection that they supported. Mezirow (1997a) analyzes the critical reflection of assumptions (premise reflection) into narrative critical reflection (bringing forth the participants' own experiences in a narrative form and relating them to the transformation that they face), systemic critical reflection (which refers to taken-for-granted cultural influences), therapeutic critical reflection (examining one's problematic feelings and related consequences), and epistemic critical reflection (when one reflects on the history behind being predisposed to learn in particular ways).

With respect to the rest of the data sources, there was used summarizing content analysis (Mayring 2004). The two researchers and authors of this article concentrated on concerns and affordances voiced by the WG members with respect to the FRBLE and its implementation in the Greek context and on comments on the learning dynamics of the WG. They then gradually developed the categories that better expressed the issues in the data sources. However, this category formation was led by consideration of the steps of Mezirow's transformative learning and the types of Mezyrow's premise reflection. Therefore, there was used a combination of inductive category formation and structuring content analysis (Mayring 2004)

The results of the summative assessment questionnaires provided by the FWG to assess student motivation and student knowledge gains are reported in this research as factors that influenced the learning trajectory of the WG, so the details of the relevant instruments do not interest this research.

The FRBLE

The FRBLE (Van der Meij et al. 2011) was designed within the paradigm of learning by design and was addressed to fifth- and sixth-grade students. It consisted of 8 two-period lessons. The students had a mission: to construct a prototype of a house in the moon. The students were guided toward breaking the initial challenge into (predetermined) subchallenges and were scaffolded toward organizing and transforming their knowledge and toward following a principled design process. However, there was limited concern about the misconceptions that students might have with respect to the scientific concepts involved. This feature of their design was in strong contrast with the theoretical priorities of the WG. During these lessons, the students were searching in the STOCHASMOS database, constructing 3-D artifacts, negotiating over resources, and reflecting on the process and content of the lesson.

Results

Phase 1: Concerns Emerging in the WG and FWG Interaction Before the FRLBE Material Was Available

The initial information that was provided relative to the FRLBE ensured that no hard constraints of the Greek educational context were trespassed. At this stage, most "foreign" aspects of the FRLBE were experienced as quite attractive and potentially educative for the members of the WG: a learning-by-design activity which had also a significant part of hands-on construction work and was using new didactical techniques. The fact that the national culture of the FWG was strong on engineering and design and that the FWG in particular had experience with this type of design increased the credibility of the expected FRLBE. The notes kept in the meeting of the two groups show, however, a mild “disorienting dilemma” as the WG members were finding difficult to imagine how the goals stated by the FWG could be realized in 8 two-term periods: The conceptual goals were addressing many physics concepts that are known, in the conceptual change literature, to be hard to learn.

Phase 2: Questions Addressed by the WG to the FWG once the FRLBE Material (Implementation in STOCHASMOS and Teacher Guide) Were Available

Upon receiving the full FRLBE curriculum materials, the members of the WG realized the disorienting dilemma in a much sharper sense: “How could a credible source provide us with such, from the WG’s theoretical perspective, ineffective design?” Moreover, with respect to ICT use in the FRBLE, the WG assumed that the STOCHASMOS digital environment would carry the weight of bringing in new information producing cognitive conflict toward the change of misconceptions. In the FRBLE however, STOCHASMOS was the carrier of questions suitably attributed to particular actors (scientist, engineer, astronaut) aiming to support inquiry. In their e-mail exchanges, the WG members expressed their fears that the FRBLE might not be up to the expectations of the curriculum and that the students would feel uncomfortable with the environment.

However, the decision to stay as close as possible to the FRBLE design (the plan of action) was pushing WG members toward trying to understand the gap between them and the FWG. There appeared arguments supporting the FRBLE design, claiming that the FWG group focused on supporting students toward reorganizing knowledge that the students already had, for the most part, so that this knowledge would be applicable to practical problem solving. Although this did not eradicate emotions of unease on the part of the WG, it made it easier to go on with the collaboration. We categorize this as an instance of epistemic critical reflection since it questions the reasons of the WG’s preference for the conceptual change approach to science education. On the other hand, the expectation of strong information content in STOCHASMOS led to systemic critical reflection.

The decision to implement FRLBE as faithfully as possible to the specifications provided led furthermore to extensive use of the step “acquiring knowledge and skills for implementing one’s plan.” This was expressed through the large number and the variety of questions that were asked to the FWG. 49 questions were collected and addressed to the FWG group. Table 5.1 shows the questions categorized in groups by the researchers.

Table 5.1 Categorization of questions addressed to the FWG by the WG

Type of question (# of questions)	Examples
Requests for Clarification: (24) of the goals of the FRLBE and the connection between goals and assessment tools (8) or of the specific ways that didactical methods are to be implemented (16)	"Do we have a mapping between the questions in the knowledge questionnaire and the goals stated?" "Are 10 min (sometimes 5 min) enough for the presentation of ideas and for critical exchanges?"
Questions about the source context: (16) How did specific directions for the teacher and the students played out in reality on the FWG context (9) Exploration of cultural differences between the WG and the FWG broader culture that might be relevant to the implementation (7)	"Did the issue of air leaks and air pressure immerge at all?" "How familiar are children in your country with water recycling, water conservation etc.?"
Indirect (reasoned) pleas for change through (5) Additional content (rational: provision for unintended directions that student investigation could take) (3) Variations in the schedule provided by the teacher guide asking whether in that case the fidelity to the designers' intentions would be trespassed. (2)	"The phases of the moon do not appear at all in the content. How come?" "Is it OK if in the case there is no collaboration among schools we do two classes per week?"
Questions about the rationale behind didactic methods proposed in the teacher guide (4)	"In many instances you not only ask for information/knowledge from the students but also their feelings, their evaluation. Please comment on this choice"

The majority of the questions (28 questions: first and last category) are indicative of the WGs purpose to stay faithful to the FWG's design principles and are in concert with "acquiring knowledge and skills for implementing one's plan." These are questions that promote a deeper understanding of the FRBLE and its rational and therefore help follow the details of the FWG's intentions.

The questions in the second category express the WGs desire to understand the grounding of the FWG design in the FWG's context and indicate thus the openness to new experience that characterizes transformative learning. These questions addressed aspects of general culture (e.g., student experience with negotiations through family life and school life), school culture (e.g., what is OK to be discussed publicly in schools), and teacher culture (e.g., the degree of detail that is expected from a teacher guide). They also addressed specific instances of the design asking concrete details about the way it would run in a Dutch school. They correspond to "exploration of options for new roles, relationships, and action," and through the requested narrative, the FWG could provide means for narrative critical reflection to the WG.

Finally, the questions in the third category express concerns about the design, but they come through as implicit suggestions leaving the center of control to the FWG.

Phase 3: The Virtual WG Meeting

During this virtual discussion, there emerged both points of interest and appreciation, referring to new learning opportunities for the participants, and points of concern.

Points of interest and appreciation that were voiced were the existence of educational goals that were not well represented in the Greek curriculum (e.g., learning to negotiate about limited resources), the new didactical approaches (e.g., learning by design), and the new didactical techniques (e.g., silent writing, scaffolding questions tailored for learning by design). The use of STOCHASMOS as a carrier of well-situated questions that supported the inquiry was experienced in an ambivalent way: both as a point of interest and as a point of concern.

The points of concern that were voiced in the virtual meeting focused on educational goals, students' responses to limited new content, and possible obstacles that could hamper the implementation (see Table 5.2).

Since the limited content was such a strong point of concern for the WG, the WG went for a very minimal change, adding a tab in STOCHASMOS that could work as a security fuse. This tab had additional information that would not be initially accessible to the students. However, if the teacher would feel really hard-pressed by the students, he could make it available.

The concerns were also opportunities for bringing forth divergent views among the members of the WG having to do with the role of content in an inquiry supported by ICT and with student motivation. Although the participants were based on their predictions in different sources (scientific literature, practitioner's experience), the foreignness of the new environment intensified the sense of "recognition that one's discontent and the process of transformation are shared." In particular, the teacher was excited for the prospect of "provisional trying of new roles."

After the meeting was recorded, the researchers heard it again and extracted the main themes that emerged (the ones mentioned above). These themes were further used to support continuing interaction in the WG by e-mail, through a process of reflection and discussion that centered around two main issues: the FWG's lack of concern with students' misconceptions and the minimal presence of new factual knowledge.

At this point, one could say that two important habits of mind of the WG were brought forth: (a) working with rich new content as an essential part of teaching with ICT, instantiated in a variety of specific meaning schemes referred to all the specific cases where teacher–student interaction was mediated by rich content and (b) understanding new and counterintuitive "truths" as the essence of significant learning instantiated in a variety of specific meaning schemes where students come to see things in a completely new light. However, it should be noted that in the

Table 5.2 Concerns voiced in the virtual WG meeting

Concerns	Questions that express the concerns
Concerns about the educational goals of the FRBLE	Is the FRBLE lowering the standards of a good science lesson because it is not concentrating on misconceptions? (In the FRBLE design there was limited new knowledge provided or opportunities for cognitive conflicts)
Concerns about students' possible responses to an environment organized around limited new content	Will the students feel unease with so little content knowledge provided? Will the students loose motivation and feign that the task is impossible since not enough content was provided? Since there is too little content, what will happen if students start to ask difficult questions that are going beyond the knowledge presented in the teacher guide and are potentially difficult for the teachers themselves?
Concerns about possible obstacles that would block the flow of the lesson	Since the design has a repetitive structure, will students be bored? Since there is both a theoretical section and a construction section in the same 90-min period, will the students ask critical questions that the teachers will be obliged to side step in order to move on with the construction phase of the activity? Is the FRBLE design taking for granted cultural knowledge that is not available to Greek students?

dialogue of the group, these issues were coming to the surface and were reflected upon, only to hide afterwards under the more pressing issues referring to the implementation in the classroom. This is probably an expression of lack of experience among the participants and especially lack of experience of the senior researcher with respect to guiding the process of reflective dialogue.

Phase 4: Formative and Summative Assessment of the Learning Environment

While the intervention was running, there were coming to the WG, through the e-mail interactions with the teacher, data of narrative kind that were undermining the ideal of the conceptual change oriented lesson: (a) The students found the FRBLE motivating and found enjoyment in the application of everyday problem-solving skills and (b) the students were doing incremental changes in their design based on criticism from their fellows which was leading to improved designs. Finally, the additional tab, carrying extra information in STOCHASMOS, was never used.

The summative assessment, which was based on the assessment instruments provided by the FWG, found that students enjoyed participating in the implementation of the FRBLE and expressed willingness to participate further in similar activities. Moreover, there was definitely learning going on, though it was not centered on the deep understanding of science concepts against prevailing student misconceptions.

The success of the FRBLE and the unfoundedness of the concerns about the possible obstacles of implementation (see Table 5.2) was a source of reflection for the WG expressed in the e-mails exchanged in the WG. First, it challenged the expertise of both researchers and teachers, in foreseeing the results of the implementation of the FRBLE in the context of their cultural environment, and thus brought forth a habit of mind related to feeling an expert on the students of one's culture (systemic critical reflection). Second, it increased the value that the WG members assigned to the FWG's goal: to organize better and more effectively the knowledge that students already had towards achieving practical ends. Therefore, a Greek habit of mind emphasizing the educational goal of "students not been taken in by simple appearances" (misconceptions fitting well on this pattern) was highlighted against a concern for knowledge reorganization toward practical effectiveness expressed in the FRBLE (epistemic critical reflection). Although the teacher reported feelings of stifled initiative from having to follow strictly the directions of the FRBLE, working with the FRBLE created also the opportunity for "exploration of options for new roles, relationships, and action" since he repeatedly was asking about how the FRBLE was actually running in the source culture.

Phase 5: Further Reflection Toward the Written Report of the Work

During the long process of writing the successive drafts of the current article, the members of the WG brought forth important issues related to this professional development experience.

First teachers' and researchers' relationship was put on a sharper relief since different dimensions were brought forth that differentiated among the two subgroups: moral responsibilities felt toward the students, professional agendas, attitudes toward the official curriculum, and differences in skills. They can be recognized as instances of "exploration of options for new roles, relationships, and action" and "acquiring knowledge and skills for implementing one's plans." Second WG members steadily commented on the realization of their overreliance on factual information and its connection with the use of ICT. Third, they realized that some WG members were bringing points of view that were novel for other WG members and were shaking the sense of a secure knowledge base that the other WG members might have till then.

Finally, teachers and researchers found themselves at the end of the implementation in a process of still pondering on troublesome features of the FRBLE implementation in the classroom: Were the goals of the FRBLE of high enough quality? What combination of activities would make the design optimum? Why does it feel so difficult to combine the goals of the national curriculum with these "foreign" goals? Are there contextual reasons that make it so hard? How is one to balance the attractiveness of the new goals with the respect older goals still have? Rather than detecting a new equilibrium, we detect a state of openness that is valuable from the point of view of transformative learning.

However, it should be noted that the WG itself did not persist in time aside from accompanying the writing of the article. Although lessons taken from the implementation of the FRBLE were reintegrated to the lifeworld of the members of the WG, the same did not happen with roles related to the collaboration between teachers, teacher consultants, and researchers. These roles did not reintegrate into the participants' lives since the WG did not extend into or got absorbed by an extended joint community of teachers and researchers. The demise of the WG in the long ran had as a consequence that the realizations that were achieved were difficult to embed in everyday school reality.

Discussion

Successful high-quality teaching using ICT in the classroom is still a sought-for goal, and teachers are a central part for the achievement of this goal (Ertmer 2005). Professional development is a principal way to affect teachers, but the changes that are needed are quite significant and thus motivated us to explore a professional development design influenced by Mezirow's theory of transformative learning (Mezirow 2009).

This design focused on intensifying premise reflection. Teachers and researchers agreed to implement what went against their habits of mind, discuss their concerns, observe carefully the distance between point of views rooted in their habits of mind and reality (in the assessment phase), and be open and interested on the details of the FRBLE implementation in its source culture.

What points of view and habits of mind related to the implementation of inquiry environments supported by ICT in the WG's local context were brought forth through critical thinking and reflective dialogue?

The main habit of mind that was brought forth relative to ICT repeats what is known from the literature: That ICT ideally is thought as a carrier of high-quality information or visualization (Karasavvidis and Kollias 2014). However, this is connected to the centrality given to factual information in the Greek educational system as presented below.

Another habit of mind relevant to ICT use, especially in the context of science education, is that the use of ICT should be strongly related to the debunking of misconceptions in science education.

Did the particular process of FRBLE adaptation bring forth new opportunities and capacities for learning for the participating members?

The combination of the data provided by the different sources reveals that this "adaptation with minimal change" experience created an opportunity for transformative learning for the participants in the WG.

First, they realized that content is indeed a main organizing factor in the Greek classroom, and its minimizing has repercussions in raising anxiety about various other educational aspects: classroom management, teacher workload, student interest, and initiative.

Second, they realized that educational goals that are closer to everyday practical efficiency than to the achievement of the esteemed knowledge of the discipline raise anxiety among teachers and researchers who are focused on the conceptual change paradigm. Kyza et al. (2014), working in a very similar context (being partners on the same project), report similar concerns being prevalent in the Cypriot educational system, leading in their case in changes of the learning environment they were adapting, in order to be implemented.

Moreover, by challenging the teachers' and researchers' "expertise about what works for the students of their own culture," there are created preconditions for more close observation of what actually goes on in the classrooms and interest to learn further about the FWG educational culture with respect to: everyday knowledge, educational goals, and educational practices.

What signs of inefficiency of this process of teacher professional development have been recorded?

In retrospect, although the intervention led to a lot of reflection and many of the steps mentioned in Mezirow's account of transformative learning were taken, the more advanced steps "provisional trying of new roles," "building competence and self-confidence in new roles and relationships," and "a reintegration into one's life on the basis of conditions dictated by one's new perspective" were not explored in depth, especially with respect to the roles and relationships between teachers and researchers. Moreover, the bringing forth of the different issues of critical reflection was not a steady companion of the WG's work but was surfacing and disappearing in the WG discussion without being fully dealt with. As a result, the whole process was protracting in time, extending over many e-mail exchanges over a rather long period of time. We think that a proper discussion of the issues that were later on realized would have to address priorities in the dominant educational science paradigm in Greece, priorities in the science education curriculum, and issues related to the place and prestige of technical education (the FRBLE's hands-on character and practical bend was making it susceptible to relevant habits of mind) in Greece (Patiniotis and Stavroulakis 1997).

Though a truly transformative approach would go through such deeper questions, the centralized nature of the Greek educational system and the tradition of limited common ground between teachers and parents would undercut such reflection by way of its impracticality for teachers. Furthermore, criticism of the main trends in science education in Greece might put the researchers in conflict with the trend in their domain. Though censorship of the relevant issues was not a conscious decision, cognitive dissonance theory (Akerlof and Dickens 1982) predicts that people avoid entering in mental paths that force them to see inconsistencies that are difficult to be practically addressed.

However, using a "strict" application of an FRBLE as a means for transformative learning, even if executed by a group with no prior experience, gave quite fruitful results. This design is also in agreement with recent ideas in the cognitive science literature. Cognitive science literature points out the difference in the manner experts and novices solve problems (Chi et al. 1981). Recently, the importance of highlighting the relations and patterns of surface features for scaffolding learners to attend deeper features in a situation has been proposed (Chi and VanLehn 2012). In our case, we saw that the "experience" of adopting the FRBLE led WG members to observe carefully the surface features of the implementation, ponder through, reflect and discuss their relations, and finally search for the deeper rational of the design. Therefore, the process created the opportunity to make apparent the deeper features of the situation while at the same time bringing to the fore habits of mind that usually are left undiscussed.

Conclusions

It may be reasonably argued that there are many drawbacks in the use of adaptation of an FRBLE, for reasons of professional development in ICT integration in the classroom, in the way suggested here. The participation of researchers makes quite difficult the scaling up of this approach. Moreover, we just reported results for one such researcher–teacher collaboration, and finally, there is perhaps a sense of treason to the best interests of the local students since the local WG reservations may turn out to be well founded. However, these considerations should not stop us from seeing the important gains of this approach even when implemented by a group with no prior experience in transformative learning methodology.

An additional and deeper point of concern, as we argued in the discussion, has to do with the limited deployment of transformative learning through the current methodology. Such learning depends on the cooperation and open dialogue between teachers, researchers, and probably parents. However, this form of dialogue needs less centralized control, more opportunities, and administrative protection of teacher initiative and the building of traditions of cooperation between teachers, researchers, and parents so that discussing the more challenging habits of mind is realized as meaningful by the participants. This is a formidable leadership challenge for educational leaders (Konidari and Abernot 2006). We therefore think that although the current results are additional indications for the potential of cooperation between teachers and researchers in the context of a well-selected task, they also point to such strong educational leadership challenges.

We can also connect the current research with the relevant literature of adapting FRBLEs. Kyza et al. (2014), working in a similar context, explored the possibility of principled adaptation while leaving more freedom for change, based on the interests of the target WG and the prevalent views of the target educational system. However, we think that the process of adaptation followed in this research provides stronger opportunities for teacher learning since it allows for implementing a process of transformative learning. It is therefore close to ideas having to do with avoiding teachers' mistreatment of RBLE's (Brown and Campione 1996) through organizing the work of professional communities who are focused on improving teachers' practice in accordance to (Thomas et al. 1998).

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Chapter 6
Evaluating the Use of Laptop Computers in Secondary Education in Greece: Findings from a National Survey of Teachers

Aristides Vagelatos and Panagiotis Angelopoulos

Introduction

Harnessing information and communication technologies (ICT) in education is a strategy adopted by most developed countries in the recent decades (Vagelatos et al. 2011b). Thus, various actions and initiatives have taken place in education systems around the world (European Commission 2013). At the same time, dozens of studies have been conducted, aiming in measuring and identifying the quantitative and qualitative results of these interventions (Wastiau et al. 2013).

In this paper, a survey that was implemented in Greek high schools ("Gymnasium") is presented, in order to assess the consequences of "pupil's laptop" project intervention. The "pupil's laptop" project was implemented in 2009 and concerned pupils of the first grade of high school (gymnasium) all around Greek territory. The survey was implemented 4 years later, in 2013, in order to investigate a period of three consecutive school years of pupils with a laptop in their daily school equipment.

More specifically in the following, "pupil's laptop" project (this was the official name of the project) is briefly described, the questionnaire and the survey process are analyzed, and the results of the research are presented. Finally, an evaluation of the results along with certain conclusions is given.

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Literature Review

There exists a rather big number of studies, surveys as well as research papers in the literature regarding ICT in education. Most of them focus on the impact that ICT might have on learning and learners, either from the teacher's or from the student's point of view (Winzenried et al. 2010). The majority of them have as a common conclusion that ICT has a positive impact on learning in general. Nevertheless, this impact exclusively depends on the way that ICT is utilized within the educational system, the school, or even the classroom.

In the last decades, there is a constant and raising penetration of ICT in the educational systems of various countries around the world. One such case is the USA, where ever since the late 1970, the introduction of computers in the classroom has started to explode. Nowadays, there are many initiatives either on a state level or from the federal government (USA, DoE 2010). In Europe, there are similar initiatives in many countries, with different tactics regarding the implementation strategy as well as the main priorities. In this framework, an interesting case is Portugal, which in 2008 started the "Magellan Initiative" (https://en.wikibooks.org/wiki/One-to-One_Laptop_Schools/Portugal) for the purchasing of more than 500.000 laptop computers (based on Intel's classmate) for pupils.

At the same time, in the last decades, there are a number of initiatives for the design and implementation of "cheap computers" targeting mainly at the underdeveloped countries (Fonseca and Pal 2003). The first such paradigm was "Simputer" (Simple Inexpensive Multilingual Computer—http://www.simputer.org/) that started in 1998. Almost the same period in Brazil, the "Computador Popular," a comparable cheap computer project was started. In the first years of 21st century, a number of additional efforts for the creation of cheap computers were started (Patra et al. 2007) with the most encouraging being OLPC (One Laptop per Child—http://one.laptop.org/).

The abovementioned exemplars are just a few among the initiatives regarding the introduction of ICT in educational systems. And all of them are grounded on the hypothesis that ICT can supplement the teacher and thus improve the educational outcome in general. Nevertheless, this hypothesis is not really commonly accepted by the majority of the researchers. Even worst, the theoretical question: "On what kind of technology should we invest in today's schools" does not have a commonly accepted answer, especially taking into account the more or less global economic crisis that we are currently experiencing. Even though researchers have already "proven" that schools with good ICT infrastructure achieve better results than those that are poorly equipped (Attwell and Battle 1998), there are opinions who support the statement that investing in ICT for education might prove quite unproductive, if it is driven by just an over enthusiasm toward technology than targeting at the improvement of the educational process itself (Becker 2000; Cuban 2001).

As a result, one can safely claim that it is not at all obvious that by introducing laptops or other ICT equipment in an educational organism, the overall educational performance will advance. On the contrary, a number of other aspects have to be satisfied (e.g., adequate support, teacher's training, content creation).

In Greece, the first projects of ICT integration in the educational system started in the late 1980 s with the introduction of a desktop computer in certain schools (within the "MOP" framework—1st Community Support Framework). The next steps continued within 2nd and 3rd Community Support Framework when the "school laboratories" were introduced, each one having between 8 and 12 desktop computers (see "Odyseia" project—http://odyseia.cti.gr). Ever since many other projects took place toward what was then named "digital school" (Vagelatos et al. 2011a).

The "Pupil's Laptop" Project

In 2009, the Greek Ministry of Education decided to implement an action named "pupil's laptop," comprising of the distribution of portable computers (laptops) to pupils of the Greek high school. The laptops were provided: a) to all pupils of first grade of high school throughout the Greek territory and b) to more than 20,000 teachers who were teaching in high school with the purpose to support part of teaching in the classroom (thus implementing a "digital classroom") (Angelopoulos et al. 2013).

Pupil's laptops were equipped with digital educational material to support the predefined courses. This material included the following:

1. The digital textbooks for the entire curriculum of high school, in "PDF" format and
2. Additional educational content by subject area (e.g., maps, pictures, worksheets, tests) as well as secure Internet navigation software, all of them approved as needed, by the Pedagogical Institute of Greece (www.iep.edu.gr).

The abovementioned educational content is stored today at the educational portal of the ministry of education (www.e-yliko.gr). Pupil's laptops were used in the coming years in different degrees and in different ways in the context of education (Xenariou 2011).

The Questionnaire and the Identification of the Target Group

In 2013, the review of the "pupils' laptop" action was requested by the Ministry of Education. For this purpose, it was decided to conduct relevant research, based on questionnaires. For the realization of the research, two questionnaires were authored: one for the teachers and one for the students (Vagelatos et al. 2014): In this paper, the teachers' questionnaire is discussed. The questionnaires were implemented on the World Wide Web (WWW) to make it easier to access and complete (Angelopoulos et al. 2013).

Questionnaires should have had specific characteristics, e.g., combine ease of filling, being relatively small, but at the same time comprehensive. Thus, they were authored to contain multiple types of questions (closed, Likert, open, etc.) (Angelopoulos et al. 2013).

Regarding the target group of the survey, it was decided to focus on the 310 teachers who at that time had completed the in-service ICT teachers' training (B' level), and thus having the knowledge and skills to use the pupils' laptop in daily teaching practice. Additionally, by that time, these teacher were working at the first grade of "Gymnasium" (high school), on courses that were proposed by the Ministry of Education to be utilized by the pupils' laptop in priority, namely the following: geography, history, biology/natural sciences, and mathematics (cf. Num. a. 88310/C2 from 22-07-2009).

Survey's Results

Questionnaires were sent to 310 educators (teachers) via e-mail (at their personal e-mail account). A 20-day deadline was given to them. Within this time period, we received back 120 complete questionnaires (38.7 %). In the followings the responds are reported.

The age distribution of the responders was as follows: under 30: none, 30–39: 16.67 %, 40–49: 45.83 %, 50–59: 37.50 %, above 60: none (sex: 51.67 female—48.33 male). Regarding teacher's experience (years in service), there were less than 5 years: 1.67 %, 5–9 years: 30.00 %, 10–14 years: 29.17 %, 15–19 years: 13.33 %, 20–24 years: 15.00 %, more than 25 years: 10.83 %. The specialties of the responders were as follows: philologists: 19.17 %, theologians: 0.00 %, mathematicians: 31.67 %, natural sciences: 43.33 %, foreign language: 1.67 %, home economics: 0.83 %, other: 3.33 %.

Most of the teachers (>94 %) have attended in-service ICT training, in the period between 2009 and 2012. In Fig. 6.1, the courses that pupil's laptop was utilized are presented, along with the school year that this took place. In the next figure (Fig. 6.2), the frequency of pupil's laptop usage is counted, followed by the usage of the laptops by the pupils at home for homework (Fig. 6.3), as well as for other activities (Fig. 6.4).

The next questions were focused on teachers' opinion regarding the use of new technologies in classroom: Can it improve the educational process (Fig. 6.5)? Are the educational content repositories necessary (Fig. 6.6)? Does the utilization of laptops improve teaching (Fig. 6.7)? Does the course get more engaging and fun with the use of laptops (Fig. 6.8)? Does the usage of laptops help low-academic performance pupils to improve (Fig. 6.9)?

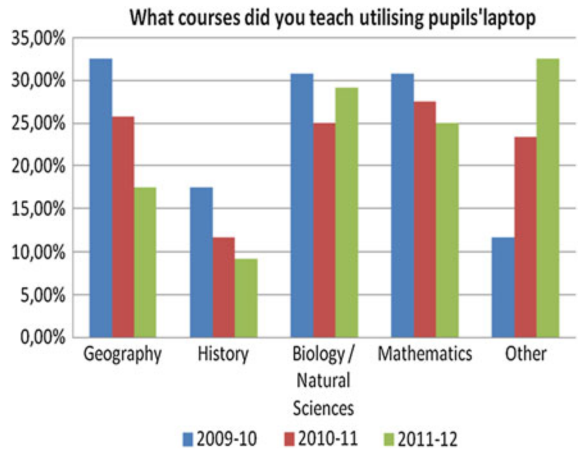

Fig. 6.1 Courses that were supported by pupil's laptop courses supported by

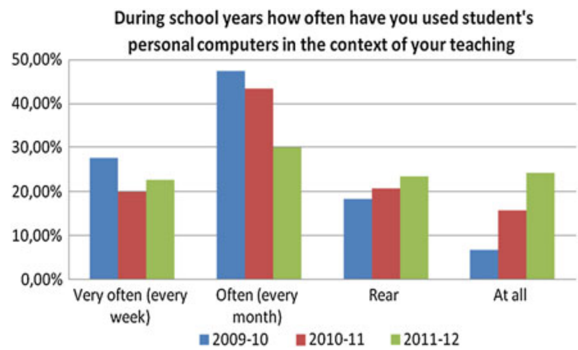

Fig. 6.2 Frequency of pupil's laptop usage

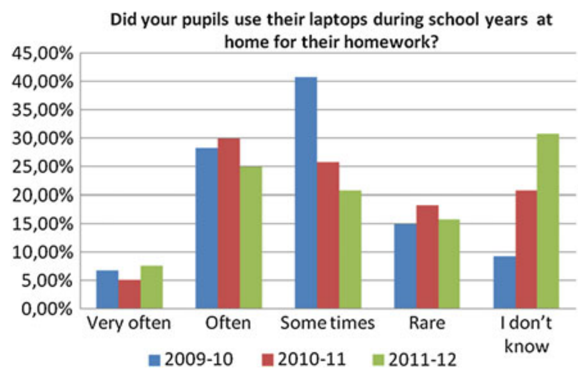

Fig. 6.3 Usage of laptops at home for homework

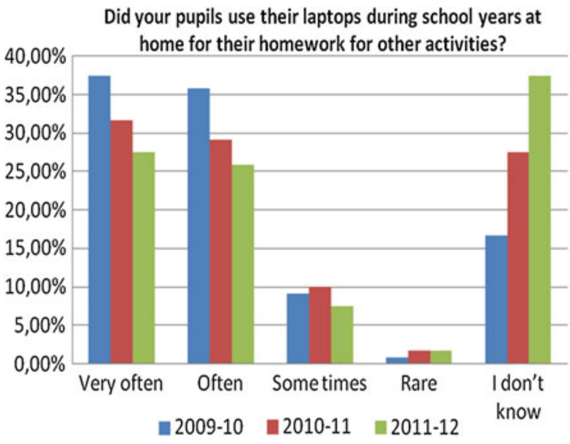

Fig. 6.4 Usage of laptops at home for other activities

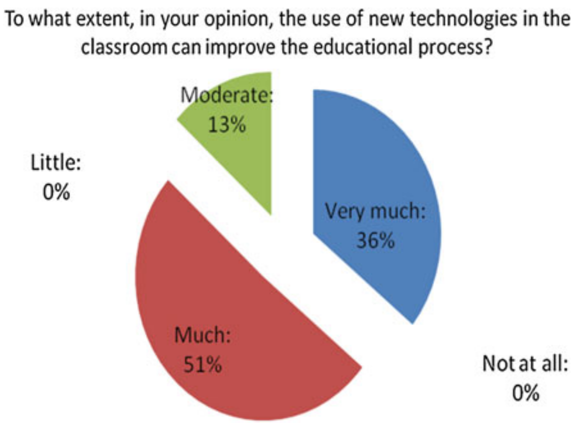

Fig. 6.5 Can the use of new technologies improve the educational process?

Next was the discussion about difficulties: Was it difficult for pupils to adapt to "digital classroom" (Fig. 6.10)? Which were the main problems that were identified (Fig. 6.11)?

And finally, there was a question regarding the degree that this action contributed in a number of parameters (Fig. 6.12):

- Improvement of the educational process (in general)
- Improvement of pupils' skills in ICT usage
- Enrichment of data and knowledge of the courses
- Direct pupils' communication and the exchange of information related to the courses
- Acquisition of digital skills that meet modern needs
- Creation of friendly and flexible environment in the classroom.

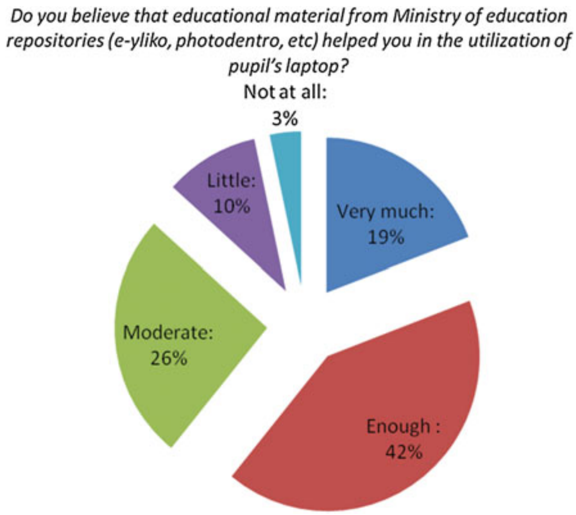

Fig. 6.6 Opinions about the educational content repositories

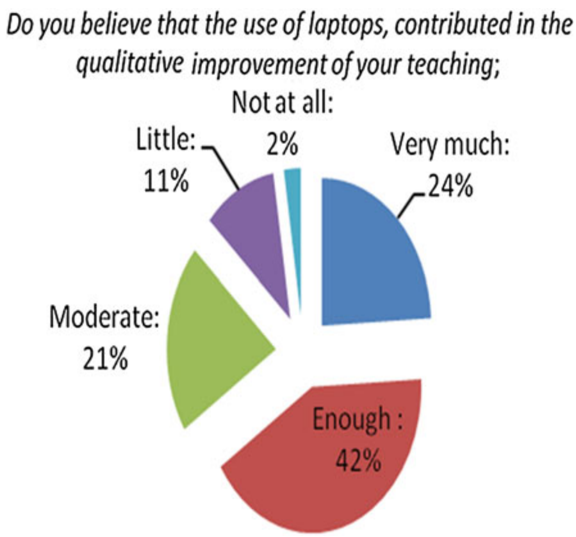

Fig. 6.7 Does the utilization of laptops improve teaching?

Discussion

Teachers' replies to the questionnaire revealed several interesting details. First of all, in relation to classroom teaching and learning, the use of the laptops appears to have decreased year by year. This reality most probably reveals the fact that the initiative was not supported over time by all necessary actions neither from a pedagogical point of view nor from the technical as well as digital content needed, not even at the level of development of appropriate technical infrastructure (Wi-fi in classrooms, etc.).

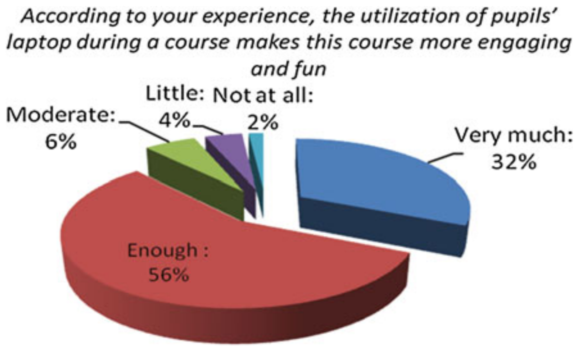

Fig. 6.8 Are the courses becoming more engaging with the use of laptops?

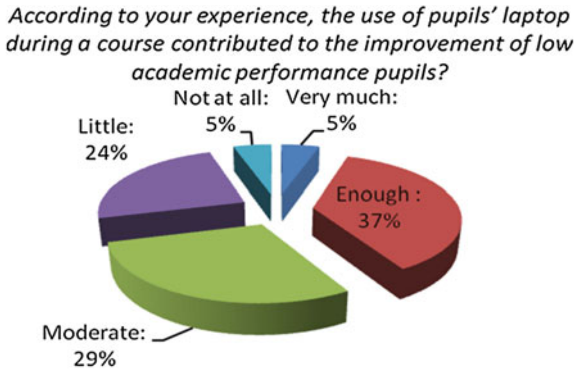

Fig. 6.9 Usage of laptop versus low performing pupils improvement

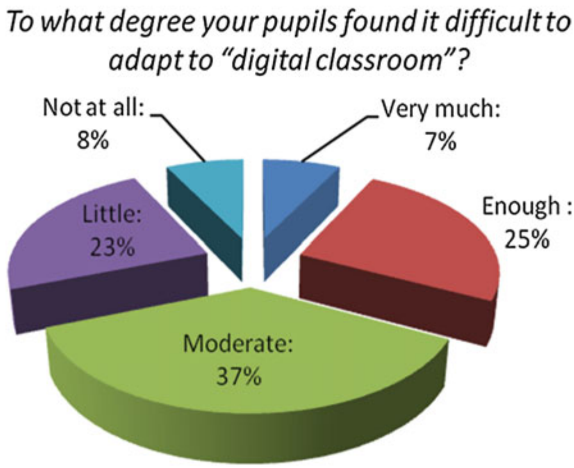

Fig. 6.10 Was it difficult for pupils to adapt to "digital classroom"?

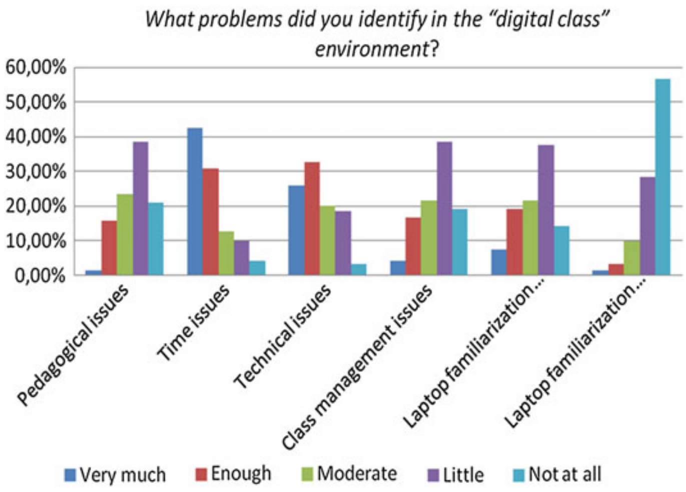

Fig. 6.11 Problems that were identified

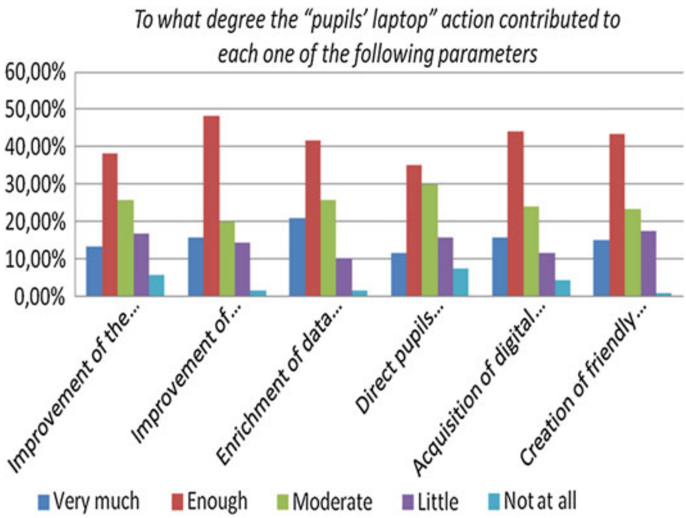

Fig. 6.12 Contribution of the initiative in certain parameters

The minimum drop was recorded by the teachers of natural sciences, while the largest drop was reported from the teachers of geography (possibly because from year to year, geography is assigned to different specializations and thus different teachers). On the contrary, over the years, the proportion of teachers used the laptops for teaching other subjects beyond their main assignment was increased considerably. This proves that teachers, who were accustomed to use ICT in the classroom, continue to use laptops in any discipline they might teach.

In the teachers' responds, it was reflected that pupils use their laptops at home mainly for other activities such as entertainment, communication, search on the Internet than for doing their homework. This agrees with what the students answered in the similar research conducted on them (Vagelatos et al. 2014).

Respondents appear to use equally all ICT infrastructures available in schools, i.e., the computer laboratory and pupil's laptop. Thus, we can conclude that teachers, who know how to use and exploit new technologies for their teaching, will do it as far as they are having access to them.

Additionally, most of the teachers believe that the use of ICT can do the following: qualitatively improve the educational process and make teaching more attractive, and that the existence of high-level educational material and in general digital educational content is of vital importance. This proves that a large proportion of teachers are convinced of the value of these interventions.

However, only 5 % (very much) and 36 % (quite) of them believe that underperforming pupils are improving by the use of ICT in classroom. Most of them (about 60 %) believe that the performance of these students does not really improve (from moderate to none).

Given that the sample involved teachers with knowledge on the pedagogical utilization of ICT, reflecting that they did not encountered pedagogical problems, but despite their experience believe that teaching time is relatively small to implement their teaching proposal.

Finally, teachers believe (the majority of them: >50 %) that using the computer can have a positive effect in almost all the factors that influence the educational process, such as enrichment of the provided information and knowledge of the subject, improving attractiveness of student objects, improving the interaction between students and teachers in relation to the subject taught, improving digital literacy of students, and finally improving the educational process in general.

Conclusions

The "pupil's laptop" initiative was a large-scale intervention in secondary level schools of Greece. As such, it should have had a considerable impact on the educational system, as long as someone can estimate and evaluate both the impact and the effectiveness of the whole action. For this purpose, a relevant evaluation took place.

The implementation of a survey was favored as it fits both scientifically and practically to such actions (ICT introduction), and it is easy to implement and gives results in a short time. The specific evaluation took less than a month to be implemented, from the moment it was decided to the time the required questionnaires were prepared, and the necessary infrastructure was in place. A quantitative presentation of the survey's results was presented in this work. However, some results found demand greater investigation to understand their origins. These results combined with the responses of pupils in the corresponding research should be weighed accordingly and analyzed qualitatively with perhaps a parallel survey on a sample of those involved through the use of interviews. And this should be done in a second phase aiming at a deeper investigation and analysis of the characteristics of the intervention described here.

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Part III
ICT in Secondary Education

Chapter 7
Producing Educational Videos: A Field-Based Implementation with PBL Methodology

Chris Panagiotakopoulos, Anthi Karatrantou and Menelaos Sarris

Introduction

Economy and society nowadays are oriented to the rapidly changing knowledge and strongly require individuals with problem-solving skills, teamwork, and self-learning capabilities (Lei 2010). Education at any level ought to support learners to acquire the 21-century skills, employing contemporary educational methods and strategies in the classroom. Traditional educational methods, especially in the area of technical–vocational Education, usually separate theory from practice. They tent to adopt a teacher-centered teaching model, using mainly lectures and well-structured laboratory exercises applying the different experiments and measurement techniques. Furthermore, exams remain the primary assessment tool for evaluating the students' performance competence and learning outcomes. Within this theoretical model of teaching and learning, students mainly receive information passively instead of holding an active role to knowledge acquisition process (Nandi et al. 2000).

The problem-based learning approach (henceforth PBL) on the other hand, usually as part of an integrated curriculum in teaching/learning sciences and technology, is student-centered. Thus, it places student in the center of the learning process. PBL methodology is strongly related to inquiry-based learning as well as with projects. Its history starts at the beginning of the 20th century with John Dewey and his famous "learning by doing" (Savery and Duffy 1995).

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An early attempt for a broader implementation started in the 1970s. Since then, the increasing use of digital technology made it easier than ever for students to gather information and to produce and share high-quality essays. At the same time, there is an increasing interest worldwide to implement new methods and strategies such as teamwork and projects in the classroom. Due to these novel trends, researchers have re-initiated to use PBL methodology in different subjects and study its dynamics and educational benefits.

In this paper, the results of an experiential type workshop, aiming to introducing the PBL methodology to teachers, are discussed. Teachers of vocational secondary education schools with various vocational specialties participated in the workshop gaining experience with the PBL method. The workshop was part of the LLP youYESdigital project (http://www.youyesdigital.eu), which was implemented in co-operation with partners from five (5) countries (Spain, Greece, Italy, Romania, and Turkey).

The evaluation at the end of the workshop offered interesting information concerning teachers' attitudes toward the PBL methodology, their willingness to exploit it in their classroom, as well as teachers' role within this methodological framework. Furthermore, data analysis provided with useful insights into participants' attitudes on educational video production as well as their evaluation of the workshop. Data collected from the implementation of the PBL methodology in the teachers' classrooms offered supplementary data concerning students' attitudes toward the method as well as its effectiveness.

The PBL Methodology

The PBL methodology is a student-oriented approach based on teamwork in order to solve authentic real-life problems utilizing activities that incorporate time for students to think, analyze, debate, and interpret (Becerre-Labra et al. 2012). Its initial implementation was made in 1841 at the Samford College in USA (Major 1998), and later, during the decade of 1920, Celestin Freinet introduced it in Europe (Clandfield and Sivell 1990). In 1960, PBL methodology was implemented in the innovative curricula in Health Sciences in North America (Savery 2006; Hillen et al. 2010). During this decade, medical education was characterized by the standards of intensive theoretical teaching of various subjects, followed by exhaustive practice in clinical cases in order to connect theory and practice.

The rapid scientific progress though in medicine, biotechnology, and information technology made the model inadequate, and the need for new experiential educational methods and techniques, included PBL methodology, emerged (Boud and Feletti 1997). In the decade of 1970, educational institutes in Europe started to use the method effectively (Clandfield and Sivell 1990). Nowadays, PBL methodology is continuously spreading and integrated successfully in many disciplines, including medicine, economy, biology, psychology, law, computer science, and engineering (Savery 2006; Eldy and Sulaiman 2013).

PBL methodology is considered to be grounded in the theories of knowledge construction (Fonteijn and Frerejean 2010), characterized by the experiential learning in small groups of students, and emphasizes to self-learning development techniques, to problem-solving approach, and to positive reinforcement of critical thinking (Barrows 2000; Imafuku et al. 2010). Teacher serves as a facilitator/mediator and a supporter to the students and does not interfere with the process neither expressing any opinion or prescriptive advice nor making steering questions. Instead, he/she poses questions to students regarding the outcome and asks for documentation of the solution. Figure 7.1 depicts the general function/structure of the methodology (Hmelo-Silver 2004; Lei 2010). Within this framework, abstraction and simulation of social experience, explanation of results, and understanding the conditions of knowledge applicability in real-world situations are promoted providing at the same time the experience of working in small groups to the students (Michel et al. 2012).

The basic stages of the methodology are as follows (Hmelo-Silver 2004; Lei 2010):

1. Description of the problem (usually an interdisciplinary and not strictly structured problem).
2. Discussion among students, creating assumptions based on their existing knowledge (problem's identification).
3. Collection of information and useful material (search) for the possible solution.
4. Evaluation of the information collected and efforts to solve the problem based on the existing and the new knowledge as well (implementation).
5. Questioning, criticism, feedback, and repetition of stages 2–5 depended on the correctness and appropriateness of the solution.

Furthermore, problem solving is a fundamental scientific activity as it is related to individual and social levels and constitutes an expression of the development of creative thinking (Becerre-Labra et al. 2012).

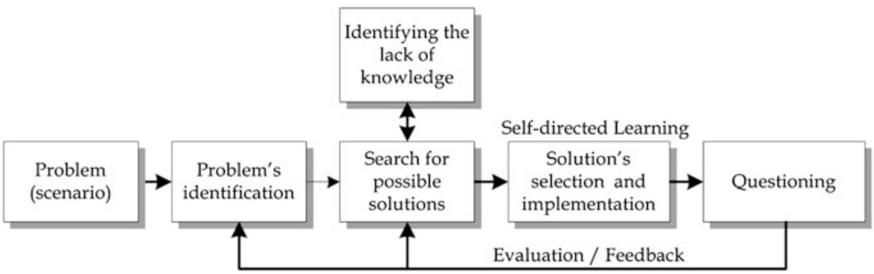

Fig. 7.1 Schematic function of the PBL methodology

Methodology

Twenty (20) teachers of vocational secondary education schools with various vocational specialties voluntarily participated to a 12-h experiential workshop (three 4-h sessions). All of them were in-service vocational secondary education teachers and had at least ten (10) years teaching experience. None of the teachers were familiar with the PBL methodology, but some of them were familiar with the project method. All of the teachers were sufficiently using computers and were certified on basic ITC skills, but none of them had used the MovieMaker software to create videos.

The workshop was held in the Computers and Educational Technology Laboratory of the University of Patras (Department of Primary Education—http://www.cetl.upatras.gr) with twenty personal computers. It was supported by four experienced instructors. The participating teachers could work individually or in small groups depending on the workshop's phase, the progress, and their personal needs. The first session involved the acquaintance of the participants, a short introduction to the general framework and the objectives of the workshop, a short presentation of the tools to be used, and the identification of the problem. All the tool guides were set up on the computers in order for the participants to have direct access at any time needed. During the second and third sessions, participants were asked to work in small groups of five in order to construct an educational video about green economy or sustainable development using the MovieMaker software. Each instructor was responsible for supporting one group. The PBL methodology was implemented according to the aforementioned stages (Fig. 7.1). The final phase of the workshop was devoted to video presentations and discussion about the PBL methodology, the experience gained by the participants during the workshop concerning the PBL methodology, the perceived effectiveness of the method, and the teachers' willingness to use it in their classroom.

Special efforts were paid for the evaluation of the whole procedure regarding the methodology effectiveness, the role of the instructor, the role of the tools used, the participants' experiences, the educational benefits raised (Marcangelo et al. 2009; Gibbon and Marcangelo 2012). At the end of the workshop, the participants were asked to fill out an anonymous questionnaire in order to evaluate the whole procedure. The questionnaire consisted of the closed-type questions (Likert scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree) and open-ended ones focused on both the strong and weak points of the workshop and suggestions to improve it as well: "This workshop could be improved by…," "Could you note the strongest and the weakest point of the workshop?" The questionnaire used in the study was piloted tested on 6 responders (3 teachers of vocational secondary education schools and 3 students) and revised on the basis of the subsequent data analysis. None of the responders neither receive the final version of the questionnaire nor participate in the workshop. Data from the pilot test were analyzed and controlled for reliability and collinearity. Finally, a

Table 7.1 The questions (Q1–Q17) for the evaluation of the procedure

Questions:	Scale: 1 = strongly disagree – 5 = strongly agree
Q1: The instructor communicated ideas and concepts clearly	
Q2: The instructor explained the material in an interesting manner	
Q3: The instructor was well-organized	
Q4: The instructor encourage participation	
Q5: The pace of the course/workshop was good	
Q6: The instructor provided guidance to the students when needed	
Q7: The instructor gave me immediately helpful feedback	
Q8: The instructor made me feel free to ask questions	
Q9: The objectives for each session was stated clearly at the beginning of each session	
Q10: This course met my expectations	
Q11: There were no problems with laboratory setting and equipment used	
Q12: The instructor's conduct was never influenced by students' personal characteristics, such as gender, ethnicity or cultural background	
Q13: The effectiveness of the methodology used met high level standards	
Q14: The instructor never intimidated or embarrassed students	
Q15: The instructor was able to give alternative explanations when needed	
Q16: I feel that I grasped very well this topic (PBL methodology)	
Q17: I feel that PBL methodology is very useful for my future work in the school	

multiple regression was performed in order to remove items with low betas (Cohen et al. 2007). The five-point Likert scale questions that were included in the final version of the questionnaire are presented in Table 7.1.

After the completion of the workshop, the participating teachers were urged to implement the PBL methodology in their classroom. Afterward, five (5) of them implemented the methodology in a course with some of their students (integrating it into their classroom activities), for 4 days at a total of 8 teaching hours (2 teaching hours per day). Twenty-seven (27) students, aged from 15 to 20 years, attending vocational secondary education schools, studying at sectors such as economy, administration services, technological applications, agronomy, and food industry, participated. Students were asked to work in small groups in order to construct a video about green economy or sustainable development relative to their specialty. Special attention was paid to ensure the homogeneity of the timetable, the activities, the material used, and the evaluation of the implementation with students. The guides used (Creating a Youtube account, Subtitles—Subtitles Workshop Soft, Add subtitles to a video file, Uploading videos to youtube, Making a video with MovieMaker) were the same guides created and used during the teachers' workshop.

Students worked according to the PBL methodology stages as these are presented in Fig. 7.1. Teachers tried to implement the method in the way they experienced it during the experiential workshop. At the end, students were called to answer an anonymous questionnaire (absolutely similar to that of the teachers) in order to evaluate the whole procedure. A few open-ended and ranking questions supplemented the questionnaire. The open-ended questions were focused on both the strong and weak points of the workshop, while the ranking questions dealt with the knowledge acquired by the participants: "Could you report the strongest and the weakest point of the workshop?" "What did you learn? Please write down three topics (hierarchically) that you learnt during this course." They were also invited to comment on their experience with the PBL methodology, as well as to report what they have learnt during their work on creating educational videos.

This study explores the PBL methodology efficiency within a secondary vocational education framework. The study's main goal was to examine both students' and teachers' field evaluation of PBL methodology on typical school settings. The key research questions concern the following: (1) to what degree the apprehension of PBL methodology may result to integrate to teachers' this knowledge to their future work, (2) to what extent do instructors' competence enhances the acquisition of PBL proficiency, and (3) to what degree the PBL methodology implementation had an effect on the students' work.

Findings

Teachers' Evaluation

After the completion of the workshop, participants (teachers) were asked to fill out an evaluation questionnaire, which composed of 17 five-point Likert scale questions ranging from one (1—strongly disagree) to five (5—strongly agree). The questionnaire appeared to have an acceptable internal consistency, $\alpha = 0.88$. All scale items appeared to be worthy of retention, and the highest alpha value would come from deleting item 17 (*Apply knowledge acquired in the seminar to future work at school*). The removal of the specific item would lead to an increase of alpha by 0.01. Inter-item correlations were high (lower $r = 0.4$). Frequency distributions are presented in Table 7.2.

A preliminary analysis involved testing whether there was a statistically significant correlation between teacher's beliefs about the skills acquired in the workshop and the methodology used by the instructors. Thus, separate Kendall's correlation coefficients were calculated. The selection of Kendall's tau rank correlation coefficient was mainly based on the fact that our data set had a large number of tied ranks (Field 2009). The statistical analysis resulted in significant positive correlation between teacher's beliefs about the skills acquired in the

Table 7.2 Frequency distributions—teachers (Q01–Q17)

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Total
Q01	0 (0.0 %)	0 (0.0 %)	1 (5.0 %)	7 (35.0 %)	12 (60.0 %)	20 (100 %)
Q02	0 (0.0 %)	0 (0.0 %)	1 (5.0 %)	13 (65.0 %)	6 (30.0 %)	20 (100 %)
Q03	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	8 (40.0 %)	12 (60.0 %)	20 (100 %)
Q04	0 (0.0 %)	0 (0.0 %)	1 (5.0 %)	3 (15.0 %)	16 (80.0 %)	20 (100 %)
Q05	0 (0.0 %)	0 (0.0 %)	2 (10.0 %)	9 (45.0 %)	9 (45.0 %)	20 (100 %)
Q06	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	3 (15.0 %)	17 (85.0 %)	20 (100 %)
Q07	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	2 (10.0 %)	18 (90.0 %)	20 (100 %)
Q08	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	20 (100 %)	20 (100 %)
Q09	0 (0.0 %)	0 (0.0 %)	1 (5.0 %)	4 (20.0 %)	15 (75.0 %)	20 (100 %)
Q10	0 (0.0 %)	0 (0.0 %)	1 (5.0 %)	12 (60.0 %)	7 (35.0 %)	20 (100 %)
Q11	0 (0.0 %)	0 (0.0 %)	1 (5.0 %)	6 (30.0 %)	13 (65.0 %)	20 (100 %)
Q12	0 (0.0 %)	0 (0.0 %)	1 (5.3 %)	4 (21.0 %)	14 (73.7 %)	19 (100 %)
Q13	0 (0.0 %)	0 (0.0 %)	1 (5.0 %)	7 (35.0 %)	12 (60.0 %)	20 (100 %)
Q14	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	2 (10.0 %)	18 (90.0 %)	20 (100 %)
Q15	0 (0.0 %)	0 (0.0 %)	1 (5.0 %)	6 (30.0 %)	13 (65.0 %)	20 (100 %)
Q16	0 (0.0 %)	0 (0.0 %)	1 (5.0 %)	8 (40.0 %)	11 (55.0 %)	20 (100 %)
Q17	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	6 (30.0 %)	14 (70.0 %)	20 (100 %)

workshop and the instructors' abilities to use clear messages and instructions [$\tau(18) = 0.55$; $p < 0.05$], instructors' abilities to use software tools adequately [$\tau(18) = 0.47$; $p < 0.05$], instructors' abilities to make the objectives clear [$\tau(18) = 0.48$; $p < 0.05$], and instructors' abilities to use efficiently the PBL methodology [$\tau(18) = 0.46$; $p < 0.05$].

In order to examine the relationship between how did the instructors reciprocate to the educational needs of the participants (Q6) and the adequacy of feedback to participants (Q7), the data were analyzed using a χ^2 test of independence. The results of the analysis indicate the statistically significant relationship between the variables [$\chi^2(1) = 12.6$; $n = 20$; $p < 0.01$]. The effect size is considered moderate [$\varphi = 0.79$; $p < 0.01$] (Cohen et al. 2007).

The evaluation of the PBL methodology, as recorded in the data, was extremely positive, since the 65 % of the participants were fully satisfied with the effectiveness of the method. The effectiveness of the methodology (Q13) was analyzed using a chi-square goodness-of-fit test. The analysis revealed statistically significant differences in the responses of participants [χ^2 (2) = 10.9; $n = 20$; $p < 0.01$]. High levels of satisfaction of the participants in the survey were also recorded in the question of how clear was the purpose of the workshop (Q9). The analysis provided with statistically significant differences between the responses [χ^2 (2) = 16.3; $n = 20$; $p < 0.001$], since 95 % of the participants chose answers 4 (agree) and 5 (strongly agree).

The statistical analysis of the variables related to the first research question are under our opinion, of a particular research interest. They actually link, in a sense, the effectiveness of the PBL methodology with the participants' intention to apply the knowledge acquired in the workshop to future work at school. The majority of the participants considered that the workshop covered their expectations [χ^2 (2) = 9.1; n = 20; p < 0.05], as high as the 95 % of respondents replied in question (Q10) "agree" and "strongly agree." In fact, it appeared that they fully comprehend the objectives of the workshop (Q13). The results of the analysis indicate statistically significant differences in the responses [χ^2 (2) = 10.1; n = 20; p < 0.05], with 35 % of respondents to reply "agree," while 60 % respond "strongly agree." It should be noted at this point that most of the participants seem willing to implement this methodology in their everyday teaching practice (Q17). The results of the "goodness-of-fit" analysis in the specific question showed significant differences between the responses [χ^2 (1) = 10.1; n = 20; p < 0.05].

In order to investigate the correlation between the effectiveness of the methodology used and both the degree that participants' understood the PBL methodology and their intention to apply this knowledge in the future to their teaching process, a Spearman correlation coefficient was calculated (Field 2009). The analysis revealed statistically significant correlation between both the efficiency of the methodology and participants' understanding of the PBL methodology [r_s (18) = 0.47; p < 0.05], and the effectiveness of methodology and their intention to implement [r_s (18) = 0.47; p < 0.05]. The correlations in both cases were positive. The effect size is considered moderate (Cohen et al. 2007).

Teachers' answers to the open-ended questions grouped and are categorized according to their meaning (Bogdan and Bilken 1982). They considered as strong aspects of the workshop the teamwork, the supporting role of the instructors, the experience of the new method, the interactive and pleasant environment, but they asked for more time to work, more tools to create and edit the videos, and more technical help in the use of the tools.

Students' Evaluation

Students after the completion of the 8-h course were also asked to fill out an evaluation questionnaire, which composed of 17 five-point Likert scale questions ranging from one (1—strongly disagree) to five (5—strongly agree). The questionnaire appeared to have an acceptable internal consistency, α = 0.84. All scale items appeared to be worthy of retention, and the highest alpha value would come from deleting item 10 ("This course met my expectations"). The removal of the specific item would lead to an increase of alpha by 0.01. Frequency distributions per question are presented in Table 7.3.

The first analysis concentrated on examining whether participating students' beliefs about the skills acquired in the course (Q16) display any significant correlations with the teachers' approach. A Kendall's rank correlation was employed for measuring the strength of dependence between the variables. The statistical analysis resulted in significant positive correlations between students' beliefs about the skills

Table 7.3 Frequency distributions—students (Q01–Q17)

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Total
Q01	0 (0.0 %)	0 (0.0 %)	2 (7.4 %)	11 (40.7 %)	14 (51.9 %)	27 (100 %)
Q02	0 (0.0 %)	0 (0.0 %)	1 (3.7 %)	16 (59.3 %)	10 (37.0 %)	27 (100 %)
Q03	0 (0.0 %)	0 (0.0 %)	2 (7.4 %)	13 (48.1 %)	12 (44.4 %)	27 (100 %)
Q04	0 (0.0 %)	0 (0.0 %)	1 (3.7 %)	8 (29.6 %)	18 (66.7 %)	27 (100 %)
Q05	0 (0.0 %)	0 (0.0 %)	2 (7.4 %)	12 (44.4 %)	13 (48.1 %)	27 (100 %)
Q06	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	4 (14.8 %)	23 (85.2 %)	27 (100 %)
Q07	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	4 (14.8 %)	23 (85.2 %)	27 (100 %)
Q08	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	27 (100 %)	27 (100 %)
Q09	0 (0.0 %)	0 (0.0 %)	2 (7.4 %)	9 (33.3 %)	16 (59.3 %)	27 (100 %)
Q10	0 (0.0 %)	0 (0.0 %)	1 (3.7 %)	16 (59.3 %)	10 (37.0 %)	27 (100 %)
Q11	0 (0.0 %)	0 (0.0 %)	2 (7.4 %)	9 (33.3 %)	16 (59.3 %)	27 (100 %)
Q12	0 (0.0 %)	0 (0.0 %)	1 (3.7 %)	7 (25.9 %)	19 (70.4 %)	27 (100 %)
Q13	0 (0.0 %)	0 (0.0 %)	1 (3.7 %)	11 (40.7 %)	15 (55.6 %)	27 (100 %)
Q14	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	2 (7.4 %)	25 (92.6 %)	27 (100 %)
Q15	0 (0.0 %)	0 (0.0 %)	2 (7.4 %)	10 (37.0 %)	15 (55.6 %)	27 (100 %)
Q16	0 (0.0 %)	0 (0.0 %)	3 (11.1 %)	12 (44.4 %)	12 (44.4 %)	27 (100 %)
Q17	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	9 (33.3 %)	18 (66.7 %)	27 (100 %)

acquired in the course and the instructors' abilities to make the objectives clear [$\tau(25) = 0.52$; $p < 0.01$], and the teacher's willingness to encourage participation [$\tau(25) = 0.49$; $p < 0.01$].

A second analysis replicated the results obtained in the teacher's evaluation on the workshop. Results indicated that there was a statistically significant relationship between the educational needs of the participating students (Q6) and the adequacy of feedback to participants (Q7) [$\chi^2(1) = 4.61$; $n = 27$; $p < 0.05$]. The effect size is considered moderate [$\varphi = 0.41$; $p < 0.05$] (Cohen et al. 2007).

As Table 7.3 shows, students held a positive view on the effectiveness of the methodology (Q13). Actually, the analysis revealed the statistically significant differences in the participants' responses [χ^2 (2) = 11.56; $n = 27$; $p < 0.005$]. Pursuing this topic further, we search for presumable significant correlations between the effectiveness of the methodology used (PBL methodology) (Q13) and students' intention to work with this method at school in the future (Q17). The outcome of the analysis clearly shows a significant positive correlation [$\tau(25) = 0.68$; $p < 0.001$].

Students' answers of the open-ended questions, as well as their statements in the discussion at the end of the procedure, acknowledges some interesting key points regarding the PBL methodology. Summing up their opinions, it may be concluded that of most importance for them were their teamwork experience, the responsibilities sharing, the supporting and non-guiding role of the teacher, the sense of expressing themselves freely during working, the use of social media to share their work, the feeling of creation, and the pleasant environment during working and learning. Moreover, they enjoyed the opportunity for discussion about the planning of their work, argumentation about the scenario and the content of their video, planning stages and details for their work, presenting and supporting their product in front of their classmates explaining to them why they choose the specific content (about green economy or sustainable development), and what kind of information they decided to share with them.

At the same time, they ask for more time to work as well as for more and alternative ICT tools. They supported that they learnt new things about video editing using MovieMaker, techniques of searching, and downloaded information, images, and video. But, working on their video they formulated knowledge about green economy and/or sustainable development (ideas, methods, applications, related jobs, and related projects) according to their perspective.

Differences Between Students' and Teachers' Evaluation

Data obtained from both students and teachers–trainees were further analyzed nonparametrically to compare presumable differences between the two independent groups. In view of the skewed distribution of scores, a Mann–Whitney U test was used to evaluate whether attitudes toward PBL methodology differ based on group. Not any statistically significant differences on attitudes toward PBL methodology between students and teachers–trainees derived. It can be concluded therefore that the evaluation of the PBL methodology, as indicated from the abovementioned results concerning participants' satisfaction from the effectiveness of the method, was extremely positive, for both groups. They link the perceived effectiveness of the PBL methodology with their intention to implement this methodology in their everyday teaching and learning practice, respectively.

Conclusions

In this paper, PBL methodology was used for the construction of educational video by teachers and students. Teachers with various vocational specialties were participated in an experiential workshop, gaining experience with the method, and successively invited to implement acquired skills in their school settings. Taking into consideration that PBL methodology is based on the collaborative solving process of real-world problems and inherently is student-oriented, and the following conclusions resulted.

The conclusions derived from the analysis of the participants' answers (teachers and students) regarding the evaluation of the research methodology used and the research questions are as follows:

- The participating teachers were acquainted to PBL technology, and they seemed inclined to apply it at their teaching practice. These results can be correlated with the effectiveness of the methodology applied, since among them a significant positive statistical correlation was found. It should be noted at this point, that the analysis revealed the effectiveness of the PBL methodology, as perceived by the teachers, is significantly associated with instructors' efficacy for meeting the educational goals. Moreover, due to the fact that PBL itself is student-oriented, participants took an active part in the learning process, since the knowledge acquisition was driven by their own personal educational needs and their prior knowledge.
- The participating teachers evaluated the presence of instructors during the seminar as helpful and compatible with the PBL methodology. The active participation of the teachers was encouraged by the instructors who were considered adequate for the project they undertook. Results indicate a substantial positive effect of instructors' role in the process, on the grounds that they managed to make the educational objectives clear and provide the adequate feedback at all phases.
- Teachers were satisfied by their participation in the workshop, and the vast majority of them noted that their expectations were met.
- It is important to notice that the statistical analysis of the student's data replicated the results derived from the analysis of the teachers' data concerning the extent to which instructors' competence enhances the acquisition of PBL proficiency as well as the extent to which the apprehension of PBL methodology results to integrate this knowledge to teachers' and students' future work.
- PBL methodology implementation seemed to have a positive effect on the students. The approach used proved to be an attractive learning novelty for students, triggering their creativity and facilitating the expression of their ideas. Video production using the MovieMaker software was considered as an easy process, and all of them achieved this goal. All of them were informed about notions and topics concerning green skills, green economy, or sustainable development, validating the educational effectiveness of the method.
- Both quantitative and qualitative data analyses indicated that the two groups (teachers and students) shared positive perceptions toward the PBL methodology.

In conclusion, utilizing PBL methodology in the classroom offers opportunities for developing skills such as flexible knowledge, effective problem-solving skills, and collaboration skills as well as intrinsic motivation. It is important to notice that further longitudinal research is considered necessary in order to determine whether PBL methodology can be effectively applied to teaching practice, in various fields of Greek educational reality, where students will be able to build up their knowledge via active ways of action and self-motivation.

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Chapter 8
Fostering Students' Understanding with Web-Based Simulations in an Inquiry Continuum Framework

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Introduction

Technological tools, such as simulations, give prominence to the potentials and advantages of educational theories. Through them, teachers can benefit and make use of the advantages that these models offer (Esquembre 2003). Despite all, educational technology is not an a priori solution for the learning process; not all technologies can be used for educational purposes (Salomon 2000). Simulations must evolve and be combined with innovative methodologies and pedagogical strategies that promote inquiry.

The goal of this project was the effective and better understanding of the Physics phenomena. This should be accomplished through the interaction with educational methods that use simulations as pedagogical tools. It is proven that blended learning education programs increase students' understanding (Garrison and Kanuka 2004). Blended learning, combined with simulations, provides a framework which enhances problem-solving skills in all aspects of instruction (Kirkley and Kirkley 2004).

In the first section, simulations and their advantages in education are described. Then, the process of creating educational simulations for promoting inquiry and students' active participation is explained. The inquiry continuum (IC) is also explained, which can be used as a map road for classifying all levels of inquiry that help students acquire knowledge and skills. Afterward, Illustrations–Explorations–Problems (IEP) approach is described, which combines with simulations, as

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Predict–Observe–Explain (POE) strategy does with worksheets. Finally, we present the results of a research that took place in Greece, in order to test the effectiveness of these methods in the educational process.

Simulations as an Educational Tool

Simulations are representations of real processes, and they have gained their place in education (Wieman and Perkins 2005). Students have better understanding of a phenomenon when they use more senses (Hertel and Millis 2002). Within a simulation, students observe the evolution of a phenomenon and interact with it by changing the initial conditions and monitor the effects of this change.

Simulations are valuable to instruction, from a pedagogical perspective, as they provide useful and effective learning activities (Christian and Belloni 2001). They help students combine all types of representations into a unified theoretical framework and make sense of the physics. Students can watch the phenomenon, interact with it, modify the initial conditions, and play it again. These help them understand the role of equations, link them with theory, and use them as a general tool for study, not just for solving exercises (Simkins et al. 2002).

Another benefit of using simulations is that students who lack imagination or experience can create a realistic image of what they hear or read and combine this information into a concrete framework (Buehl 2009). The production of images and motions through simulations can help in the creation of a strong knowledge background and mental models (Mayer 2005). Simulations can play a role of "note of thoughts" which students use to describe and explain what they learned.

Use of Simulations in Science Instruction

Simulations are useful for pre-class, in-class, and after-class instruction. Pre-class assignments prepare students for the classroom activities, give feedback to teacher about students' current knowledge in order to organize and design the next classroom session, construct the out-of-class time, and create a team spirit. All of the above fit perfectly in just-in-time teaching (JiTT) strategy (Novak et al. 1999). JiTT mainly uses Web-based assignments, but it is proven that it can also blend with simulations for increasing students' level of understanding.

Simulations are also very helpful for in-class instruction. Physics education research has shown that simulations and instructional graphics in general must satisfy five purposes: cosmetic, motivation, attention getting, presentation, and practice (Rieber 1994). There are many researches that focus in the advantages of using simulations in classrooms (Moore et al. 2013).

This work focuses on Web-based simulations for after-class activities. The Web-based part is chosen due to the fact that they are easily distributed, platform independent, and always available. The after-class activities give us a lot of benefits. The size, in time, of typical introductory classes can be a significant barrier to implement successful simulation-based instructional units (Bernstein et al. 2010). Students can have access to Web simulations anytime, anywhere. Brant et al. (1991) found out that simulations are equally effective and students score higher when used as an integrating activity following formal instruction.

After-class Web-based simulations provide students with a powerful tool which continues to offer knowledge and comprehension of the phenomena, long after the in-class instruction is finished (Mackinnon and Brett 2010). Dealing with simulations after class can eliminate any misconceptions and misunderstandings that might appear in-class or during the at-home study from text books. For instance, by changing the value of the initial velocity of a horizontal throw and pressing play, students can see that the body will always fall from a certain height to the ground at the same time, but the throw will not have the same range.

In contrast to classic homework, students can obtain all the benefits simulations offer for in-class teaching, such as attention getting and practice, understanding of the role of equations and link them with graphic plots, etc.

Creation of Educational Simulations

Simulations were created by one of the authors with the use of the program Easy Java Simulations (Fig. 8.1). Each simulation contains three panels, action panel, graphics panel, and control panel (Jones 1998).

In action panel, we can see the evolution of the phenomenon. In graphics panel, plots are created. This is done simultaneously with the evolution of the motion so that students realize which condition is linked to every single point of the graphic plot. In control panel, the ability to change the initial conditions is given. Also, there is the ability of showing or hiding vectors in action panel, making a graphic plot visible, etc. A time bar provides the feeling of time evolution. Underneath time bar, handling buttons are placed. Nevertheless, the most important thing in the design of a simulation is an open environment that can fully describe a phenomenon and supports educational methodologies that promote inquiry.

Theoretical Framework and Educational Methodologies

The context of simulations must be within a pedagogical framework, which should promote inquiry. Simulations are combined with an educational approach, such as IEP. The framework of this approach is an inquiry continuum (IC), which classifies the level of inquiry in each activity and describes the tasks distributed to teacher and

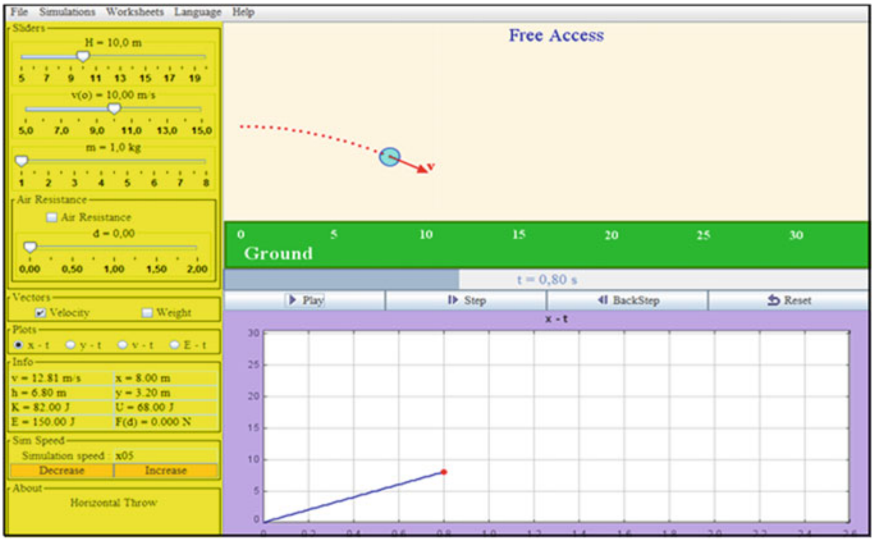

Fig. 8.1 Horizontal throw simulation

students. Worksheets also define the level of inquiry, so students have the appropriate descending scaffolding to help them succeed in the desired goals, gain knowledge, acquire skills, and increase their confidence. To do so, our worksheets follow the POE strategy.

The Inquiry Continuum

Inquiry-based science is an approach to science education that is student-constructed as opposed to teacher-transmitted (Wilfred 2010). Inquiry learning uses questions about a theme and to answer them it engages students into various activities. The inquiry continuum (IC) is a scheme that describes every experiment or activity can be done according to inquiry-based learning.

Many researchers have created an IC to describe the levels of inquiry in many educational procedures, such as laboratory experiments and in-class lectures. Du et al. (2005) describe a six-level IC that is suitable for engineering experiments and can be used in order to understand what processes and skills are needed to design an experiment. Although this IC refers to engineering experiments, it was originated for middle school classroom inquiry. Our approach uses a four-level IC, originated by Bell et al. (2005). It was proposed for in-class inquiry instruction, but we find it an excellent framework for Web-based simulations. Korr (2013), in her research, used the same framework for in-class science instruction with the implementation of simulations to support inquiry.

The levels of inquiry are closed, structured, guided, and open. As we move along the scale, we also move from teacher-centered teaching to student-directed and the responsibility of the tasks gradually shifts from teacher to students. The level of inquiry is critical for the learning experience and the skills we expect from students, such as critical thinking and problem-solving analysis. In closed level, professor is responsible for every aspect of the procedure and students watch teacher perform, collect information, or follow instructions. Moving gradually to the next levels of the IC, students take charge of the process and are obligated to take more initiatives. This way they gain important skills.

In closed level, teacher poses the questions that have to be answered, selects the appropriate procedure, and analyzes data. In structured level, teacher lets students to analyze data and find the answers. In guided level, students select the procedure that will lead them to the correct answers. In open level, students are responsible for all aspects of the concept: pose questions, select procedure, analyze data, and find answers.

Inquiry-based simulations are considered of a higher educational quality, as students take initiative on what to learn, how to identify the problem, formulate questions, design and carry out procedures. Let us take a phenomenon like the horizontal throw (Fig. 8.1). If we permit students to have free access to simulation and ask them to define the parameters in order for the ball to reach the ground at a distance of 20 m, with no explanations or instructions, this is an open level inquiry. This way teacher sets the goal and students should pose the right questions about this concept, design a procedure to collect data, analyze, and reach to a conclusion. If teacher poses hint-like questions to help students identify the problem, but let them decide for the appropriate procedure, it is a guided level inquiry. Furthermore, if teacher locks all the parameters but one to specific values and ask them to test all values of that one parameter or give detailed instructions for the procedure, it is a structured level inquiry. Finally, if teacher asks students to enter some specific values to all parameters, just to see that these are the correct ones, we have a closed level inquiry. Teacher sets the framework, and the level of freedom given to students sets the level of inquiry.

Inquiry continuum is the framework which supports inquiry. To benefit from it, we must use a method for presenting the topic to students, such as Illustrations–Explorations–Problems (IEP) .

Illustrations–Explorations–Problems (IEP)

The method IEP (Christian and Belloni 2003) can succeed in the presentation of a phenomenon to students with an easy and comprehensible way. The IEP approach is based on media-focused problems, where students observe a phenomenon, apply appropriate procedures, and measure the important parameters in order to solve a problem, not just analyze it mathematically (Titus 1998). Although IEP method, as

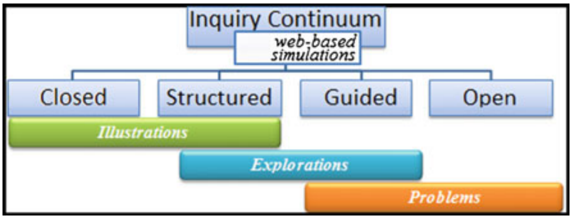

Fig. 8.2 IEP method and inquiry continuum

introduced by Christian and Belloni, was not connected directly to an inquiry continuum, there is a strong connection between them.

In Illustrations, students pay attention to a physical quantity or a graph and run the simulation, altering each time the initial conditions and observing for differentiations. The answer is easily determined from the interaction with the simulation, in view of IC. Illustrations are from the closed to structured levels of inquiry, depending on the level of guidance and instructions given.

In Explorations, students are urged to explore the relation between the involved physical quantities or the form of a graphic plot and describe the evolution of a phenomenon. Explorations are hint-like and teacher helps students by providing the questions and even the process of finding the answers. Explorations are at the levels of structured to guided of the inquiry continuum.

In Problems, the required knowledge is examined and students take charge of the whole process and analysis of the problem. At the same time, skills are granted, such as analyzing the general concept into simple questions, designing procedures to examine those questions, and finding answers. Problems are constructed in a way so that students have a more active role in the procedure and take control of their knowledge. This fact places Problems to open inquiry.

IEP can be applied to each concept of physics individually, not only in a whole chapter. Every step of the IEP approach can be corresponded to some levels of the IC (Fig. 8.2). The beginning and the end of each step is not absolutely specified; there is a small overlap between steps, which makes the transition from one step to the next smoother and easier for the students to adapt.

Predict–Observe–Explain (POE)

Worksheets follow the POE strategy (White and Gunstone 1992) and are given to students as homework. POE strategy helps students to contrast their existing knowledge and perceptions with new ones and highlights the conflicted opinions in order to lead students to the correct conclusions, in such a way that they accept them because they participate in the process (Mthembu 2006). POE provides the framework which guides students' thinking and is essential for improving their conceptual thinking and problem-solving abilities (Theodorakakos et al. 2010).

In Predict, students are asked to predict the evolution in a specific relational change and they usually answer based on the knowledge that they already have, or the respective theory's study. The purpose is the enhancement of the existing student's knowledge.

In Observe, students watch a phenomenon. This step also contains the experimental part. Students not only observe the simulation, but they perform other actions too, as explained at the IC. Students are given instructions on how to execute some actions to the simulation. How much of these instructions and information are given in Observe can give prominence to a simulation that promotes inquiry and lets students develop their own procedures, or restrict its capabilities in order to create a scene with less inquiry-oriented, such as the closed level. This way, a worksheet can cover all the range of the IC.

In Explain, students are asked to explain what they understood in Observe, proving they gained the desired knowledge. If there are discrepancies between the answers in Predict and Explain, students should explain why they changed their answer; if not, they should reinforce their prediction with the data from Observe.

Our research's worksheets follow the POE strategy, but each step is refined so that the inquiry continuum is implemented. Simulation has many parameters, but each worksheet force students to use some or all of them, depending on the level of inquiry we want to achieve. As mentioned before, worksheets play a critical role in the way students will handle the simulation. A well designed, fully featured simulation is desirable, but this is also true for worksheets. No matter how good a simulation is and how many features has, students would not make use of them if it is accompanied by a poor designed worksheet. Designers and professors may try to create a simulation that promotes inquiry but the accompanied worksheet may restrict simulations' capabilities. It is understood that the question in Predict and the instructions in Observe step of a POE worksheet are very significant for the level of inquiry. A question with a not very obvious answer in Predict and a "hint-like," as opposed to "do-like," Observe part can trigger an inquiry procedure and challenge students. If the question in Predict has a complex answer, which cannot be based in a single equation, students will be urged to use an inquiry-based procedure and design a process which will lead them to the right conclusions. On the contrary, a well-designed worksheet can only exploit the advantages of a well-designed simulation, not the other way around.

Research About the Effectiveness of Simulations

In the past 4 years (2011–2015), a research was conducted for studying the effect of simulations and the above methods in students' performance. Sixty-three students from various schools in Thessaloniki, Greece, participated in the research.

Students were given worksheets to complete along with the simulations; a total of 343 worksheets were collected. Teacher made an introduction to simulations and the way they work, as well as how to complete the worksheets. Each student

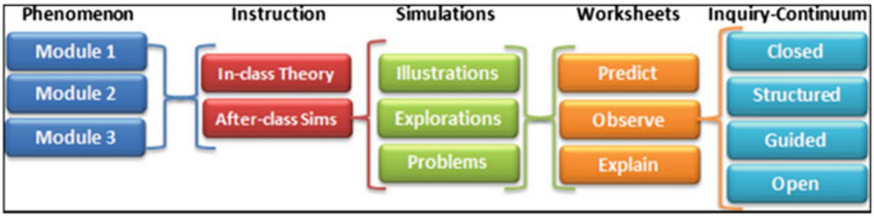

Fig. 8.3 The unfolding structure of the sequence

worked individually from his home, through Internet connection in order to have access to simulations. For this purpose, a Web site was created (hosted on server). Students had been supported by a Facebook's group created for the research.

Our teaching learning sequence on horizontal throw is shown in Fig. 8.3. The instruction of a phenomenon is divided into modules. Each module consists of in-class theory instruction and after-class homework with Web-based simulations. Simulations use the IEP method. Each step is accompanied with worksheets that use the POE strategy. The Observe part follows the IC as a framework.

Another parameter of the POE method is the certainty of the answers given in Predict and in Explain steps (Dalziel 2010). This is measured in a forced Likert-type scale in order to force students to give a positive or negative answer.

Answers not only were studied as a whole, but also were separated into groups in order to see whether there is a factor which affects the learning ability:

- Student's age: 3rd Grade (33)—2nd Grade (21)—1st Grade (9)
- Students' sex: Girls (30)—Boys (33)
- School: Public (52)—Private (11)
- Field of Study: Physical (35)—Social (19)—Not Specified (9)

The parameters in which research was focused were the following:

1. Can students follow alternative teaching methods?

   Check whether they completed worksheets, no matter what answer they gave.

2. Can students achieve higher levels of knowledge with these methods?

   Check whether they answered correctly, especially in Explain step.

3. How do students feel about these methods?

   Check time for completing the worksheets and whether they liked the method.

4. Do simulations increase students' certitude about their answers?

   Compare the level of certainty in Predict and Explain.

Statistical Analysis and Research Results

All worksheets were analyzed with IBM's tool SPSS, version 22. At first, data were analyzed to check the frequencies of the correct answers given. After that, a set of independent t-tests were applied, in order to examine whether there were any differences between groups. All t-tests were conducted independently for Predict and Explain. Worksheets were divided into groups according to age, gender, type of school, field of study, and the certainty of the given answer.

The general conclusion is that all students completed the worksheets and were able to follow the instructions. The total number of correct answers in Predict was 138. In Explain, the total number of correct answers was 287, an increment of 108 %, alongside with the decrement of the wrong answers (109 in Predict, 16 in Explain). Students increased their knowledge and also their confidence about this knowledge. Seventy-three students answered they were certain about their answer in Predict, but 193 students were certain about their answer in Explain (Fig. 8.8).

Despite not having any previous experience with simulations, students adapted quickly and performed well; the use of computers did not affect their performance negatively, but helped them understand the phenomena, as well as attracted their interest. At the end of this research, all students could answer to questions that demanded personal judgment and a more complicated way of thinking.

In Fig. 8.4, we can see the total results for Predict and Explain. The number above each bar shows the total number of worksheets for the current answer. At first sight, we see that correct answers were doubled at explain.

Next step was to compare Predict and Explain answers by gender (Fig. 8.5). SPSS analysis showed no significant difference between answers given by gender (sig. = 0.347). Again, the increase in correct answers was obvious at both genders.

Examining the answers given in worksheets by type of school (public or private) was our next query (Fig. 8.6). In Predict, students of public schools had more correct answers than students of private schools. In Explain, it seems that both public and private school students increased the percentage of correct answers to the same level. SPSS shows a statistically significant difference in Predict (sig. = 0.043), but not

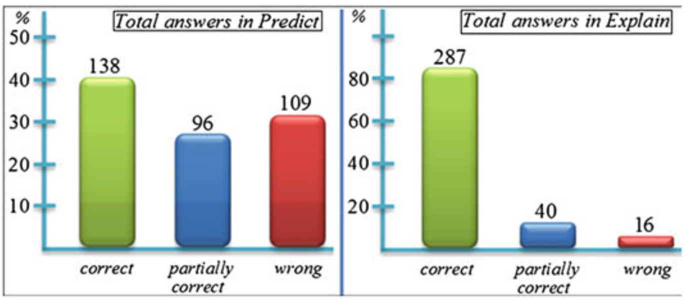

Fig. 8.4 Total answers in predict and explain

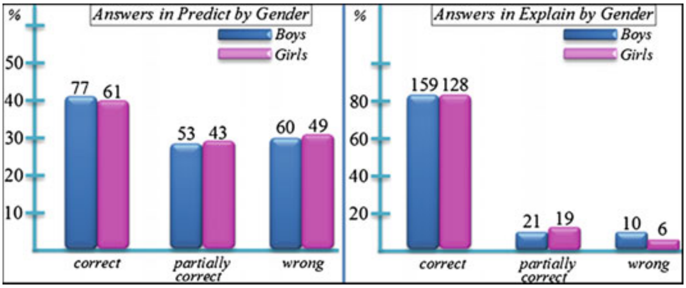

Fig. 8.5 Answers in predict and explain by gender

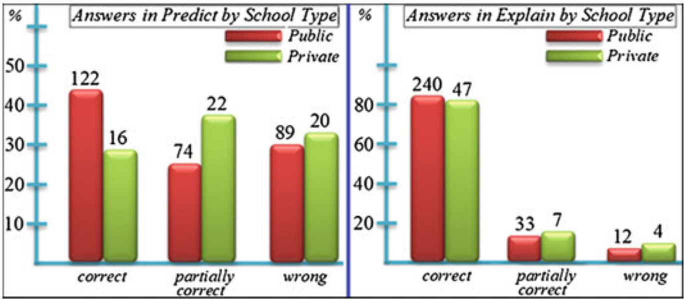

Fig. 8.6 Answers in predict and explain by school type

significant in Explain (sig. = 0.593). This result is under question because the number of students from private schools who participated in the research was very small, so no safe conclusions can be made regarding school type.

The last separation was between students who have not decided the field of study yet, those who have chosen physical sciences and those who have chosen social sciences (Fig. 8.7). SPSS showed a significant difference between physical and social sciences (sig. = 0.017). This seems to be understandable, as students of physical sciences have generally more knowledge about physics.

Every Predict and Explain step was followed by the question "how certain are you?" Students should circle one of the following: uncertain, somewhat uncertain, somewhat certain, and certain. The results indicated that simulations can increase student's confidence (Fig. 8.8). What is also important to notice is that some students who answered correctly in Predict were not very confident about their answer. In Explain, they answered correctly but they were more certain about it.

Students were also asked to mark how much time took them to fill the worksheets. Answers vary from 2 min to 20; the method is not time-consuming. What is also important to notice is that playing a simulation usually takes 5–10 s to complete, but managing the simulation takes more time.

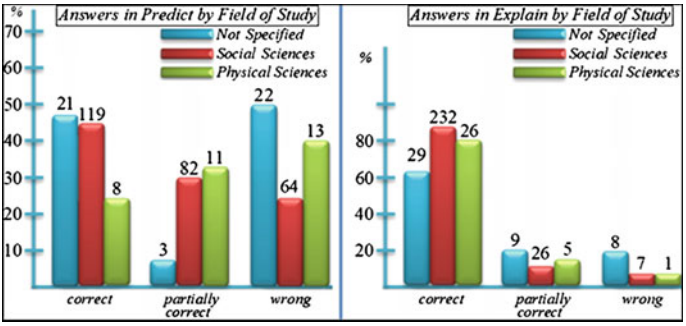

Fig. 8.7 Answers in predict and explain by field of study

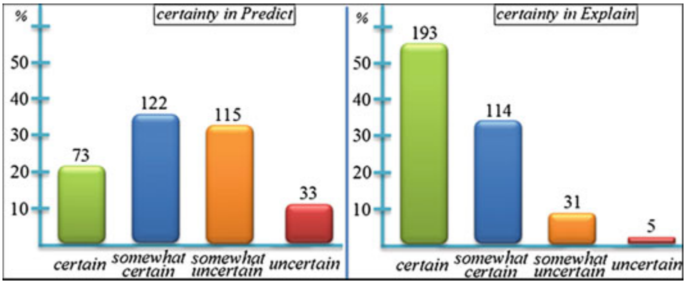

Fig. 8.8 Certainty of answers in predict and explain

Results regarding the 1st parameter show that students can follow new methods. Also, students showed a positive stance, as most comments were positive.

As for the 2nd parameter, we observed that each student individually increased his knowledge about the phenomena. The total correct answers in Explain are much higher than the total correct answers in Predict, with a simultaneous decrement of the wrong answers. This increment was noticed in every separation that was made, between genders, type of school, fields of study.

As for the 3rd parameter, students think that studying with the use of computer simulations is easier, faster, and pleasant. Most students were excited with the fact that they would do homework from their computers, whereas many comment the simultaneous vision of the movement and graphs as very useful.

As for the 4th parameter, the certainty of the answers was increased at Explain, contrary to Predict (Fig. 8.8). This means that simulations give to students a hands-on experience which increases their confidence about the gained knowledge.

Conclusions

This teaching method manages to provide students with a holistic learning experience which improves their performance independently of their level of knowledge. Along with the help of simulations, teachers have all the tools and resources they need in order to guide students and let them discover knowledge by their own. The use of computers and Internet gives an extra motivation to students. Additionally, simulations succeed in helping students understand the graphs, as they have declared. Finally, the short time which is demanded for the worksheets does not function contradictorily, mainly for the least capable students.

This process could be applied simultaneously with the existed curriculum of Physics teaching, for a comprehensive and integrated learning experience.

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Chapter 9
How Personalization May Benefit the Learning Design Process with LAMS

Eva Papazoi, Kyparisia A. Papanikolaou, Evangelia Gouli and Maria Grigoriadou

Introduction

In the growing area of Web-based education, personalization can be considered as a new means of development and deployment of adaptive mechanisms into traditionally non-adaptive environments such as learning management systems (LMSs). The area of adaptive learning environments (ALEs), including intelligent tutoring systems and adaptive hypermedia educational systems, has a lot to offer to this end (Grigoriadou et al. 2010; Knutov et al. 2009).

ALE commonly offers learners individualized support and guidance taking into account their individual characteristics and needs. A common source of adaptation is the learner's individual characteristics that are involved in the knowledge acquisition process such as learning goals, knowledge level, background, browsing experience, preferences, prior knowledge, and learning/cognitive style (Akbulut and Cardak 2012; Brusilovsky 2001; Nakic et al. 2015; Graf et al. 2009). In this context, adaptation is defined based on the level of control on the adaptation mechanism that the user is allowed (Brusilovsky 2001), ranging from the complete

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control of adaptation by the system (adaptivity) to the complete control of adaptation by the learner (adaptability). In addition, most of these systems offer the teacher the appropriate authoring tools for developing learning material that can be reused by learners with a different profile (Brusilovsky 2003; Papanikolaou 2015).

Lately, several studies have explored how personalization might benefit the users of learning management systems (LMS) provided that the individual characteristics of learners and their behavior during the interaction have a significant role in learning contexts mainly controlled by the learner (De Bra et al. 2013; Graf et al. 2009; Mazza and Botturi 2007; Zhang et al. 2007). These studies focus on the development of appropriate functionalities and tools for facilitating adaptivity and/or adaptability, whereas user needs and expected benefits for the learner or the course designer have to be further explored (Papanikolaou 2014).

The current study, aiming to combine research in the area of ALE with the LMS area, analyses the development process of personalized courses in Learning Activity Management System (LAMS). LAMS is a community-based open-source software for the design, management, and delivery of online lessons that take the form of sequences of learning activities (LAMS Foundation 2015). Lesson designers compose activities using tools of various categories such as activity tools, flow tools, and grouping tools at the designer environment and place them in sequences. The added value of this process for the course designers is explored according to the Technological Pedagogical Content Knowledge (TPACK) framework. Moreover, the appropriateness and adequacy of the available tools by which adaptation can be implemented in LAMS are evaluated. LAMS has been used for designing personalized courses in a few cases (Nat et al. 2010; Leontides and Papadakis 2013) in which the adaptive lessons created were based on the Felder–Silverman learning style categorization (Felder and Silverman 1988). As we consider important to further investigate how personalization can benefit the educational community using LMS, in this study we focus on the following research questions:

Research Question 1: How can personalization be introduced in LAMS lessons based on learners' individual characteristics?

Research Question 2: How do users use and evaluate LAMS tools for implementing personalization?

Research Question 3: Which types of knowledge may a course designer cultivate through the development of personalized content for LAMS?

Empirical Study

The study was conducted in the context of a postgraduate course on distance learning organized at the University of Athens over a period of 6 months. Twenty-four students participated in the study, 22 of which came from the department of informatics and telecommunications and two from the department of philosophy and history of science.

Students were assigned to design a lesson in LAMS (version 2.2) in two phases. During the first phase (Phase A), students were asked to design a lesson for distance learning selecting the topic, the learning outcomes and the target group. Fifteen lessons were created by the students who worked either individually (in 5 cases) or in groups of two (in 10 cases). During the second phase (Phase B), students were asked to transform their lesson in an adaptive one, taking into account specific learning characteristics and traits of their choice. The duration of each lesson varied from three to five teaching hours. Finally, students completed a questionnaire entitled LAMS evaluation questionnaire, in order to reflect on their experience of developing the initial and the adaptive version of a lesson.

The first results of this study have been presented in Papazoi et al. (2015), focusing on the technological knowledge and gains of developing personalized courses in LAMS.

Data of the Study

The data of the study consist of the two versions of the lessons authored in the LAMS environment, namely the initial version (Phase A) and the adaptive version (Phase B), as well as the LAMS evaluation questionnaires completed by the students at the end of the course.

During Phase A, fifteen lessons were created. The subjects of these lessons varied from topics related to informatics to more general topics. Figure 9.1a presents the initial/non-adaptive version of the lesson entitled “Databases” created during Phase A, as it is previewed through the LAMS authoring environment. The sequential nature of the lesson is depicted through the arrows that show the order in which the tasks are to be completed by the learner.

In Phase B, students were asked to transform the lesson created in Phase A into an adaptive lesson. In total, 14 adaptive lessons were created due to member changes in the initial groups. Figure 9.1b shows the adaptive version of the lesson on “Databases”, where branching and grouping tools appear. Each branching tool contains various paths based on the values of the individual characteristics of the learners used as sources of adaptation (the branching tools are presented in frames). The addition of a grouping tool to a sequence allows other activities to run in small group mode, rather than as a whole class activity.

The contents of the lesson on “Databases” are the following: *Introduction*, *Study guide, Unit 1.1*: Entity-relationship model (ER Model): theory, quizzes, activities; *Unit 1.2*: Relational Model: theory, quizzes; *Unit 1.3*: Quality Design: theory, activity; and *Unit 2.1, 2.2*: Introduction to SQL: theory, quizzes, activities, *Lesson Evaluation*. In Phase B, branching tools were added in all the lesson units personalizing tasks based on students’ prior knowledge on databases.

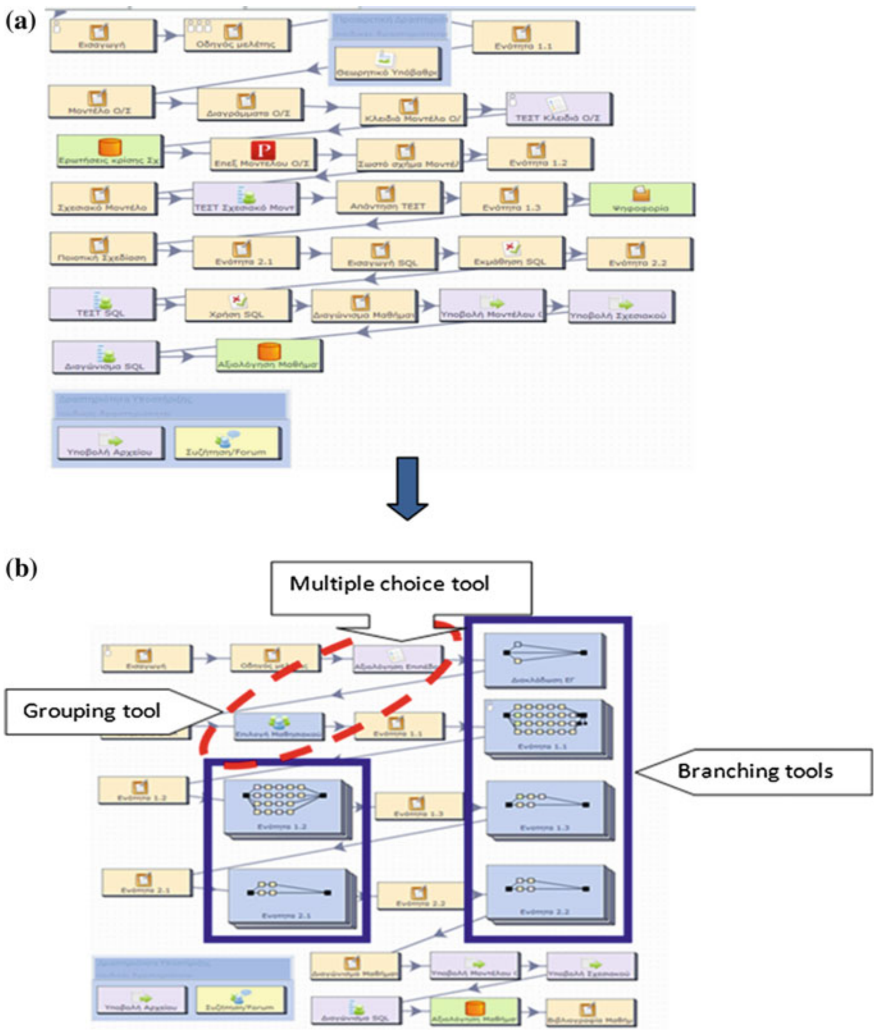

Fig. 9.1 The author perspective of the initial version of **a** the lesson in LAMS and **b** the adaptive one including the LAMS tools used for implementing adaptation: branching, grouping and multiple-choice tools (*Source* Adaptive lesson on "Databases")

Data Analysis

In order to explore the ways in which adaptation was introduced (*research question 1*), we conducted a comparative analysis between the adaptive versions of the lessons concerning (a) the characteristics of the learner used as sources of adaptation, (b) the characteristics of the system differentiated according to the learner profile, and (c) the adaptability features offered.

Moreover, students' answers to the evaluation questionnaire were analyzed in order to identify technical restrictions of the system and explore their proposals for future extensions (*research question 2*).

Then, we used the theoretical TPACK framework to identify instances of the initial and adaptive versions of the learning designs that reflect the knowledge areas that were developed (*research question 3*). The basis of the TPACK framework is that the process of integrating technology in education is a particularly complex one that draws on the various diverse knowledge areas of content, pedagogy, and technology (Mishra and Koehler 2006). Due to the continuously increasing importance of technology, TPACK stresses also the particularly complex relationship between these three knowledge areas. The various types of knowledge proposed by TPACK were used as the basis for evaluating and comparing the initial and adaptive lesson versions created by the students.

The TPACK questionnaire (Schmidt et al. 2009), commonly used to measure students' self-assessment of TPACK knowledge, was used as the basis for the qualitative evaluation of the various types of knowledge developed. In particular, we selected specific questions from this questionnaire which we reformulated into 23 evaluation criteria in order to assess the lessons.

An example of this reformulation is the following: the sixth question of the initial questionnaire

"*6. I have the technical skills I need to use technology"*

was made more concise and adapted into four criteria assessing students' technological knowledge (TK) on the four types of technologies cultivated through the course; the particular criteria appear in Sect. 'Results and Discussion', under Research Question 3 where an excerpt from the criteria used for the evaluation of various TPACK knowledge areas is provided.

Thus, the 15 initial and the 14 adaptive lessons were analyzed and evaluated with these 23 criteria and scored by the authors of the paper with a five-point rating scale (0 = Poor, 1 = Fair, 2 = Neutral, 3 = Good, 4 = Very Good). A similar approach has also been used in (Graham et al. 2012). In this study, students' artifacts were analyzed using a coding scheme derived by the TPACK framework.

Results and Discussion

Research Question 1: How can personalization be introduced in LAMS lessons based on learners' individual characteristics?

Regarding the learner characteristics and traits selected as a *source of adaptation* on which the system adapts its output, we observed the following:

- In all the lessons designed in Phase B, adaptation was implemented according to learning style and various models have been adopted; in eleven lessons, adaptation was based on the Honey and Mumford (1992) learning style theory, in two lessons on the Kolb (1984) learning style categorization, and in one lesson according to the Felder and Silverman (1988) learning style categorization.

- In Phase A, although it was not requested by the assignment, four lessons were designed with adaptive features based on learners' prior knowledge, while in Phase B the adaptive lessons based on the same characteristic rose to ten.
- Two lessons took into account learners' preferences of the way the material was presented.
- One lesson gave learners the choice to follow a different sequence (path) based on their corresponding roles, i.e., parents or teachers.

Regarding the *adaptation method*, i.e., method adopted for designing what to be adapted, we observed the following:

- The most prominent implementation method of adaptation was the presentation of learning units (e.g., activity, theory, exercise) in various orderings based on the learning style of the learner, as in INSPIRE*us* (Papanikolaou 2015). The sources of adaptation used were as follows: learning style (in fourteen lessons), learner preferences (in two lessons), performance in assessment tests (in two lessons), and combinations of the above-mentioned sources of adaptation.
- The second most prominent implementation method was the provision of different material using different tools according to learners' learning style. This method was implemented in five lessons. According to this implementation method, various types of educational material were developed. For example, if a learner has a theoretical learning style, the system presents more bibliographical resources, while if a learner has a more practical background, the system provides the learner with more activities.

Regarding *adaptability* as the control of adaptation features by the learner himself, we observed that in the majority of lessons (twelve lessons), the participants used specific tools to implement adaptability. These tools were the optional and supportive activities that a learner can freely select. The method that the students used in order to implement adaptability allowed learners to freely choose or change: (a) their prior knowledge level of the topic (in ten lessons) and (b) their learning style (in thirteen lessons).

Research Question 2: How do users use and evaluate LAMS tools for implementing personalization?

In Phase B, all the lessons have been enriched with more activities and tools compared to the initial version. This rise in the number of tools ranges from to 2 to 16 extra tools (see Table 9.1). The tools used for the design of the lesson in both phases were mostly tools that the LAMS environment offers. From the available LAMS tools, the most frequently used ones were notice board, multiple-choice tool, Q and A tool, forum, and file upload provided as supportive activities. These tools reflect the interactive nature of the activities composing the lessons.

Adaptation was mainly implemented with the branching tool of LAMS allowing the design of various learning paths within the main sequence (see Figs. 9.1b and 9.2). Apart from the branching tool, other tools used for the implementation of adaptation include grouping tools that allow the formulation of specific groups of students (automatically generated or based on students' choice), tools for creating multiple-choice

Table 9.1 LAMS tools adopted in both versions of lessons 1–7

Lesson	Phase A	Phase B	Types of tools added in Phase B
1	19	33	Notice board tool and sequence management tools
2	28	32	Sequence management tools
3	17	21	Survey tools, branching tools, optional activity tool, share resources tool, survey tool for defining the learning style of the learner
4	25	27	Share resources tool, notice board tool, and branching tools
5	13	16	Branching tools, activity tools, and assessment activities
6	43	46	Notice board tool, share resources tool, and branching tools
7	31	47	Share resources tool, submit files tool, Q and A tool, notice board tool, branching tool, and multiple-choice tool

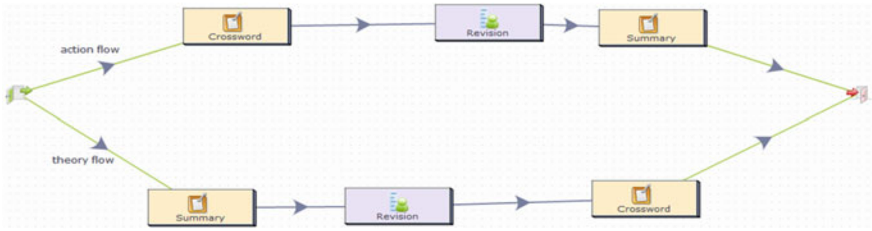

Fig. 9.2 The branching tool proposing two learning paths with different ordering of the same activities based on learners' style or students' choice

questions, and evaluation tools that can be used as input to the condition controlling branching or students' grouping; e.g., based on the results of a test assessing learners' knowledge, learners can be automatically organized in groups (see also Fig. 9.1b).

One of the main findings of the study was that according to students' answers to the questionnaire, LAMS has significant potential in creating lessons with adaptive characteristics. It offers appropriate tools for the creation of alternative learning paths (such as the branching and grouping tool). LAMS allows the development of adaptive lessons, even though it is a general purpose e-Learning environment that has not been originally designed as an adaptive environment. At the same time, it has less potential in the implementation of adaptability, due to the sequential nature of the environment.

By analyzing student answers to the LAMS evaluation questionnaire, we identified interesting proposals about improvements that may facilitate the creation of adaptive lessons in LAMS and certain technical restrictions of the system. The main restrictions of the system concerning the development of content and mainly adaptive content that were acknowledged are as follows: (1) LAMS tends to get "heavy" when many branching tools are used in a lesson, (2) the sequential nature of LAMS makes it difficult to choose how to visit activities, and (3) lack of content reusability.

Furthermore, we identified students' proposals for possible improvements: (1) The option of copying an entire branch or multiple activities to another branch would make the implementation process significantly easier for the designer, (2) an index of the lesson activities would enable the learner to overcome the strict sequential nature of the lessons (adaptability feature), (3) the integration of a learning style or an individual characteristics' identification questionnaire, and (4) the option of creating a learner profile/model including variable values or answers to specific questions; this can be used for personalizing the interaction as an alternative method of implementing adaptation through the branching tool.

Research Question 3: Which types of knowledge may a course designer cultivate through the development of personalized content for LAMS?

Based on the comparative analysis between the initial version of the lesson (Phase A) and the adaptive one (Phase B), the main result was that the second version of all lessons scored higher points according to the 23 evaluation criteria assessing the various types of knowledge of TPACK. Table 9.2 indicatively shows the means per evaluation criterion grouping them in means per type of knowledge for each type of knowledge at both Phases A and B; technological knowledge (TK), technological pedagogical knowledge (TPK), content knowledge (CK), pedagogical knowledge (PK), pedagogical content knowledge (PCK), and technological pedagogical content knowledge (TPACK).

Criteria with the biggest increase are those evaluating (a) the ability to create learning objects using Web 2.0 tools (see in Table 9.2, TK—Criterion 3, mean per criterion from 1.87 in Phase A to 3.14 in Phase B), (b) the ability to personalize instruction based on learners' knowledge level (see in Table 9.2, PK—Criterion 10, mean per criterion from 1.93 to 2.57), (c) the ability to personalize instruction to the individual characteristics of learners (see in Table 9.2, PK—Criterion 11, mean per criterion from 0.53 to 3.14), and (d) the ability to adapt the use of technologies to the context of learning activities and instructional approaches (see in Table 9.2, TPK—Criterion 20, mean per criterion from 2.07 to 2.54).

Moreover, the types of knowledge mostly developed seem to be (a) technological (see in Table 9.2, TK, mean per type of knowledge from 2.65 in Phase A to 3.16 in Phase B), (b) pedagogical (see in Table 9.2, PK, mean per type of knowledge from 2.10 to 2.82), and (c) their combination TPK (see in Table 9.2, TPK, mean per type of knowledge from 2.10 to 2.82).

Regarding technological knowledge, certain technological skills and competencies seem to develop when a designer creates content for LAMS and especially for an adaptive lesson. In particular, we used four criteria assessing students' knowledge on using specific technologies like tools of the authoring environment (LAMS), locating resources on the Internet, creating learning objects using Web 2.0 tools, and using other digital technologies for implementing an educational scenario (see Table 9.2, technological knowledge). For example based on criterion 3 (ability to create learning objects using Web 2.0 tools), the lessons of both phases were analyzed in order to identify the Web 2.0 tools that were integrated in learning activities such as cognitive maps, presentations, word clouds, and assessment activities based on crosswords and quizzes. Actually in Phase A of the study, the

Table 9.2 Scoring of lessons in Phases A and B based on TPACK evaluation criteria

	Phase A		Phase B	
Criterion	Mean per criterion	Mean per type of knowledge	Mean per criterion	Mean per type of knowledge
TK: Criteria 1–4		2.65		3.16
Criterion 1: Ability to use the various types of tools of the authoring environment (LAMS) for designing a lesson	3.20		3.57	
Criterion 2: Ability to search for, evaluate, and select appropriate information and multimedia on the Internet	2.80		2.93	
Criterion 3: Ability to create learning objects using Web 2.0 tools	1.87		3.14	
Criterion 4: Ability to select and use a variety of digital tools for implementing an educational scenario	2.73		3.00	
CK: Criteria 5–8		2.94		3.05
PK: Criteria 9–14		2.10		2.82
Criterion 9: Ability to assess students' knowledge in various ways	2.27		2.64	
Criterion 10: Ability to personalize instruction (introducing adaptivity/adaptability) based on learners' knowledge level	1.93		2.57	
Criterion 11: Ability to personalize instruction to the individual characteristics of learners	0.53		3.14	
Criterion 12: Ability to use a variety of instructional techniques such as inquiry, case studies, problem solving, and role playing	2.47		3.00	
Criterion 13: Ability to focus on content concepts on which various difficulties in understanding and misunderstandings have been evaluated	2.27		2.36	
Criterion 14: Ability to set learning outcomes categorized in knowledge, skills, and competencies	3.13		3.21	
PCK: Criteria 15–16		2.7		2.82
TCK: Criteria 17–18		2.67		2.9
TPK: Criteria 19–20		2.07		2.54
Criterion 19: Ability to incorporate technologies that enrich the instructional approaches adopted	2.33		2.50	
Criterion 20: Ability to adapt the use of technologies to the context of learning activities and instructional approaches	1.80		2.57	
TPACK: Criteria 21–23		2.58		2.81

Table 9.3 Number of lessons including specific Web 2.0 tools at Phase B

Categories of Web 2.0 tools	Number of lessons
Quiz tools	10
Presentation tools	6
Word cloud creation tools	4
Concept/Mind mapping tools	4
Video editing tools	3
Subtitling tools	2
Image processing tools	2
Comic creation tools	1
Tools for creating Web sites	1
Tools for map processing	1
Specific purpose tools such as applets, online compilers, games	4

lessons developed included a small number of Web 2.0 tools and multimedia elements, whereas in Phase B, an increase of the Web 2.0 tools was observed leading to activities with significant interactivity. In Table 9.3, the categories of Web 2.0 tools used in the adaptive lessons appear.

Accordingly, regarding pedagogical knowledge and technological pedagogical knowledge, specific instances were explored in the lessons of both phases based on the Criteria 9–14 and Criteria 19 and 20 correspondingly.

Conclusions

This study highlighted various implementation approaches of adaptation in LAMS as well as the potential of the environment in supporting adaptation. In particular, we observed that students used the tools of LAMS in various ways concerning the *source of adaptation*, the *adaptation method* and the *adaptability* opportunities offered in their lessons. This was due to the various possibilities offered by the environment or due to the individual characteristics of the authors such as their knowledge background or interests. This is an interesting topic to further explore. Improvements on LAMS to facilitate the authoring process, personalization, and further support learner control, i.e., adaptability, were proposed. The results of the study were mainly based on the evaluation of students' artifacts using as a theoretical background the TPACK framework; this is a work in progress. In particular, the evaluation process was based on criteria derived by the TPACK questionnaire providing evidence about their applicability and reliability as well as their adequacy as a base of comparison between the initial and the adaptive versions of the lessons developed. This study is a first step providing important evidence about how the development of adaptive lessons cultivates all the TPACK knowledge areas.

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Part IV
e-Learning in Higher Education

Chapter 10
The Design, Implementation, and Evaluation of a Two-Layer Peer Assessment Scheme in an Undergraduate Course Wiki: Findings from a Case Study

Ilias Karasavvidis

Introduction

Web 2.0 technologies have attracted considerable attention over the past few years. Owing to the phenomenal success of Wikipedia, Wikis are among the most popular Web 2.0 tools. A Wiki is defined as a "freely expandable collection of interlinked webpages, a hypertext system for storing and modifying information—a database, where each page is easily edited by any user with a forms-capable Web browser client" (Leuf and Cunningham 2001, p. 14). Wikis enable the collaborative creation of associative hypertexts through various modes of work: individual work (creating a Wiki page), joint work (e.g., collaborative creation of a Wiki page), communication (threaded discussions), and evaluation (e.g., peer review). Wikis are unique in that they afford a dual focus on both the finished product (i.e., a wiki page) and the very process of creating it (i.e., cumulative record of edits through the page history).

Generally, Wiki applications can support a wide range of practices such as learning, collaboration, communication, interaction, sharing, meaning making, and reflection (e.g., Guzdial et al. 2001; Choy and Ng 2007; Elgort et al. 2008; Minocha and Thomas 2007; Yukawa 2006; Rick and Guzdial 2006; Ravid et al. 2008; Wheeler et al. 2008). While the affordances of Wikis are undisputed, in higher education (HE) settings, educators still need to figure out how to harness the Wiki potential (Wheeler and Wheeler 2009). There is a considerable knowledge gap regarding the integration of Wikis in HE. This is a complex challenge to undertake because research indicates that engineering (Rick and Guzdial 2006; Raman et al. 2005), scaffolding (Guzdial et al. 2001; Cole 2008), and course integration (Choy and Ng 2007; Wheeler et al. 2008; Cole 2008) are among the determinants of

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successful use of Wikis. What complicates things even further is that to successfully integrate Wikis, educators might eventually have to completely redesign a course (Dohn 2009; Cole 2008).

The issue of assessment is one of the Wiki dimensions in need of more systematic research. Pusey and Meiselwitz (2011) point out that typically student work in Wikis has been evaluated in traditional ways, i.e., focusing on individual participation and contributions. Similarly, Dohn (2009) notes that even though Wiki work is the outcome of collaboration, individual student contributions constitute the focus. The evidence indicates that students do not exactly appreciate it when their work is revised (Wheeler et al. 2008; Vratulis and Dobson 2008) and criticism is not always well-taken by fellow students (e.g., Minocha and Thomas 2007). It is contradictions like these which necessitate the systematic study of assessment practices in Wikis. The present study explores peer assessment in Wikis in the context of a HE setting.

Peer Assessment

Assessment is an essential constituent of learning. Formally, assessment can be defined as "the determination of the amount, level, value or worth of something" (Topping 2003, p. 58). In terms of *function*, assessment can be distinguished in formative and summative. In terms of the *assessor*, assessment can be distinguished into (a) instructor assessment, (b) self-assessment, and (c) peer assessment (Topping 2003). *Peer assessment* can be defined as "an arrangement for learners and/or workers to consider and specify the level, value or quality of a product or performance of other equal-status learners and/or workers." (Topping 2003, p. 65). The primary goal of peer assessment is to provide learners with feedback (Topping 2009; Kollar and Fischer 2010).

Peer assessment has been associated with several *gains* such as increased time on task, higher responsibility, early error and misconception detection, and increased reflection (Topping 2009). However, peer assessment research is still in its early stages (Kollar and Fischer 2010). For instance, the literature review on peer assessment conducted by Van Zundert et al. (2010) included only 26 empirical studies. Due to the lack of many published studies, the authors concluded that determining what exactly constitutes effective peer assessment is difficult. Similarly, Kollar and Fischer (2010) concluded that, from a learning perspective, the relation between particular forms of peer assessment such as feedback provision and learning is not presently evident. Peer assessment has been primarily used in HE settings and especially in writing tasks (Topping 2003). Considering that Wiki tasks involve writing, this makes Wikis ideal as candidates for exploring novel peer assessment practices.

Peer Assessment in Wikis

New online settings necessitate alternative evaluation methods which involve peer assessment as an essential component (Kearns 2012; Cartney 2010). Assessment 2.0 differs from traditional assessment in several ways as it is authentic, personalized, engaging, problem-oriented, and collaborative. While traditional assessment focuses on individual students, Web 2.0 practices are essentially collaborative. Consequently, individual students can no longer be the sole focus of assessment (Elliott 2008).

As online environments, Wikis are highly relevant for assessment for two main reasons. First, by virtue of being an essentially collaborative practice, Wiki tasks are, by definition, open to peer review. Moreover, the editing of Wiki content is open to all participants. Shared editing in the form of peer review represents a type of peer assessment which is embedded into Wiki practices by design. Second, it is also possible to engage students into peer assessment by formalizing the peer review, extending it to a new level which targets assessment per se rather than the Wiki product.

Students' Wiki work has been typically assessed in terms of individual contributions rather than group ones (Pusey and Meiselwitz 2011). Dohn (2009) stressed the contradictions between collaborative wiki production practices and individual assessment ones. This is a major limitation that can be resolved through peer assessment. De Wever et al. (2011) advocate the incorporation of peer assessment into Wikis for both practical and theoretical reasons. As the authors note, while instructors can retrieve all data regarding student participation in the wiki, evaluation is not practical, especially in large-scale classes. Moreover, Wiki co-participants have a much better representation of the collaborative processes than instructors. On a more theoretical level, De Wever et al. (2011) argue that the incorporation of peer assessment is crucial for improving the reliability and validity of assessment.

Despite the potential of Wikis for peer assessment, the existing literature is rather limited. The typical focus is either on *self-assessment* (e.g., Barry 2012) or on assessment methods such as *quizzes*, *rubrics*, and Wiki *usage* (Pusey and Meiselwitz 2011). Few studies have examined the feasibility of peer assessment in Wiki tasks. Overall, the findings reported are promising, indicating that Wikis can be used effectively to support peer evaluation in online courses (e.g., He 2011).

Some studies have targeted *assessment rubrics* in an attempt to explore their potential for facilitating peer assessment in Wikis. Lai and Ng (2011) concluded that assessment rubricscan be successfully employed for assessing Wiki work. De Wever et al. (2011) examined the impact of rubrics on the reliability of intra-group assessment and reported that the reliability of the overall peer assessment is high.

Other studies have explored how **factors** such as *practice* or *evaluation criteria* influence the quality of peer assessment. Regarding the former, **practice** appears to be a critical condition for successful peer assessment. Lai and Ng (2011) report that integrating self- and peer assessment in a Wiki is possible with sufficient practice. A similar conclusion was reached by De Wever et al. (2011) who suggested that the reliability of peer assessment might be improved through repeated scoring practice.

Regarding the latter, it appears that the use of **explicit criteria** for peer assessment also makes a difference. De Wever et al. (2011) found that the reliability of peer assessment increased as a function of using explicit rubric criteria. Similarly, Gielen and De Wever (2012) report that providing students with instructions on how to provide feedback was effective, as the students perceived the feedback received as more detailed and profound.

Considering that in Wiki contexts research suggests that students are reluctant to revise the work of others as much as accept others revise their own work, it is interesting to note that student perceptions of peer assessment in Wiki-based settings are positive. In a study on peer assessment in an ESL course, de Paiva Franco (2008) reported that learners become less dependent on teacher feedback. Student views of the peer feedback were positive as 44 % of the participants rated peer feedback as the best Wiki feature. He (2011) also reported that student responses to the use of Wiki for peer review purposes was favorable as 69 % of the participants expressed agreement. Lin and Yang (2011) examined student perceptions of using a Wiki for peer feedback in an ESL course. The authors report that students welcomed peer feedback as it made them less anxious compared to instructor feedback.

Despite favorable findings, some studies reveal substantial *challenges* that need to be overcome: first, the issue of consistency regarding assessment rubrics. The high variability in how the assessment rubrics were used by the students led Ng and Lai (2012) to question their viability as assessment tools for Wiki evaluation purposes. Second, the existing evidence suggests that peer assessment in Wikis does not seem to be a function of feedback. Gielen and De Wever (2012) conducted an experimental study comparing the effect of structured vs. unstructured peer assessment on learning. The authors report that, while the Wiki pages improved significantly because of feedback, there were no differences from pre- to post-test between the two conditions. Finally, some studies raise concerns about the quality of peer feedback in the case of Wiki peer assessment (e.g., Lin and Yang 2011).

As the proceeding review suggests, the potential of Wikis on peer assessment has been largely unexplored. As there is only a small number of published studies, the evidence is mostly preliminary. The findings suggest that still many open questions remain. For instance, it is not known whether social networking-based peer assessment schemes such as voting up work and to what extent. Furthermore, the criteria students employ for peer assessment purposes in Wiki contexts have been unexplored. The study reported in this work aimed to address this knowledge gap by examining the effectiveness of a peer assessment scheme that is based on a common social networking practice, voting up.

Rationale of the Study

The research reported in this work is part of a longitudinal, ongoing design experiment project aimed to address some of the limitations identified by previous research (for more information on the project, see Karasavvidis 2010; Karasavvidis and Theodosiou

2012; Karasavvidis and Karagiannidis 2013). More specifically, the project investigates the conditions for successful Wiki integration in HE and focuses on the design, development, evaluation, and refinement of a Wiki task in the context of an undergraduate course on learning with information and communication technologies (ICT). The course was offered in the author's host institution and had two main objectives: (a) introduce students to educational software types and the underlying theories and (b) render them capable of designing and teaching an educational software-based lesson plan. More information about the project is provided elsewhere (see Karasavvidis and Karagiannidis 2013, for more details). The present work focuses on the 6th design cycle which was implemented in 2013. The components of the Wiki assignment are presented in Fig. 10.1. One of the innovations in this design experiment run was related to the peer assessment scheme that was introduced.

A two-layer peer assessment scheme was implemented. *First*, peer assessment was embedded in the Wiki task per se in the form of scripted peer review. As part of their assignment, the students were asked to provide feedback to the work of other teams in the form of constructive comments. An important requirement for this feedback was that it needed to be constructive. While the students could point out errors or any other problems with the lesson plans, they were also expected to make specific suggestions for improvement. *Second*, peer assessment was implemented after the Wiki task. A voting up task was introduced in which the students were asked to reflect on their overall Wiki experience and identify the 3 most influential lesson plans posted on the course Wiki. As no specific criteria were given, the students were completely free to employ any criteria they liked provided that they documented their decisions sufficiently well (Fig. 10.2).

The students were given credit for this peer assessment. On the top of that, if their lesson plans were voted up, i.e., selected by others as being significant, they would receive extra credit. Using the familiar concept from social networks,

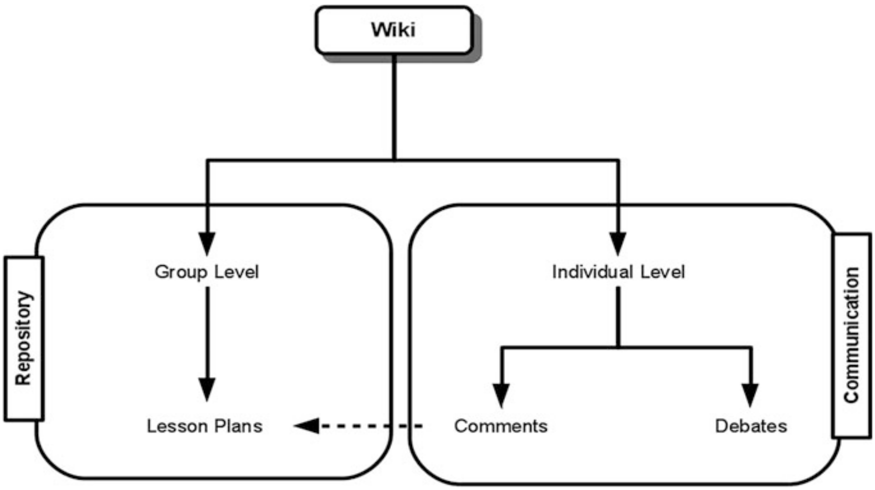

Fig. 10.1 The components of the Wiki assignment

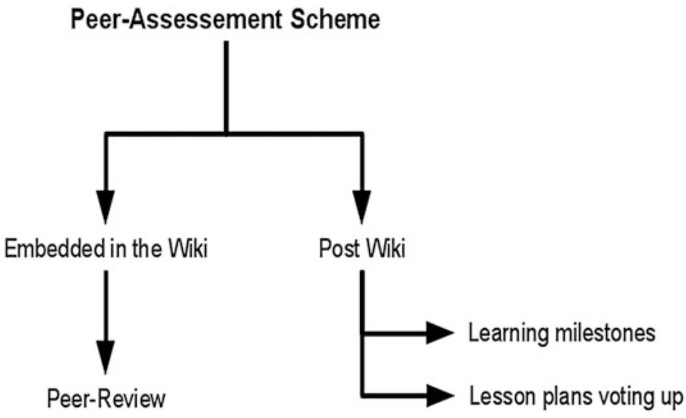

Fig. 10.2 The peer assessment scheme

students' contributions that were judged by others to be more substantial were to receive extra credit. To make the process as objective as possible, all contributions to the Wiki were made using aliases. The overall evaluation scheme was as follows:

lesson plan assessment by the instructor: 10 %
comments assessment by the instructor: 10 %
lesson plan assessment by peers: 10 %
comment assessment by peers: 10 %
final assessment survey: 10 %
final oral exam: 50 %

As this scheme indicates, 30 % of the final course grade could come from peers. The students were informed about this assessment scheme in the beginning of the course and were aware of the fact that their fellow students would be actively engaged in peer assessment.

Study Objectives and Research Questions

The present study examined the implementation of a peer assessment scheme that was based on voting up artifacts (lesson plans) or feedback (comments) in the context of Wiki work in an undergraduate course. The following research questions were addressed:

#1. What is the correspondence between instructor-assessed and peer-assessed lesson plans?

#2. Which criteria students use in determining the most influential Wiki contributions in terms of lesson plans?

#3. What are the implications of the criteria for learning?

Method

Participants and Context

Ninety-one student teachers participated in the study. All students were female in their 3rd year of study at a preschool education department in a public Greek University (age range 20 years 6 months–23 years 4 months). The present study draws on data from a survey administered at the end of the course. In this survey, the students were asked to rate (a) the top 3 lesson plans using any criteria they liked and (b) explain their reasoning behind their choices. Eventually, 68 students completed the questionnaire (74 % response rate).

Analysis

Content analysis was used to determine the criteria the students used to justify their selections. A bottom-up approach was used for the content analysis of student responses. Rough categories were initially used in the first coding pass. This initial coding round resulted in an extensive set of codes. Similar criteria were then merged in all subsequent passes, resulting in 7 categories.

Results

The first research question targeted the convergence between the instructor and student peer assessment. The instructor (who is also the author of this work) evaluated all lesson plans posted on the Wiki for the purposes of the course. This evaluation resulted in the compilation of a comprehensive list with the ranking of all Wiki lesson plans. Next, student votes were tallied, creating a second comprehensive list of the lesson plans with the student votes. The juxtaposition of the two lists indicated that 4 out of the 6 lesson plans had received the largest number of votes and also topped the instructor list. Interestingly enough, the rankings of the instructor list coincided with the peer assessment rankings with respect to the 2 highest student-rated lesson plans. This suggests that in terms of quality, 4 lesson plans clearly stood out from all the rest and the students were able to recognize this without been given explicit assessment criteria.

As Table 10.1 shows, there was only one team whose lesson plans clearly stood out from the work of all others. The lesson plans created by 10 teams also received a considerable number of votes, ranging from 8 to 11. The remaining teams received 7 votes or less while the work of 5 teams (17 % of all teams) got no vote whatsoever.

Table 10.1 The distribution of votes per team

Total number of votes for all lesson plans	Number of teams
27	1
11	1
10	4
9	3
8	2
7	1
6	3
5	1
4	1
3	2
2	2
1	2
0	5

Regarding the second research question, 85.29 % of the survey respondents (58/68) answered the specific survey question in sufficient detail, i.e., fully justified their selection choices. As a rule, the students used several criteria to justify why they favored the particular lesson plans they had picked. The results from the content analysis of student responses are presented in Table 10.2.

The criteria the students used can be distinguished in terms of surface and deep features. Surface features concerned all aspects of the lesson plans that were not related to core concepts of the course, addressing form, topic, and other features. On the other hand, deep features had an explicit learning focus and described how technology would facilitate learning.

Table 10.2 Criteria used to identify the top 3 lesson plans

	Type	Description
Surface features	Form	Presentation, structure, elaboration
	Topic	Content domain, originality, importance
	Feasibility	Possibility of implementation
	Instructional organization	Introduction, main learning activities, evaluation
Deep features	Software integration	Ways in which the software was integrated into the lesson plan
	Learner focus	Extent to which the justification referenced the learners
	Advancement of understanding	Explicit help in overcoming conceptual obstacles

Surface Features

The *form* of lesson plans was among the popular criteria the students used. Prioritizing form meant that the students valued presentation features such as structure or elaboration. Typically, lesson plans of this type were concise and balanced, skipping irrelevant details and avoiding unnecessary elaborations. The actual *topic* of the lesson plans was also a popular selection criterion. Lesson plans of this type were seen as original, attracting a lot of attention and praise. However, the use of lesson plan topic as a criterion was vague, as what counts as original is open to discussion. Another prominent criterion the students used to explain their preferences was the *feasibility* of the lesson plan. This referred to the possibility of actually applying a lesson plan in a real classroom. As a rule, lesson plans that required a lot of teacher preparation, spanned over several instructional periods, and required special hardware (e.g., the use of video cameras) and/or software (e.g., a combination of different educational software applications) were not particularly popular. The last surface criterion used by students was the *organization* of the instructional sequence per se. A lesson plan is typically comprised of an introductory activity, a series of learning activities, and a final evaluation activity. Some students singled out instructional features as being important in ranking the lesson plans. Most students favored introductory and evaluation activities, while only a minority expressed interest in the particular learning tasks included in the lesson plans.

Deep Features

Deep features included software integration, learner focus, and advancement of understanding. The way software was *integrated* into the learning task was one of the measures the students used to identify the top 3 lesson plans. In the majority of the lesson plans, the software was integrated into the task in a rather contrived manner, serving little or no purpose. The students simply designed an instructional activity into which an ICT application was integrated. Consequently, technology integration had little added value in terms of learning. Although it was an important course objective, the students failed to devise lesson plans in which technology integration had a high added learning value. Instead, technology was peripherally integrated into the lesson plans. Consequently, the lesson plans that stood out were typically the ones in which technology integration had a high added value learning-wise: Removing the technology from the lesson plan would necessarily make it impossible to materialize it.

Learner focus was the 2nd deep-level criterion the students used to identify the most substantial lesson plans. Educational software is not an end in itself, it is merely a means to facilitate student learning, which is the ultimate goal of all teacher actions. The analysis suggested that only a handful of students actually discussed lesson plans in relation to the learners, i.e., considered technology as a mediational tool for advancing student learning.

Finally, a few students used the extent to which certain lesson plans helped them *advance their understanding* of certain core concepts as a measure. In these rare occasions, outstanding lesson plans were determined in terms of how they functioned as stepping stones to facilitating understanding. For example, some students discussed their selection of certain lesson plans by pointing out how exactly these had helped them understand, e.g., what a cognitive tool is.

Discussion

Assessment is an essential constituent of learning. It can be distinguished in many forms (summative and formative) and types (Topping 2003), one of which is peer assessment. What makes peer assessment effective is currently unknown (Van Zundert et al. 2010; Kollar and Fischer 2010). Blended and fully online learning environments constitute interesting settings for peer assessment because they typically involve collaborative practices many of which are often based on peer review. Wikis are prototypical examples of such Web applications as they rely on peer review in the form of shared editing. Although such features render Wikis ideal candidates for exploring the potential of peer assessment, only a handful of studies have been conducted. Aiming to contribute to this knowledge gap, the present study implemented a two-level peer assessment scheme and examined (a) the convergence between instructor and peer based assessment, (b) the criteria students use when voting up the work of peers, and (c) the implications of these criteria for peer assessment.

The study findings indicate a correspondence between instructor and student lesson plan ratings. The use of the voting up practice suggested that, quality-wise, the lesson plans that received the most votes were actually the best ones and that the students were able to identify the ones that stood out. This suggests that, at least in the case of high-quality contributions, a convergence of instructor and student ratings is likely.

Unlike other studies in which explicit evaluation criteria were used in the form of rubrics (e.g., De Wever et al. 2011; Lai and Ng 2011; He 2011), the participants in this study were furnished with no evaluation guidelines. Our findings indicate that the students used several criteria for judging the quality of the lesson plans posted on the class Wiki. The results obtained are similar to that of Ng and Lai (2012) who also reported high variability in the peer assessment criteria the students used.

However, in addition to variability, the present study also indicated significant quality differences. More specifically, the criteria the students used prioritized form over content, i.e., some of the criteria employed were surface rather than deep-level ones. This suggests that not all the assessment criteria the students used were relevant to concepts the course introduced. The surface criteria were applicable to a vast array of situations, most of which were principally unrelated to the course.

Conversely, deep criteria were uniquely related to course concepts, constituting its learning core. While comprehensive reviews report peer assessment to be sufficiently reliable and valid—at times as effective as teacher or expert assessment if not more (e.g., Topping 2003, 2009)—the findings of this study suggest a different picture in that respect. The considerable variations in quality reflected in the use of both relevant (deep-level) and less relevant (surface-level) criteria suggest that the validity of peer assessment in Wiki settings should not be assumed in the case of a peer assessment scheme based on voting up the work of peers.

As novices, the students cannot be expected to develop sufficient cognitive and metacognitive understanding of a domain so as to employ deep-level criteria in a short time span such as a single semester. Considering this lack of meta-level understanding of a domain, the provision of some form of systematic support for peer assessment appears necessary. The results of the present study suggest that only a portion of the criteria the students used (i.e., deep-level) were pertinent to the course. Consequently, in the case of voting up, explicit criteria might be called for so as to guide student thinking in the direction of conceptual features rather than superficial ones. Thus, the findings of this study are in agreement with former studies which report that there are certain preconditions for peer assessment such as extensive practice or explicit criteria (Lai and Ng 2011; De Wever et al. 2011).

While some form of support appears to be called for, the study findings also indicate that leaving the selection of the criteria for voting up entirely to the students allows the identification of what they value as important. As this value judgment is highly situated and authentic, it discloses their genuine level of conceptual understanding. The findings suggested that the students using deep-level criteria had attained a higher level conceptual understanding. Thus, while the lack of explicit criteria allowed the students to employ any measure they favored, it also facilitated the assessment of their conceptual understanding in a contextualized way. Future studies should replicate this finding and inquire the proper mix between support in the form of rubrics and complete freedom to employ any criteria.

To conclude, the two-layer peer assessment scheme implemented in this study required students to assume very active and responsible roles, thereby engaging them judges of the work of their peers (Topping 2009). The study findings are promising but this social networking practice and its variations need to be more systematically explored in future studies.

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Chapter 11
Gamification and Game Mechanics-Based e-Learning: A Moodle Implementation and Its Effect on User Engagement

Evaggelos Katsigiannakis and Charalampos Karagiannidis

Introduction

Over the past few years, various attempts have been made to define Gamification. Some researchers generically refer to it as “The use of game design elements and game mechanics in non-game contexts” (Deterding et al. 2011), or as “The process of game-thinking and game mechanics to engage users and solve problems” (Silva 2010). For the purposes of this paper, the following definition will be used: Gamification is the process of applying elements associated with (video) games in non-game applications which aims to increase people’s engagement and to promote certain behaviors.

Gamification has been incorporated with commercial success into web applications (Zichermann and Cunningham 2011), while education is an area with high prospective for application of this concept (Kapp 2012). Despite the fact that most empirical studies indicate that gamification provides positive effects on user engagement and motivation (Hamari et al. 2014), empirical evidence reports mixed results (De-Marcos et al. 2014), some surveys indicating that gamification can affect negatively intrinsic motivation and user satisfaction (Hanus and Fox 2015), and case studies reporting gamification’s failure on real-life learning settings (Berkling and Thomas 2013). Therefore, further research is required to investigate the effect of gamification on user engagement.

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The term engagement indicates the connection between a consumer and a product or service. There is no single metric on the web technology that sufficiently measures engagement. Therefore, "engagement should be better considered as a series of interrelated metrics that combine to form a whole. These metrics include recency, frequency, duration, virality, and ratings" (Zichermann and Cunningham 2011). Moreover, it is really essential to define the importance of each metric on a given system, as they can vary depending on the type of the application. Turning an experience into a game, by including some reward for achievement, aims to provoke users' behavior change. This change indicates that users will score higher percentages of the engagement metrics.

In order to create a gamified system that increases student engagement, it is necessary to focus on the fundamental elements that make games popular to people. "Games are motivating because of their impact on the cognitive, the emotional and the social areas of players" (Lee and Hammer 2011). There are actually two types of gamification. Structural gamification is the application of game elements to propel a learner through content with no alteration or changes to the content, while content gamification is the application of game elements and game thinking to alter the content to make it more game-like (Kapp 2012). Kapp also stresses that in order to successfully gamify a learning experience, "the first priority is to codesign instructional elements along with gameplay elements and not as an afterthought."

Some of the most popular game elements are points, levels, leaderboards, and badges. Those elements are also the most common in structural gamification. Badges have existed for a long period, since people desire badges for all kinds of reasons. For many players, collecting them is a powerful drive, while other players enjoy the sudden rush of surprise or pleasure when an unexpected badge shows up in a gamified system.

Related Work

Literature reviews carried out in the area report that gamification is gaining increased attention during the past few years (Caponetto et al. 2014; Hamari et al. 2014). Those reviews attempted to shed light on the emergence and consolidation of gamification in education/training and emphasized the rapid increase in the publication of academic writings during the past couple of years. They also indicated that the total research is evenly split between conceptual/theoretical papers (51 %) and empirical studies (49 %), as well as that the 43 % of the target population of the research focuses on University students (Caponetto et al. 2014). From a global perspective on usage of uptake of gamification in education, there is a big digital divide with USA, England, Spain, the Netherlands, and Germany being the largest users, while developing countries have limited usage (Surendeleg et al. 2014).

Some of the conceptual approaches, in which gamification is thoroughly treated, are "Gamification by design" (Zichermann and Cunningham 2011) and "The gamification of learning and instruction" (Kapp 2012). The first textbook indebts to the work of notable game designers, which helps clarify the process of game design, making it a quantifiable science, while the second provides the game methods, the design strategies, and tactics for training and education. Moreover, theoretical papers that shaped a rich theoretical background in the area of gamification indicated that gamification is linked to added value in the learning process (Lee and Hammer 2011), and confirmed gamification's close relationship with learner engagement (Muntean 2011) and motivation (Khaled 2011). Many empirical studies on gamification have based their experiments on the Self-Determination Theory (Deci and Ryan 1985) which states the existence of two types of motivation: intrinsic and extrinsic, while Fogg's behavioral model for persuasive design is also highly referred to (Fogg 2009).

One of the first empirical studies in the field was conducted on University students and utilized an isolated gamification element, points (Gaasland 2011). The evidence indicated that the gamified e-Learning system was *somewhat motivating*, but was merely based on students' responses to questionnaires. Another study that also lacked control group but provided specific quantitative empirical evidence on users' engagement and task completion was conducted on teachers' training (Ferreira 2015). Instead of isolating a gamification element, the study added different gamification strategies to the original software, according to the individual characteristics of the users. Many empirical studies often lack controls between implemented game mechanics. Some studies have implemented both badges and leaderboards (Domínguez et al. 2013), while others combine a great range of different game mechanisms (Li et al. 2012). Empirical studies on the gamification of training and learning usually utilizes points (Gaasland 2011; Morschheuser et al. 2014), leaderboards (Witt et al. 2011; Hamari and Koivisto 2013), and badges (Denny 2013; De-Marcos et al. 2014). Most of the empirical evidence indicates that gamification provides positive effects on user engagement positive attitude toward learning and increased student learning productivity and motivation (Hamari and Koivisto 2013; Denny 2013; Morschheuser et al. 2014), while there are case studies reporting gamification's failure on real-life learning settings (Berkling and Thomas 2013).

Besides the academic writings, there are various successful web and mobile applications that use badges in order to establish long-term relationships with their users. Foursquare, for instance, uses badges to represent players' progress, as well as to create a sense of delight or surprise, due to the fact that *it doles out those badges with seeming randomness* (Zichermann and Cunningham 2011). Farmville, on the other hand, reveals the challenges more clearly to the player compared to Foursquare. Instead of badges, Farmville uses ribbons, which act in close concert with the challenges set by the application.

The literature review suggests that, indeed, gamification does work, since the majority of the reviewed studies did yield positive results. However, several shortcomings could be also identified (Hamari et al. 2014): (1) the sample sizes were small in some studies (around N = 20), (2) some experiments lacked control groups and relied solely on user evaluation, (3) controls between implemented game mechanics were often lacking and multiple mechanics were investigated as a whole, (4) many presented only descriptive statistics, and (5) experiment time frames were in most cases very short. Finally, since most of the experiments were conducted on custom platforms, there is limited empirical evidence on experiments conducted on gamified courses accommodated by Moodle, which is one of the most popular Learning Management Systems.

In this context, the research aims to contribute to the empirical evidence by implementing an isolated gamification element to a Moodle course and evaluating its effect on students using a systematic interrelated metrics approach (Zichermann and Cunningham 2011). By assessing the way control and treatment groups interacted with the system, the research aims to answer the following questions:

- How engaging can a reward system, merely based on badges be, when integrated to an e-Learning system?
- Is it possible to combine badges which represent students' progress to badges awarded with seeming randomness in order to motivate students in completing a course's challenges, while pleasantly surprising them with random trophies, so as to further engage?

System Design and Development

The design of the gamified e-Learning system was based on three axes, including designing the cognitive, the emotional, and the social areas of the learning experience. As mentioned before, this technique aims on utilizing game-like rule systems and player experiences to shape learners' behavior (Lee and Hammer 2011). Moreover, no alteration or changes to the content of the gamified course were made, while the application of badges aimed to propel the students as structural gamification indicates (Kapp 2012).

The cognitive area consisted of the system of rules, in which students would obtain the skills provided by the course, as well as the tasks that would guide the users through mastering those skills. In an attempt to keep the gamified platform as similar as possible to the typical one, a hierarchical tree was structured composed of three levels (Fig. 11.1). The first level matched the course's curriculum, which was distributed in the weeks that the experiment lasted; the second hierarchy level consisted of the different categories in which the curriculum's content was organized, while the third hierarchy level consisted of the curriculum's content itself. The system of rules defined the way students would interact with the third level, gain access to the content, get the rewards, socialize, and proceed further to the learning experience. Students could freely access any topic and its tasks once it had

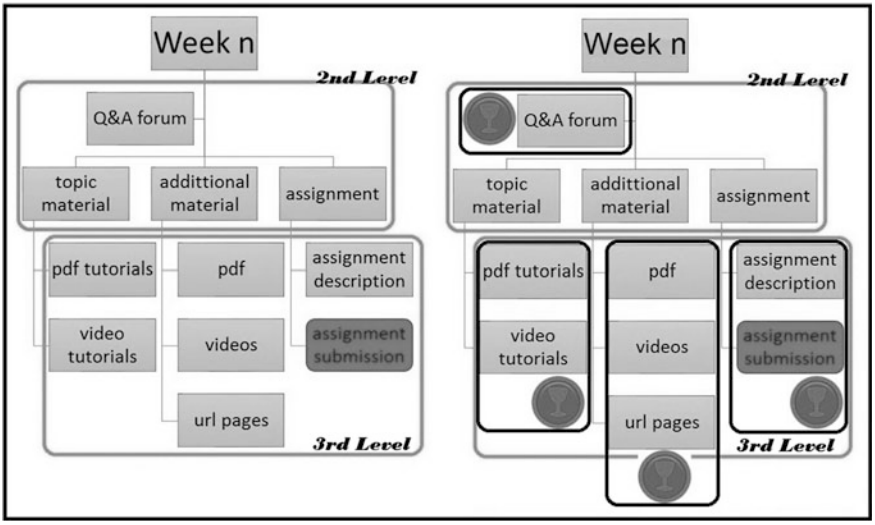
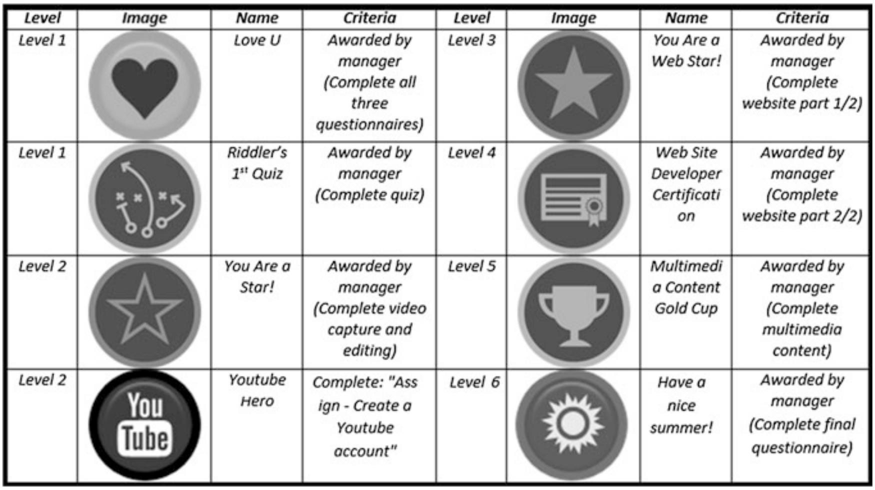


Fig. 11.1 Hierarchical tree of the structure of the SEAC200 course for both platforms

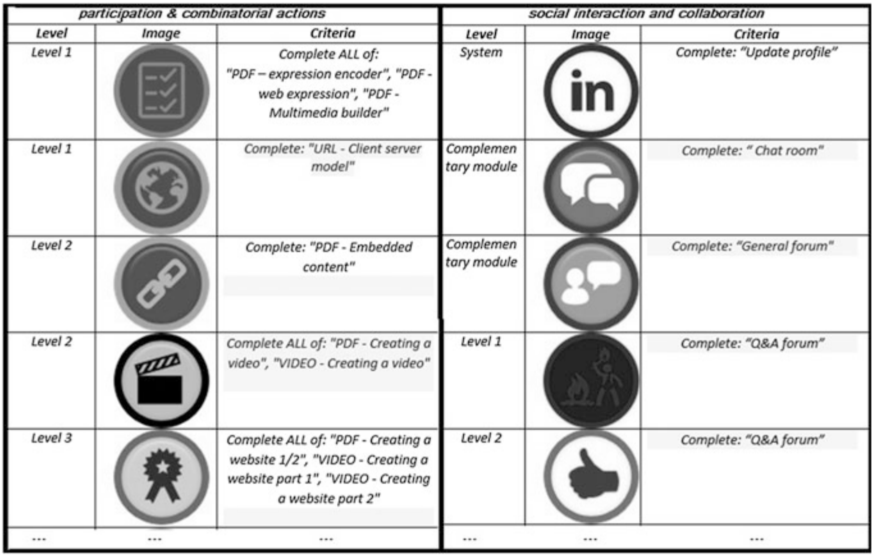
been introduced, and although repeated experimentation regarding the topic's material was allowed, assignments, quizzes, and questionnaires submissions were allowed only once. Regarding the gamified course, students would get rewards for accessing all different forms of the topic's material, as well as the additional material, and for successfully submitting their assignments. Moreover, "In game design, level complexity is neither linear nor exponential. Applying transitions in the complexity from one level to the next is how games work, and this is a process that has also proven highly engaging" (Zichermann and Cunningham 2011). Motivated by this particular notion, transitions were applied to the complexity of each week's lessons.

The next step was to design how to impact on the emotional area of the students. A virtual reward system should be included, so as to create positive emotions on task completion, thus motivating students to complete more tasks. For the particular gamified system, two major badges' categories were designed, with a view to impact the emotional area of the students. The first category, inspired by Farmville, consisted of badges designed to act in close concert with the challenges set by the e-Learning system. Such badges would be awarded to students on assignment, quiz, or questionnaire completion, and would serve students keeping track of their progress (Fig. 11.2). The second category, inspired by Foursquare, consisted of badges designed to be awarded on students' participation, and after they had taken combinatorial actions that met certain criteria. Those badges would be awarded with apparent randomness, since the criteria that should be met in order for those badges to be awarded were not revealed to the students, so as to create a sense of delight and surprise for the students (Fig. 11.3). Moreover, in an attempt to increase the



Level	Image	Name	Criteria	Level	Image	Name	Criteria
Level 1		Love U	Awarded by manager (Complete all three questionnaires)	Level 3		You Are a Web Star!	Awarded by manager (Complete website part 1/2)
Level 1		Riddler's 1st Quiz	Awarded by manager (Complete quiz)	Level 4		Web Site Developer Certificati on	Awarded by manager (Complete website part 2/2)
Level 2		You Are a Star!	Awarded by manager (Complete video capture and editing)	Level 5		Multimedi a Content Gold Cup	Awarded by manager (Complete multimedia content)
Level 2		Youtube Hero	Complete: "Ass ign - Create a Youtube account"	Level 6		Have a nice summer!	Awarded by manager (Complete final questionnaire)

Fig. 11.2 Badges awarded on tasks completion



participation & combinatorial actions			social interaction and collaboration		
Level	Image	Criteria	Level	Image	Criteria
Level 1		Complete ALL of: "PDF – expression encoder", "PDF - web expression", "PDF - Multimedia builder"	System		Complete: "Update profile"
Level 1		Complete: "URL - Client server model"	Complementary module		Complete: " Chat room"
Level 2		Complete: "PDF - Embedded content"	Complementary module		Complete: "General forum"
Level 2		Complete ALL of: "PDF - Creating a video", "VIDEO - Creating a video"	Level 1		Complete: "Q&A forum"
Level 3		Complete ALL of: "PDF - Creating a website 1/2", "VIDEO - Creating a website part 1", "VIDEO - Creating a website part 2"	Level 2		Complete: "Q&A forum"
...	...	...	...	...	...

Fig. 11.3 Example badges awarded for participation and impact to social area

engagement of the students, the more they progressed in the system the more the difficulty with which they would earn a badge should increase.

The final design step was related to the social area of the system. There are different ways of student interaction: cooperative, competitive, and social (Lee and Hoadley 2007). Therefore, it was decided to combine cooperative mechanisms to

Fig. 11.4 Student profile on the typical platform and on the gamified platform

the social modules that had already been utilized, in order to motivate students' collaboration and avoid the negative impact of competitive mechanisms such as leaderboards. In the initial design chat rooms, general forums and questions and answers forums had already been integrated to the e-Learning systems. Therefore, it was decided to encourage students' social interaction and collaboration by awarding badges for actions that would include instant messaging, posting questions, and answering to classmates' questions, or other minor actions such as profile updating and photo uploading, which indicate commitment to the system (Fig. 11.3).

Finally, both e-Learning systems were designed to be identical. Therefore, the design of the typical system's cognitive area followed the same pattern as the design of the gamified one. The only difference between the two systems was that the typical one lacked badges. Figure 11.4 depicts how users would perceive the interface while interacting with each of the two systems.

Methodology

The experiment was conducted on a total of 32 undergraduate students of the Department of Special Education of the University of Thessaly in Greece, all female, who participated in the activities designed as the elective laboratory part of the course. The research was designed according to the model of semi-experimental design with pre-equivalent groups. According to this model, the students were divided into two groups, treatment and control, which were equivalent, and with a high degree of similarity in their composition. In order to achieve the required equivalence, pre-control was conducted in the form of 3 rounds of questionnaires. The first round of questionnaires recorded the familiarity level of students to use the computer and the Internet. The second round of questionnaires recorded students' prior knowledge on the learning subjects of the course's curriculum, such as their prior knowledge in video and multimedia content creation tools and their prior knowledge in building basic static websites. The final round of questionnaires recorded students' attitudes on the use of ICTs and games to support the learning process. Students with similar skills, prior knowledge, and attitudes formed each of the two groups, one using the typical platform, while the other would work with the gamified one.

For the purposes of this research, badges, one of the most popular game elements, was selected, so as to isolate and measure the influence of its utilization in learning context. Moreover, since the study was conducted in the context of a semester course, the time period allowed for the students to test the system and provide data for the evaluation was limited to 6 weeks, and the content of the course was organized accordingly. The laboratory part of the course SEAC200 includes video and multimedia content creation and building basic static websites. The e-Learning course was designed to include a lesson each week. The first week students were taught general computer and Internet skills such as accumulating and installing all the necessary tools that they would need for the purposes of the course. The second week students were instructed on creating educational videos using Microsoft's expression encoder, while the next two weeks students were taught building basic websites using Microsoft's expression web. The fifth week the lesson included multimedia content creation for educational purposes, and students were instructed on Multimedia builder tool. The last week the lesson had a revising character and students were mainly assessed on the knowledge they had acquired during the past weeks.

Furthermore, in order to measure the engagement metrics noted by the students, as well as the task completion and their interaction with the system throughout the experiment, Moodle's statistical tools had been utilized. Moodle reports through log files the information about the frequency, the recency, and the duration of students' interaction and also provides useful data through activity and participation reports about the students' achievements and their actions in the context of the e-Learning systems. For the purposes of the evaluation, the data produced by those tools were gathered and processed.

Experimental Results

Frequency

Initially, the two groups noted similar frequency rates. Similar initial rates were expected, since the two groups had been selected to be equivalent. Moreover, by the third week, the frequency rates of the treatment group constantly rose, in contrast to the control group whose frequency rates ranged indistinctly. This fact is particularly encouraging, since users of the gamified platform tended to return more often to the system over time. Finally, an average of 1.407 and 1.516 logins is noted for users of the typical and of the gamified platform, respectively (Fig. 11.5a).

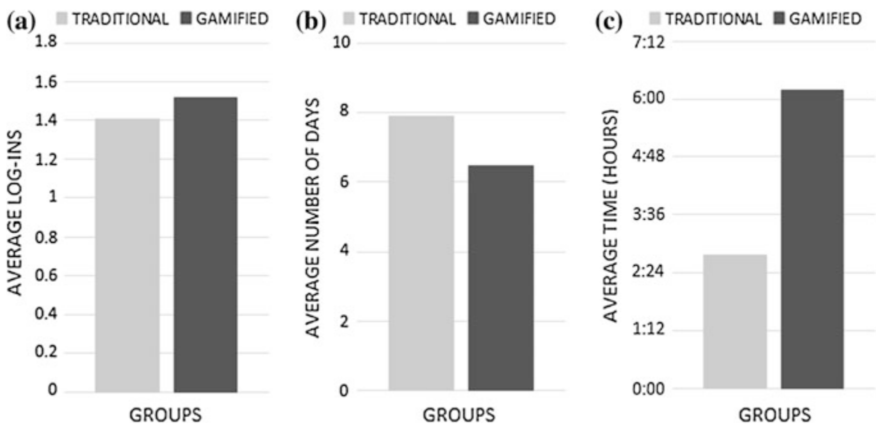


Fig. 11.5 **a** Average frequency per group, **b** average recency per group, **c** average duration per group throughout the entire experiment

Recency

In an attempt to generalize the amount of time that had gone by before a student returned to each system is being reported that for the typical platform, the students would return to the system every 7.896 days on average, while for the gamified one, they would return every 6.461 days on average. The period of time is sorted up to 18.2 % for the students of the gamified platform, compared to the students of the typical one (Fig. 11.5b).

Duration

Although the amount of time devoted by a student to an educational activity does not necessarily enclose pedagogical value, the fact that the students of the gamified platform spent more time on it, compared to the students of the typical platform, is particularly encouraging in respect to the purposes of this research. More precisely, students of the treatment group spent an average of 6 h and 11 min on the gamified platform throughout the entire experiment, which is up to 123.5 % higher, compared to the average of 2 h and 46 min that the students of the control group spent on the typical platform (Fig. 11.5c). Moreover, the duration that the treatment group interacted with the gamified e-Learning system constantly rose throughout the experiment.

Engagement

Collectively, frequency, recency, and duration had been amalgamated as an engagement score (Zichermann and Cunningham 2011). In order to form this score, relative importance of each of these metrics had been used. Duration, also called time on site, is one way of measuring visit quality. However, time on site can be misleading. Therefore, it was considered appropriate to assign to duration half the proportion assigned to frequency and recency, respectively. Moreover, although ratings is a popular mechanism, it was not integrated to the e-Learning systems presented by this thesis. Therefore, Ratings was a metric excluded from the proportions used to measure engagement. Finally, virality is widely used to describe social distribution, or more commonly, how many additional new users a system will get, given one new user. Therefore, since the number of the enrolled users of our system was predefined, and the system was confined, there was not any point in measuring virality. In summary, we selected the following relative weights for measuring the overall engagement: 40 % recency, 40 % frequency, and 20 % duration. In an attempt to qualitatively depict the difference in the engagement rates between the two groups, the average engagement of the control group was considered, as the overall average engagement rate, for any typical group given. Results suggested higher engagement up to 19.7 % for the treatment group which engaged to the gamified platform, compared to the control group which engaged to the typical one.

Course Participation

Complementary to the data collected, so as to measure the student engagement to each platform, data were collected in order to measure the general course participation, and, therefore, further evaluate the two e-Learning systems. Collectively for all modules integrated to the systems, an average of 92.066 actions per student were performed on the typical platform, while an average of 132.166 actions per student were performed on the gamified one. Therefore, up to 30.3 % more actions per student were performed on all modules cumulatively on the gamified platform (Fig. 11.6a). Actions, as defined in Moodle's report tools, are the number of views plus the number of posts made by the users in the course, over a period of interest.

Activity Completion

Furthermore, an additional way to measure students' accomplishments, and to evaluate how they interacted with both e-Learning systems, is to examine the data collected regarding the activities completed by the students. An average of 16.333

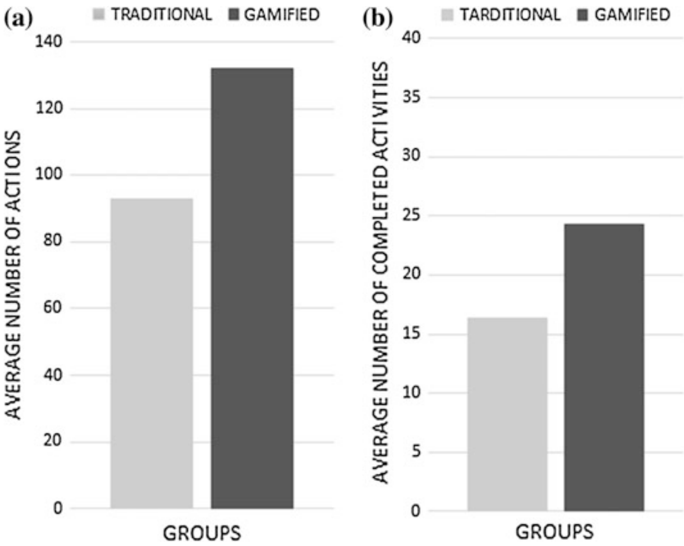


Fig. 11.6 **a** Average actions per group for all modules cumulatively, **b** average completed activities per group throughout the entire experiment

activities per student were completed in the typical platform, while an average of 24.25 activities per student were completed in the gamified one, which results in 32.7 % more activities completed in the gamified e-Learning system (Fig. 11.6b). Out of the 14 types of activities that Moodle offers, for the purposes of the experiment, the activities selected to be implemented to both platforms were assignments, quizzes, and feedback activities.

Conclusions and Future Work

The results of this particular research indicate that gamification had a significant effect on the engagement of the different groups of students, who perceived the learning experience in a different way in general.

Regarding the first research question, a reward system merely based on badges can be engaging when integrated to an e-Learning system. The amalgamated engagement score (Zichermann and Cunningham 2011) that treatment group noted was higher up to 19.7 % compared to the control group. Regarding the individual metrics that were used to form the engagement score, treatment group noted better rates compared to the control group. Students working with the gamified e-Learning system showed higher frequency rates up to 7.2 %, lower recency rates up to 18.2 %, and higher duration rates up to 123.5 %, compared to the students working with the typical e-Learning system. Regarding the second research question, results suggest that it is possible to combine badges which represent students' progress to badges awarded with seeming randomness in order to further motivate students in completing a course's challenges. Students working with the gamified e-Learning system performed more actions and completed more activities to the modules integrated to the platform, compared to the students working with the typical e-Learning system. Up to 30.3 % more actions per student were performed on all modules cumulatively on the gamified e-Learning system, while 32.7 % more activities were completed in the same system.

This work aims to form the basis for a number of similar experiments which will investigate the use and effect of different gamification elements and gamification mechanisms in learning—this is the main reason behind the selection of Moodle as the underlying platform. In the context of this work, structural gamification was implemented, due to the fact that the course's content and the interface of both systems were chosen to be identical, in order to avoid any criticism on the part of the students. Currently, we are carrying similar experiments with students with learning difficulties, while our future work aims to investigate and compare the effects of different gamification elements for different categories of students with special needs. Moreover, our future work aims to combine structural gamification to content gamification, as game thinking is a more critical gamification factor compared to gamification elements by themselves, and since the two types of gamification together may have a wider impact.

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Chapter 12
Investigating the Role of Structure in Online Teachers' Communities of Learning

Panagiotis Tsiotakis and Athanassios Jimoyiannis

Introduction

Virtual learning communities are generally thought as social structures, authentically developed under a common purpose, with the aim to promote knowledge sharing and continuously support members' personal development in a specific field. In the context of situated learning, learning communities are based on dynamic and social participation processes, captured in collaborative activities, working artefacts, routines, stories or perceptions that promote participants' professional development (Barab and Duffy 2000; Lave and Wenger 1991). Therefore, an effective social learning environment (a) is situated and meaningful (not abstract), (b) activates members through their engagement into learning activities, (c) is mutually constructed through personal contribution and interaction with peers who share common interests, (d) refers to relationships that developed through negotiation rather than to objectives related to formal education.

In last decade, the idea of online teacher communities (TC) has received a growing interest among academics, policy makers and educators as an alternative to both isolated manner of work and the traditional teacher professional development approaches (Brouwer et al. 2012; Jackson 2009; Jimoyiannis et al. 2011). TCs create (a) unique conditions for informal learning and (b) a sustainable environment for teacher communication, interaction and collaboration, without temporal or spatial restrictions. Due to their participatory and collaborative affordances, teacher communities are expected to improve teaching and schooling practices, since teachers have the opportunity to collectively examine and study new conceptions of

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learning, to share educational material, experiences and practices, to create shared views and improve their instructional practices and, finally, to mutually develop meaning towards achieving their professional growth (Delfino et al. 2008; Jackson 2009; Levine and Marcus 2010; Skerrett 2010).

Online communities have been effectively applied to support educational, training and professional development programmes (Baran and Cagiltay 2010; Delfino et al. 2008; Gray and Smyth 2012; Tang and Lam 2014; Vandyck et al. 2012). There are many studies showing that learning communities can improve teaching practices (Jackson 2009; Levine and Marcus 2010; Skerrett 2010) while they can develop a cooperative culture among teachers in everyday school reality (Vescio et al. 2008). However, any online teacher community could not be successful and not every member will benefit from his/her participation. Literature review has shown that teachers' motivation and commitment to participate, their perceptions of community learning as well as their collaboration and achievements as members of a community are determined by a wide range of factors (Hur and Hara 2007; Hur and Brush 2009). With regard to the technological environments, asynchronous discussion forums (Cilliers 2005; Correia and Davis 2008; Zydney and Seo 2012) and learning management systems (LMS), such as Moodle and Blackboard, were the most popular and widely used tools to support TCs. On the other hand, the rapid growth and diffusion of Web 2.0 tools have led to increased interest about creating dynamic online TCs (Cho et al. 2007; Gray and Smyth 2012; Hou et al. 2010). Therefore, the design, implementation and investigation of online TCs constitute an open research problem in both areas, teacher development and e-Learning as well (Baran and Cagiltay 2010; Jackson 2009; Levine and Marcus 2010; Roth and Lee 2006).

This paper reports on the design, the implementation and the investigation of two teacher communities with different structure, organization and operation. The first was an open community of computer science teachers who were free to undertake their own initiatives and behave freely within the community. The second was a semi-structured teacher community ran in the context of a masters' degree course entitled "e-Learning and ICT in education," at the Department of Social and Educational Policy, University of Peloponnese, in Greece. The conceptual and design framework of the two communities is presented in detail. Preliminary findings about teachers' performance, community indicators and the role of community structure were derived using a combination of qualitative and social network analysis methods. Conclusions are drawn for future research on online teacher communities of learning.

Theoretical and Design Framework

In the context of situated learning (Lave and Wenger 1991), many design features and ideas have been proposed with regard to teacher communities, where members are using tools and educational material, construct their working artefacts, collaborate and support each other, in order to achieve their learning goals and fulfil common needs (Brown and Duguid 1991; Wilson 1995). In a community of learning, each member is willing to offer his knowledge, experience, abilities and creations to the whole community; thus, he can contribute decisively to the establishment of a social learning culture through collective thinking and knowledge sharing among participants (Siemens 2003). In line with Wenger (1998), there are three core dimensions in an online TC which reflect the nature of a learning community:

Group identity: Mutual engagement that bind teachers together in a social entity.

Shared domain: A joint enterprise as understood and continually negotiated by community members.

Shared interactional repertoire: Shared practices, communal resources and beliefs that teachers have developed over time.

Social interactions in online communities are varied and often complex. Community indicators are directly related to different aspects of community operation and they are expected to be present and evolving over time (Galley et al. 2014; Wenger 1998; Williams et al. 2011). Our research design aimed to better monitor, observe and support successive and iterative teachers' activities, which are expected to be evolving within the community at three mutually related levels, i.e. personal, group and community level (Tsiotakis and Jimoyiannis 2014).

Therefore, the conceptual framework that supported our design and analysis is built around six interrelated factors-aspects of community, which have a multiplicative effect on each other and, as a whole, they reflect the complexity of members' learning presence within a teacher community:

Participation: Individuals' enrolment, self-presentation and ways of attending community activities.

Engagement: Members' social presence, participation in general discussions and online video conference meetings.

Interaction–reflection: Teachers' negotiation of ideas and meaning through discussion forums and live journal articles, teachers' engagement in working groups.

Creativity: Teachers' content contributions, creation and sharing new knowledge in the community, ability to cocreate new artefacts with others (articles, educational material, original educational scenarios).

Cohesion: Ties among individuals and the community as a whole construct.

Community identity: Cultivating a sense of belonging in the community, common practices taking place within the community and values perceived by individuals in the community.

The Concept of Structure and Community Design

Literature review suggested that community structure is a critical design factor in online teacher communities which has not been studied in a systematic way (Graham 2007; Levine and Marcus 2010). The notion of structure is related to the openness of the community with regard to members' engagement and contribution constraints. The results presented in this paper refer to a comparative study of two teacher communities, an open community (OC) and a semi-structured community (SC) which used the same operational principles and technological tools. Following the pilot study (Tsiotakis and Jimoyiannis 2013), the community facilitator shaped an ongoing cooperation framework with the aim to support a high level of dialogue, interaction and collaboration among members.

The community platform that used in both communities was designed to provide, in an integrated way, a variety of community tools supporting communication, content sharing, constructive activities and collaboration among participants. From its technological perspective, the platform was structured around the following four core components: LMS unit (Moodle), e-portfolio unit (Mahara), wiki (Mediawiki) and the videoconference system (BigBlueButton) (Tsiotakis and Jimoyiannis 2013).

Table 12.1 presents the TC dimensions analysed along the specific community indicators and the related members' actions that are expected to be evolving during the community operation. The structure of the community indicators is characterized as high (+) when the particular community activities were mainly determined by the coordinator and they were, more or less, obligatory for the members. On the other hand, it is characterized as low (−) when the expected activities are optional and authentically directed by the participants themselves.

The Study

Objectives and Research Questions

The main objectives of this study were as follows: (a) to extend previous research findings by revealing and analysing critical community indicators, and (b) to shed light into the role of the community structure by revealing the different ways of individual contributions, social interaction and the dynamics of two teacher communities. Based on the theoretical considerations and in accordance to the research objectives, two research questions were addressed:

- What was the role of community structure and how did it affect teachers' learning presence and social interaction within the communities? What types of teacher activities were effective?
- What was the architecture of the two communities? What were the main roles of the teachers recorded?

Table 12.1 Learning community dimensions and indicators

Dimension	Community indicators	Expected teacher actions	Structure	
			OC	SC
Group identity	Participation	Enrolment	+	+
		Self-presentation (profile)	+	+
		Attending community activities	+	+
	Engagement	Following community activities	–	–
		General discussions	+	+
		Meetings (online, FtF)	–	+
	Interaction	Social presence	–	–
		Synchronous discussions	–	+
		Asynchronous discussions	–	+
		Engagement in working groups	–	+
	Collaboration and reflection	Live journal groups	–	+
		Participation in working groups	–	+
		Artefact cocreation (wiki)	–	–
		Dialogue, feedback	–	+
Shared domain	Context	Content negotiation	–	+
		Community activities negotiation	–	–
	Common goals	Goals and ideas negotiation	–	–
	Knowledge sharing	Sharing knowledge, resources and educational material	–	–
Shared interactional repertoire	Common practices	Contribution to blog articles	−	+
		Content sharing, artefact creation	−	+
	Community cohesion	Collaborative actions, initiatives	–	–
		Roles interchange	–	–
	Attitudes and behaviours	Peer-support, feedback, critical commentaries	–	–

Participants and context

Two different teacher communities were established in this study. Open community was a homogeneous, domain-oriented community, which ran from October 2011 to March 2012. Computer science teachers in primary and secondary schools were invited by the community facilitator (T) to participate on a voluntary basis, after an open call. Finally, 72 teachers (41 male and 31 female) remained active and exhibited a consistent or periodic presence in the community activities. There were two phases in this self-organized community. In the preparation phase, which lasted 9 weeks, the community facilitator was shaping an ongoing operation framework and the teachers were continually encouraged and supported to keep dialogue, interaction and collaboration active. Following, his role was fading out and the teachers were free to undertake their own initiatives within the community.

The semi-structured community ran from January to June 2013, in the context of a masters' degree course entitled "e-Learning and ICT in education," at the Department of Social and Educational Policy, University of Peloponnese, in Greece. Twenty-three students (20 of them were in-service primary and secondary education teachers) attended the course. The community facilitator (T) was acting as e-moderator by setting the context, the expectations and the activities within the community in an emergent and mutually agreed way, in order to achieve a balance between openness and teachers' constraints. Hence, a minimum level of contributions was requested from each student-teacher: (a) to write one article per month on the journal–blog area presenting a new topic of their choice, and (b) to create and publish a WebQuest scenario in OpenWebQuest platform (OpenWebQuest 2015).

The participant teachers, in both cases, were familiar with digital technologies; however, they had no prior experience of teacher communities and online collaboration tools or platforms. Common activities that teachers were encouraged but free to contribute, both individually and collaboratively, were the following: starting new discussion topics, debating and interchanging ideas, sharing experiences, writing articles in the community blog and commentating on peer contributions, uploading content material, suggesting content resources, creating specific interest groups, undertaking roles and responsibilities, creating original educational scenarios that could be applied in school practice, etc.

Source Data and Social Network Analysis

Data collection and analysis were based on a combination of systematic observation of community online activities along an operation period of 24 weeks. In addition, social network analysis (SNA) methods were used with the aim to reveal students' engagement, learning presence and individual position within both teacher groups and the whole community. SNA provides a set of algorithms to quantify and give insight into member relations and group dynamics in terms of network structure parameters and graphs, i.e. cohesion, power centrality and betweenness centrality (Jimoyiannis and Angelaina 2012). To determine a starting point for our analysis, we have recorded any isolated incidence of community activities and we established a range of standard statistics. Every member contribution was considered as the unit of analysis (platform enrolment, forum postings, article/blog publications, blog commentaries, wiki page contributions).

Table 12.2 Teachers' actions and community indicators

Community indicators	Community presence	Participants		Actions	
		OC (N = 72)	SN (N = 23)	OC (N = 72)	SN (N = 23)
Participation	Enrolment	73	24	–	–
	Self-presentation	45	23	33	–
	Attending community activities	63	23	–	–
Engagement	News (educational themes)	10	11	12	28
	General discussions	8	–	21	–
	Meetings (online, FtF)	18	23	–	–
Interaction	Social presence	3	8	4	10
	Synchronous discussions	15	23	–	–
	Asynchronous discussions	33	23	101	80
	Participation in working groups	34	23	20	14
Collaboration and reflection	Live journal groups (blogging)	8	22	6	135
	Collaboration in working groups (e-portfolio forum)	17	17	103	113
	Artefact cocreation (wiki)	5	11	3	11
	Dialogue, reflection, feedback	5	22	16	178

Results

Teacher Community Presence

Table 12.2 shows the results representing teachers' community presence in relation to the community indicators according to our conceptual framework. In both cases, the overall results were quite similar as far as the indicators of participation, engagement and interaction. It is quite clear from the data in Table 12.2 that the majority of the semi-structured community members were very effective. They were actively interacting and collaborating with each other. They created 14 working groups which were not addressed by the tutor but they appeared as the outcome of teachers' interests and their spontaneous initiatives to collaboratively work with peers in order (a) to study a new educational topic and (b) to design new educational scenarios. In addition, 11 teachers contributed to the wiki activities of new content co-creation.

On the other hand, the majority of the members in the open community (OC) appeared to watch the community activities but they had limited interaction and collaboration with other teachers. Only 17 (out of 72) teachers appeared to be systematically involved into the collaborative activities; 5 teachers contributed to the wiki and 8 teachers published their ideas on the blog. On the other hand, 4 working groups were present in the open community with lower rates of activity and individual contributions. Based on their participation, the OC members were classified into four groups.

The first group includes 10 teachers who sporadically were logging to the community platform without any contribution at all. The second group contains 14 members (observers) who periodically were visiting the community platform, having access to the material and observing discussions; they were not interfering with comments or messages. The third group includes 31 members who regularly attended the events on the platform and participated with few messages in the asynchronous discussions. Finally, 16 teachers were active members and devoted enough time to the community activities, they participated into the teleconference sessions, they contributed to the discussions by posting messages and they were interacting and collaborating with peers to design educational scenarios and share ideas about educational topics of common interest.

Table 12.3 shows the results of the teachers' activities in the semi-structured community which depict individual engagement and contribution, i.e. (a) active participation in working groups, (b) individual articles published on the community blog, (c) article commentaries received by peers, (d) article views by peers, (e) posts uploaded in the community forum and (f) total time spent in the community platform.

The majority of the teachers in SC were active community members; this finding is also confirmed by the time they spent in the platform. A total of 135 original articles were published on the blog area presenting theoretical and practical educational themes; for example, contemporary pedagogy and ICT, learning design, educational scenarios and practices with ICT. Comprehensive discussions were evolving around the topics above. A total of 647 article commentaries were uploaded by the teachers to share ideas, perceptions or alternative opinions. The number of member views per article is another indicator of intensive social interactions among participants In addition, 21 WebQuests were individually constructed and shared within the community for peer reviewing and commenting.

Social Network Analysis

Cohesion analysis can reveal important information regarding the architecture of a teacher community, i.e. the existence of cliques (subgroups) of community members who were connected internally more than externally. In the semi-structured community, 58 teacher cliques were recorded. The e-portfolio sub-system was adopted by the teachers as the main area around which community activities were

Table 12.3 Teacher activities in the semi-structured community

Member	Member in groups	Articles	Article views	Article comments	Forum messages	Total time
S1	4	7	641	23	6	13:31:10
S2	5	5	491	7	3	2:44:34
S3	3	7	729	46	17	29:49:29
S4	4	6	357	27	8	4:51:05
S5	4	5	318	15	2	8:40:48
S6	6	5	558	22	20	15:30:35
S7	3	7	594	58	3	19:59:08
S8	5	9	674	25	15	11:03:07
S9	1	6	239	15	2	3:25:07
S10	6	4	338	20	10	13:35:35
S11	3	0	0	1	0	2:56:43
S12	4	6	270	1	0	5:33:53
S13	7	6	425	66	4	9:24:19
S14	7	6	434	33	5	8:56:51
S15	10	6	555	41	8	8:43:40
S16	8	6	315	23	1	39:25:32
S17	8	6	420	19	1	5:42:07
S18	6	4	375	15	21	5:15:14
S19	3	7	417	19	2	9:26:38
S10	11	6	308	25	6	16:26:17
S21	5	7	446	44	2	24:25:31
S22	8	5	591	24	40	10:57:59
S23	8	7	588	48	24	7:02:18
T	10	2	591	30	6	21:05:33
Total	14	135	10674	647	206	298:33:13

evolving; 49 cliques were recorded in e-portfolio. In addition, 4 cliques were in Mediawiki and 5 cliques in the discussion forum concerning general topics. It is important to be pointed that the majority of the cliques (46) included a great number of members, ranging from 7 to 12. This indicates that the SC was a highly cohesive community. In other words, members tended to develop strong interrelations and a wide scope of interactions among them, thus having enhanced opportunities for knowledge sharing and collaborative knowledge construction. The coordinator was present in 13 of the 58 cliques. This is an indicator that SC was self-directed in a great extent and the coordinator' role was not critical towards influencing participants' contribution and promoting community operation.

In the open teacher community, on the other hand, we identified 31 cliques. The majority of them included three members, while 8 cliques had 4 teachers and one clique 5 members. The community coordinator had a central role since he was present in 26 cliques. Cohesion analysis confirms the findings of descriptive

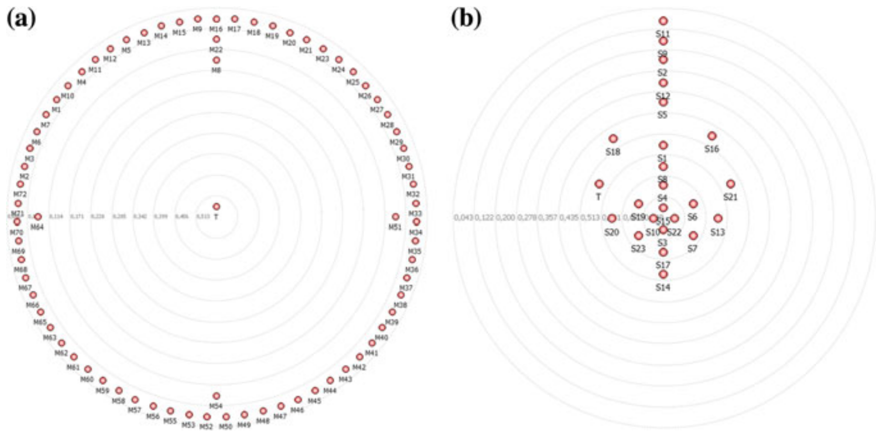

Fig. 12.1 Power centrality map **a** open community, **b** semi-structured community

analysis concerning the factors of participation, engagement and interaction. The OC was not cohesive but a rather static construct. In other words, the type of interactions and the ties among members were very weak.

Power (centrality) analysis is an effective SNA method to measure network activity in terms of community structure as well as the impact each member had with respect to spreading information and influencing others in the community (Jimoyiannis and Angelaina 2012). Figure 12.1 presents the power centrality maps for both communities. In the open community, the coordinator (T) is placed at the centre of the map; he was the most active and influential member in the community (Fig. 12.1a). Teachers M8, M22, M51, M54 and M64 were moderately active members while the majority of the teachers had a marginal (non-visible) contribution. A balanced operation was revealed in the semi-structured community (Fig. 12.1b). The majority of the participants had a significant contribution while the coordinators' role was not central with regard to the evolution of the community activities. A large group of teachers were placed near the centre (i.e. S3, S10, S22, S15, S4, S6, S7, S8, S17, S19 and S23). They were the most active, influential and powerful members in the community; they had many connections to other powerful participants. On the other hand, as moving to the periphery, teachers were less powerful and important community members. The teachers S9 and S11, for example, had a marginal community contribution.

Figure 12.2 presents the betweenness (intermediation) centrality maps of the two communities. Betweenness centrality highlights the influence each member had as a connector among other teachers. In the open community, the coordinator was the central mediator. The majority of the members, with exception of teachers M8 and M22, had limited contribution and they are placed in the periphery. In SC, teacher S15 was the most effective member towards connecting others. Therefore, he had more control of the interaction and information interchange within the community. Teachers S22, S3, S10, S23, S14, S4 and S7 were also good connectors compared

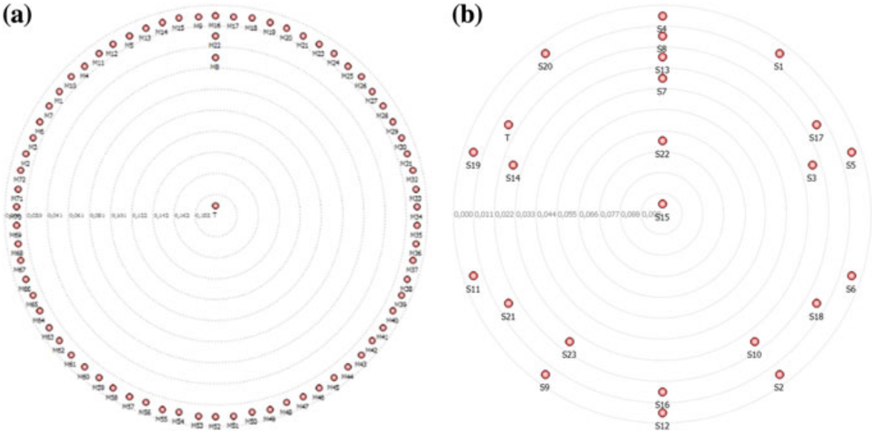

Fig. 12.2 Betweenness centrality map **a** open community, **b** semi-structured community

to their peers in the periphery. As an overall view, SC was a very cohesive community; the majority of the participants had significant contribution while only one member (S11) had a marginal role (lurker). In addition, the coordinator (T) had a rather peripheral than decisive role to the community operation.

Conclusions

This paper reported on an investigation concerning the role of community structure by comparatively analysing teachers' performance in an open and a semi-structured teacher community. With regard to the methodological perspective, the paper proposed a twofold analysis framework based on (a) descriptive analysis of log data extracted from the community platform, (b) social network analysis of teachers' individual contributions to the various platform subsystems (discussion forums, blog articles, wiki pages, e-portfolio).

Both descriptive and social network analysis revealed important information regarding the dynamics and the cohesion of the communities, the teacher groups developed therein, as well as the role and power each participant had within the communities. Confirming existing research findings (Graham 2007), our results provided supportive evidence that the structured community framework was effective towards promoting teachers' engagement, interaction, ideas and experiences interchange, collaboration, and knowledge sharing and co-creation, thus developing a live and evolving learning community. In addition, SNA revealed a decentralized teacher community; the facilitator was not the central member of the learning community network while the majority of the participants demonstrated enhanced motivation to be actively engaged into the community activities (uploading articles and postings, supporting dialogue and discussion topics, interchanging ideas, sharing content and resources, cocreating educational material, etc.).

On the other hand, the open community turned out to be very centralized, evolving around the coordinator's initiatives. Low rates of teachers' interaction and presence in group activities were recorded. Individuals' commitment to contribute was not decisive, and the whole community operation was reduced over time. Despite that an open, self-directed design framework would be expected to be more effective and encouraging towards increasing active participation and cooperation among community members (So and Kim 2013), the community structure and the coordinator's role appeared to be critical success factors, influencing members' control and motivation to keep the community active.

The proposed analysis framework revealed valuable information regarding critical community indicators, i.e. participation, engagement, interaction, creativity and cohesion, which depict members' individual contributions, peer interaction and ties, the community structure and teacher groups developed, teacher connections and information flow, group cohesion, as well as the power (influence) each participant had within the community. Therefore, this study offered an integrated framework to track and analyse how an online teacher community was structured and evolved as well as important aspects of members' presence in the community, i.e. teacher connections and information flow, the power and the influence each participant had within his community.

In conclusion, this study contributes to the existing knowledge by confirming that both openness and constraints are critical factors to effectively organize, support and implement online teacher communities for professional development (Cilliers 2005). Online teacher communities should be, in many senses, self-organized and dynamic; however, a balance between structure and constraint is required to constructively influence the community operation. In addition, the combination of both virtual and physical network aspects seems to be important.

Exploring the role of structure in shaping social learning environments, especially in the field of teacher communities, is an open research problem. Our current efforts are directed towards combining SNA findings with qualitative data from content analysis of teachers' online discourse (blog articles comments, discussion posts, contributions to the wiki, etc.) and teachers' interviews. We expect thus to further analyse teachers' learning presence and knowledge construction as well as common practices and values perceived by individuals within the community. The ultimate goal of this research project was to propose an integrated framework for the design and implementation in practice of effective teacher communities with the affordances to promote professional development of the participants.

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Part V
e-Learning for Educators

Chapter 13
Online Learning and Self-Regulation: Balancing Between Personal and Social Dimensions

Panos Vlachopoulos and Maria Hatzigianni

Introduction

As online delivery courses and distance education (DE) continue to expand, students' learning experiences and course outcomes become critical issues that need to be addressed. Consistent with this growth is the plethora of studies around the affordances and challenges of distance education and/or online learning. The expansion of constructivism, sociocultural theories and other reforming paradigms has made an impressive entrance in education and has been the principal frameworks in research around online learning as well. According to these theories, learners are able to construct their own understandings with the assistance of 'experts' such as 'teachers' or 'colleagues'. There is a shift from the traditional 'active', 'individualistic' participation to a more 'collective', collaborative and holistic approach to learning. Learners are able to learn but they will do even better if they cooperate with others. Team work is expected and encouraged. This collaborative nature of education has attracted a lot of attention and terms such as social learning (Bandura 1994); learning communities; peer learning; and 'scaffolding' are eminent in this area.

The growing presence of DE makes the constant need for research in this area imperative. In this chapter, we will present research around an area that is particularly important for DE students but can also have implications for all higher

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education students. We will concentrate on research around self-regulation, a major field of educational research for more than two decades that has recaptured researchers' interest as a necessary prerequisite for successful online engagement and learning. A study conducted in a university will inform our discussion and will shed more light on existing educational research in the field of online learning and self-regulating skills.

Literature Review

Definition of Self-Regulation (SR)

According to one of the most eminent researchers in the field of self-regulation, Zimmerman, self-regulated learning (SRL), refers to the self-directive processes and self-beliefs that enable learners to transform their mental abilities, such as verbal aptitude, into an academic performance skill, such as 'writing' (Zimmerman 2008, p. 166). According to the same researcher, self-regulating students are 'metacognitively, motivationally and behaviourally active participants in their own learning' (Zimmerman 1990, p. 4) and SR is different to other self-constructs because it involves 'agency, purpose and instrumentality perceptions by learners' (p. 5). In line with this conceptualisation of SR, Pintrich (1999, p. 453) defined SRL as 'an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate and control their cognition, motivation, and behaviour, guided and constrained by their goals and the contextual features in the environments'.

Studies Around Self-Regulation and Online Learning

There are three types of self-regulation interactions that have captured researchers' interest. The first type is the '*effort regulation*' (Cho and Shen 2013) or 'student-content' (Bol and Garner 2011) regulation where students try to manage the quantity and quality of the content they have to engage with and the effort they have to make in order to reach their goal; the second type is the '*social or interactive regulation*' or 'student–student, student–instructor' regulation, where students interact with other students in team work or collaborative tasks and interact also with their instructors to complete their courses. Finally, the third type is the '*metacognitive regulation*', where students with good regulating skills reflect back on their efforts, the strategies that they used to reach their goal and they self-evaluate in order to become more efficient learners in the future.

Cho and Shen (2013) underlined the importance of '*interactive regulation*' since online learners are required to complete a number of activities as part of a group. In this study, they investigated the role of SR in students' academic achievement in an online course by using several constructs to measure SR: goal orientation; academic self-efficacy; effort regulation; metacognitive regulation and interactive regulation. Their findings suggested that all three types of SR had a positive association with intrinsic goal orientation and academic self-efficacy (p. 296) and were positively correlated with academic achievement. Consistent with these findings, Bernard et al. (2009) in their meta-analysis of distance and online learning quantitatively verified the importance of these three interactions (p. 82) and Bol and Garner (2011) recommended that researchers need to take a more holistic approach and investigate all three types of regulation instead of focusing only on one type.

Nevertheless, '*social or interactive regulation*' has not been sufficiently explored (Cho and Shen 2013, p. 297). Zimmerman and Tsikalas (2005) have argued that the majority of research in SRL has concentrated on the cognitive aspect of SR and the impact on performance and achievement, over-emphasising the metacognitive element of SR and under-exploring the social aspects of SRL, such as motivation and self-reactions.

Research has also underlined the need for social presence of students who are doing online courses being larger than for students who are attending face-to-face classes. Tsai et al. (2013) explored (path analysis) how students' social experience of online learning is influenced by their motivation and SR. They advocated for the social nature of SRL and not just the cognitive and they also underscored the constructive and active dimension of SRL (p. 90). Similarly, Zhan and Mei (2013) measured the effect of both academic self-concept and social presence on students' learning and concluded that the effect of social presence was greater for students who are completing an online course.

Self-Regulation and Reading

There are numerous studies on self-regulation and related constructs and their association with online learning and although the majority of online learning courses require their students to complete a number of readings, limited research has explored students' self-regulatory practices when engaging with online readings.

The characteristics of a self-regulated reader are established from a young age and include: setting realistic goals; selecting effective reading strategies; monitoring understanding of the text; and evaluating progress towards reaching the set goals (Horner and Shwery 2002; Martinez-Pons 1996; Zimmerman and Pons 1986). This cycle is consistent with the self-regulation model as outlined by Zimmerman and Pons (1986) based on the social cognitive theory. According to Zimmerman, there are different phases in the self-regulation cycle starting from the 'preparatory phase', going to 'action or completion' and then to 'appraisal' of strategies and new 'adaptation' phase. This cycle emphasises the 'social foundations of thinking and behaviour' and the 'constructive, self-generated nature' of SRL (Puustinen and Pulkkinen 2001, p. 280).

This study explored one key component of online learning which was reading in two different modes (synchronous and asynchronous) and focused on the social aspect of learning. However, it is important to mention that previous studies suggested that there are students whose goal online is to 'master skills' (a process goal) and there are those whose goal is to 'master the subject matter' (content goal). The process goal resonates with the extent to which students trust each other online, while interaction with their tutors is not important. Achieving a content goal requires higher levels of connectedness with their tutors than with their peers (Laffey et al. 2006; Yang et al. 2006). These findings are consistent with previously reported evidence supporting that the connection between self-regulation and goal orientation depends on both the social dimension (individual or collaborative) of the learning experience and the type of goal set (content or process) (i.e. Pintrich and Schrauben 1992). There are no studies to date that have problematised the aforementioned notions of social dimension of learning and goal setting in a fully online environment. It is with such an omission that the present study aimed to engage with.

Method

The study presented here aimed to explore the perceptions of fully online distance learners of four different types of reading activities in relation to some predefined dimensions of self-regulation. In particular, the authors were interested in finding out the extent to which the students self-regulated while participating in collaborative reading activities in different online settings. A mixed methods' approach was employed in this study to allow a better understanding of the problem under scrutiny (Creswell and Garrett 2008). The sample were Master of Education students ($N = 16$) who studied fully online over one academic semester in a New Zealand University.

Measures

Measures combined questionnaires with semi-structured focus group interviews. A seven-item long questionnaire was developed based on the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich and De Groot 1990) and piloted. The adaptation of the questionnaire was necessary since this study involved online students. The questionnaire asked students to state in a five-point Likert scale (1 = least effective, 5 = most effective) how effective or ineffective the four reading activities were in relation to: (1) their individual belief in their capacity to complete the reading task (self-efficacy); (2) the value of the reading task for their learning (internal task value); (3) the value of their task to complete their assignments (external task value); (4) organise their strategies for learning (set learning-oriented goals); (5) appear to perform well (set performance-oriented goals); (6) develop a sense of belonging with other students (community building); and (7) provide opportunities to receive and give feedback (Feedback). Examples of the questions included: '*the activity helped me focus on the reading task*', '*the activity provided me with the opportunity to learn from other students*' and '*the activity added pressure on me to perform well in the online platform.*'

All students were asked to engage with four compulsory activities as follows:

1. A tutor-led 2-week-long reading group using an online discussion forum in a Learning Management System (asynchronous guided reading activity).
2. A student-led 2-week-long reading group using an online discussion in a Learning Management System (asynchronous discovery reading activity).
3. A tutor-led 2-h-long synchronous reading group using a Web-conferencing tool (synchronous guided reading activity).
4. A student-led 2-h-long synchronous reading group (synchronous discovery reading activity).

At the end of each activity, students were asked to complete a seven-item long 'motivation-to-learn' questionnaire as a means of debrief. There were no final exams for this course and participation in the online reading activities were rated as pass or fail. No grades were assigned.

One week after the end of the course, participants were asked to participate in a fully online focus group session using a Web conference tool. The interview took place after all marking of the assignments was complete and marks and feedback were released to the students. Thirteen out of the 16 students participated in the focus group interview and gave their consent for their voices to be captured and analysed for research and publication purposes. The interview included questions related to self-regulation and online participation in the reading activities. All the research was conducted following the Research Ethical Code of Practice of the University.

Analysis

All items of the short questionnaire were inserted in Excel for basic descriptive analysis. Data were represented in the form of graphs to visualise and better understand the responses of the students and help us form the prompt questions for the interviews. Students' interview replies were recorded and transcribed for thematic analysis in NVivo 10. A Kappa reliability check in a quarter of the qualitative data set gave a reliability score of 75 % which was satisfactory.

Results

Quantitative—Questionnaires

The results of the descriptive quantitative analysis of the questionnaire are presented in Table 13.1. The synchronous guided (SG) activity was valued high by the students with regard to the dimension 'community building' ($M = 5$); however, dimensions 'internal task value' and 'setting learning-oriented goals' were low ($M = 2$). When students worked synchronously without the presence of their tutor (Synchronous discovery: SD), the score on the dimension 'feedback' was the highest of all the situations ($M = 5$) and there was a slight increase of one point in the dimension 'self-evaluation'.

There was also a change in how students perceived the value of the task; they felt that the task was more meaningful to their learning and felt less pressured to perform well when the teacher was not present. The asynchronous guided (AG) activity was valued high with regard to students' perception of their ability to complete task (self-efficacy; $M = 4$) as well as several other dimensions related to internal task value, setting learning-oriented goals, self-evaluation and feedback ($M = 4$). Finally, the asynchronous discovery (AD) activity was perceived by the students to be the most effective of all ($M = 5$) for helping them to identify their own learning goals. However, this type of activity scored the lowest combined score in the dimensions 'self-efficacy', 'setting performance-oriented goals', 'community' and 'feedback'.

The patterns of all four activities are also illustrated in Fig. 13.1. The figure presents the mean scores (numbers 1–5) and how the four different activities were scored with regard to SR dimensions (represented in different lines). The figure is divided into two halves. The right half is related to individual dimensions (self-efficacy; task value; set learning-oriented goals) of SR and the left half is related to co-regulation (feedback; community building; set performance-oriented goals). The figure highlights the lower perceived effectiveness of the synchronous activities (both discovery and guided) and the higher perceived effectiveness of the asynchronous activities (discovery and guided).

Table 13.1 Respondents' mean scores of perceptions of usefulness of reading activities in relation to self-regulation dimensions

Predefined self-regulation dimensions	SG	AG	SD	AD
Self-efficacy	2	4	3	2
Task value (internal)	2	4	3.5	**5**
Task value (external)	4	2	2	4
Set learning-oriented goals	2	4	4	**5**
Set performance-oriented goals	4	3	3	2
Self-evaluation	1	4	2	4
Community building	**5**	3	4	2
Feedback	3	4	**5**	2

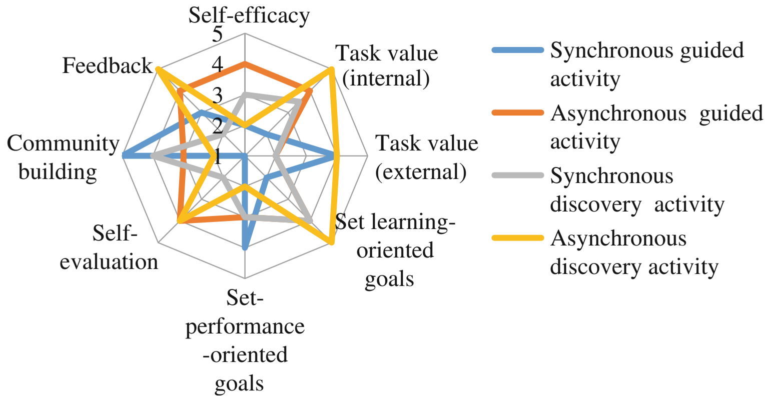

Fig. 13.1 Patterns of perceived effectiveness of four different types of activities in relation to self-regulation dimensions (*1* least effective, *5* most effective)

Qualitative—Interviews

There were four main themes that emerged from the analysis of the focus group semi-structured interviews. These themes were 'Promotion of a 'Sense of Community', 'Performance Goals', 'Personal Development' and 'Feedback'.

In this study, students reported that the promotion of a strong community feeling was achieved mostly during the synchronous activities and especially when they were participating in the synchronous student-facilitated discussions (Synchronous Discovery). One student reported that '*working with other students during the web conference activity was fun! It was nice to put some faces on the names, listen to their voices …it made me feel that there is a real class.*' Another student emphasised, however, that the presence of the tutor in the synchronous activity worked well but that she '*was not feeling that comfortable to express my opinions … I definitely enjoyed more the student-facilitated web conference session.*' The reasons that other students offered about the perceived usefulness of the synchronous activities towards completing the reading tasks included '*it gave me some clear deadlines to complete my readings before we met to discuss them' and '.. not worrying about having to write lengthy replies to the online discussions forum, I just turned up and spoke.*' An important point was raised by half of the students in relation to the value of the task in achieving their performance goals in synchronous sessions. The following extract is indicative of this theme: '*the synchronous nature of the discussion with the presence of the tutor made me feel pressurized to perform well…I was stressed about what I would say to contribute to the discussion as opposed to listen to what others have to say.*'

In relation to personal development and feedback, students agreed that it was the asynchronous activities that helped them the most with both reflecting on their learning and offering and providing feedback. The reasons offered were in accordance with many of the declared benefits of asynchronous learning. For example, one student reported that '*having my contributions in writing, I could always go back, read them again, read other contributions by other students and think deeper about the key points*'. Another added that '*the time delay in the online discussion forum helped me formulate my thoughts first in my mind before sharing them with my group… I went many times and read other comments before I posted mine. Yes, it helped reflect on my views*'. In particular, the student appreciated the efforts by the tutor in the asynchronous guided activity to ask questions as a critical friend and prompt them to reflect and evaluate their contributions. A student emphasised that '*having the tutor asking us questions about why we wrote something, or how well one idea connects with another or with my own views, helped me look at the discussion forum from a more critical perceptive*'.

Overall, as can be seen by the analysis of the interviews, students clearly identified the synchronous discovery activity as the one supporting their sense of belonging and community enhancing at the same time their co-regulation. A final point is that the replies from both the quantitative and the qualitative data agreed that the asynchronous activities were most effective as far as the personal dimensions of SR are concerned and the synchronous were effective for co-regulation.

Findings and Discussion

In online learning environments, self-regulation has been shown to be strongly associated with the social ability of students (ability to work together in groups) as well as with students' self-efficacy and ability to set their own goals (Laffey et al. 2006; Yang et al. 2006). In this study, we tried to shed some light into how different types of online activities can motivate distance learners to engage with readings by setting realistic process and content goals and achieve them. We tried four different types of activities that provided students a variety of online learning rhythms (asynchronous and synchronous) and degree of student-centeredness (tutor-led and student-led discussions). We report from our findings that the four different types of activities with regard to the self-regulation dimensions were effective but for achieving different goals. None of the four activities was perceived individually to be the most effective in promoting SR. It was the combination of the four activities that created the best condition for SR.

The rhythm of the activity (synchronous or asynchronous) appeared to have an influence on students' perceived self-regulation. In particular, the asynchronous nature of the activity was perceived as more effective for self-efficacy and motivation, whereas the synchronous nature of activity impacted more on community engagement and co-regulation. This finding resonates with well-referenced studies on the importance of asynchronous online discussions in supporting individual learners to reflect and set their own learning goals (Garrison 2003; Salmon 2002). Moreover, previous studies related to synchronous interactions also suggest DE students' preference for not being required to participate in synchronous activities (Murray et al. 2008; Webster and Hackley 1997).

Finally, teacher presence appears to have an influence especially on setting internal or external goals. Their role should be that of 'critical friend' and 'fellow learner' as opposed to the 'instructor' and their online tutoring approach should be carefully planned (Vlachopoulos and Cowan 2010). Other studies have found the role of the tutor to be influential in creating the conditions for SR in online learning environments. Guldberg and Pilkington (2007) found that the ability of students to self-regulate enhanced their learning but they suggested that the tutor also has had a crucial role to play in supporting SR. In line with this finding, Oliver and Shaw (2003) reported from a study of asynchronous discussions that the only contextual element that appeared to influence SR in any important way was the tutor.

Implications for Practice

There are a number of implications that our study has for future research and educational practice. Addressing educational practice first, we recommend considering the following:

- Setting up asynchronous student-led discovery reading activities (where students can search and select academic readings of interest to them) to improve intrinsic motivation and internal task value as well as adding some external task value;
- Setting up synchronous discovery reading and discussion sessions, preferably led by students, to increase community feeling among students;
- Avoiding the temptation to directly intervene in reading discussions, unless you are doing so in a collegial way as a critical friend. Direct interventions, especially in synchronous settings, do not appear to promote a self-regulated attitude on the part of the students;
- Particular design elements (individual accountability, group goals and positive interdependence) are essential for these learner–to-learner benefits to occur; and
- The provision of synchronous experiences in online learning should be considered and designed carefully without the expectation that all DE students are required to participate.

As far as future research is concerned, although the research in this field is abundant, there is still need for more studies with a clear theoretical framework and that will measure SR in all its diversity. SRL is a cyclical, recursive and active process encompassing motivation, behaviour and context and as such, very challenging to capture in its entirety (Winters et al. 2008). Furthermore, Artino and

Stephens (2006, p. 147) argue for the need to study SR from a developmental perspective, explore possible developmental differences in students' SR practices as these practices might evolve and be transformed with experience and new knowledge.

In terms of methodology, concerns for self-report measures and trace data collection methods have been expressed as inadequate to capture motivation and interest (Puustinen and Pulkkinen 2001, p. 283) A need for more think-aloud methodologies/protocols as recommended by Ericsson and Simon (1984) will focus on asking students to verbalise their thinking, not explaining, as verbalising their thoughts does not interfere with cognitive processes.

Finally, as also emerged in this study a field of SRL that also deserves further investigation is the role of self-regulation in the learning design, delivery and evaluation of the effectiveness of instruction in DE environments (Bol and Garner 2011, p. 105).

Conclusions

Online learning is steadily growing and its firm establishment in Higher Education has provided us with opportunities to revisit educational practices, theories and pedagogies. One of the concepts that emerged as' highly relevant and valuable' (Cassidy 2011, p. 990) and a major goal for any modern educational system is the development of SR skills. Investing in the promotion of SR skills is an investment for lifelong learning as envisioned in today's society. The key message from our study is that a social and holistic approach to designing online courses is also effective in building SR skills. A carefully designed online course should include a good balance of both synchronous and asynchronous activities with the tutor taking the role of a 'critical friend' or 'fellow learner' that allows room and scaffold learners to be able to take control of their own learning, which in turn promotes their SR skills.

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Chapter 14
Development of a Blended Learning Program and Its Pilot Implementation for Professional Development of Science Teachers

Dimitris Psillos

Introduction

Blended learning approaches have been tried out in several areas, combining live educational activities implemented in traditional teaching environments with distance-learning activities supported by digital technologies and educational contexts (Gerbic 2011; Owston 2013). A number of studies have explored the effectiveness of the blended learning approaches that have been adopted and implemented mainly in higher education as well as their relation to distance learning and face to face (Ginns and Ellis 2007). Blended learning approaches can be at least, if not more, effective than wholly online systems and conventional face-to-face teaching (El-Deghaidy and Nouby 2008). In the area of teacher education, the knowledge that (science) teachers must have in order to integrate ICT in the educational process is complex. It has to combine scientific content with the technological and pedagogical aspects and be sufficiently functional to condition their teaching practices. Mishra and Koehler (2006) have suggested a widely used model in in-service teacher professional development (TPD) programs that combines content, pedagogy, and ICT through a complex system of interrelations defined by these three parameters, namely technological pedagogical content knowledge (TPACK) model (So and Kim 2009; Doering et al. 2009; Park et al. 2011). Concerning the integration of ICT in teaching, in-service teacher professional development (TPD) is often conducted in live, face-to-face sessions. There are valid reasons for turning to blended learning approaches, among them the possibility of providing professional development to a population of teachers that is either widely scattered or does not have access to training centers with appropriate infrastructures and giving opportunities for participants to experience the actual use

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of advanced LMS tools in authentic learning situations. Besides, blended learning programs have been successfully implemented for developing teachers' TPACK and were positively perceived by participating teachers to be (Alayyar et al. 2012) or in-service teachers (Owston et al. 2008).

There is no accepted model combining face-to-face and distance activities in a blended learning approach. The mix of the three forms of educational activity (face-to-face, synchronous, and asynchronous), the personal involvement of the students, and the learning procedure are determined by the aims. The design principles, the kind of learning objectives, and the profile of the students and instructors are the objects of study by researchers and educationists (Hofmann 2006). One important issue is whether the three forms of activities are structured in added on type, which implies that Web-based materials simply enrich face-to-face ones, or in an integral form, which implies taking advantage of the transformative value of the interactions between them (Garrison and Kanuka 2004). A second important issue is whether blended materials facilitate teachers to be actively learners being engaged in design and application of lessons and activities integrating ICT (Fozdar and Kumar 2007).

In Greece, teacher professional development (TPD) in the pedagogical exploitation of ICT, which is known as B-Level, and we shall use this term hereafter for the sake of brevity, is part of the broader multi-year TPD program in the knowledge and use of ICT that is being implemented, by the Computer Technology Institute "Diophantus" with the support of the Ministry of Education, under the supervision of a scientific committee (CTI 2007). The program, which has been in progress across Greece since 2007, until recently only in classical face-to-face sessions, has gradually begun to offer professional development possibilities to teachers who cannot easily get to a training center (e.g., in remote locations or with social, financial or mobility problems), with the pilot implementation of an innovative blended learning program called Meikto that combines face-to-face teaching with two forms of distance instruction, synchronous, and asynchronous. The blended learning program Meikto, called hereafter simply Meikto for the sake of brevity, is addressed to science, literature, mathematics, and informatics secondary teachers as well as to primary teachers.

In this context, the aim of the present paper was to outline and discuss the basic design principles and structure of the blended learning program Meikto, and we shall muse this term hereafter, for science teachers, present selected results from its pilot application concerning the views of the participating teachers on the distance activities, their knowledge gains from the program as well as their interest toward it.

Design of Meikto Blended Learning Program

The program for science teachers was designed on the basis of the following principles.

(i) Development of technological pedagogical content knowledge (TPACK) as a design framework and aim of the program

The TPACK basic elements are (scientific) content, which has to do with the subject to be taught, pedagogical knowledge, which covers contemporary theories of and approaches to education, and technological knowledge (TK), which concerns the technological environments and their relations with the particular (scientific) content. The interaction of these three interrelated factors has a synthetic result, yielding pedagogical content knowledge (PCK), which includes knowledge of strategies and representations that are suitable for teaching the particular subject, e.g., science, technological content knowledge (TCK), which includes familiarity with software and awareness of its possibilities, and technological pedagogical content knowledge (TPACK), which includes knowledge of how ICT can support the design and implementation of specific pedagogic strategies in the classroom, e.g., encouraging explorative or cooperative learning using ICT. Mishra and Koehler (2006) suggest that teachers have to understand the relations between the three components of TPACK if these technologies are to play a real role in classroom practice.

Meikto, and by presumption its applications, is based on the TPACK model and aims at developing teachers' relevant knowledge and skills but indirectly and without direct reference to the terms, as we have mentioned elsewhere (Psillos and Paraskevas 2014). For example, pedagogical content knowledge (PCK) includes topics such as students' ideas about natural phenomena and concepts; students' conceptual difficulties; constructive and inquiry approaches to school science. Technological knowledge (TK) covers aspects of using general tools, technological content knowledge (TCK) includes the basic approved software by the Ministry, for example Interactive Physics (http://www.design-simulation.com/ip/) and Iridium VLab (http://chemcollective.org/vlab_download), issues of content transformation such as visualizing concepts, representations, description, and transformation of scientific concepts and processes in specific technological environments. Technological pedagogical knowledge covers the gains from software and Web applications, such as the use of ICT in the modeling of scientific concepts. Technological pedagogical content knowledge (TPACK) includes knowledge of how ICT can be used to support specific science teaching strategies, for example, designing experimental procedures in virtual environments or promoting geography investigations by taking advantage of Google Earth and interactive white board.

(ii) Integration of face-to-face and distance activities, synchronous and asynchronous

One thing that is important in a blended approach is coherence as regards the organization and interrelation of distance and face-to-face educational activities so that they are interconnected and meet the needs of the teachers (Vaughan 2007). This principle was applied in Meikto as is discussed in detail further on.

(iii) Learning through design

It has been shown that teachers, as adults, are eager to learn and develop new skills relating to their professional work through involvement in designing authentic learning activities, that is, activities that lead to classroom applications and are incorporated into classroom reality (Kalantzis and Bill 2010). Design and classroom implementation are, or should be, one main aim of teacher professional development in integrating ICT in teaching of science. Chai et al. (2013) in a recent review of empirical studies concerning TPACK concluded that all intervention studies "required the teachers to plan or design lessons for ICT integration as an important part of the course." In Meikto, much of the specific part, which concern science teaching, focuses on involving teachers in designing authentic innovative activities, worksheets, and teaching scenarios combining science teaching integrating ICT in thematic units that cover the whole spectrum of school sciences.

In Meikto, the teachers are taught by instructors in synchronous sessions; take part in asynchronous activities concerning the analysis of prepared scenarios and designing innovative activities, worksheets, and scenarios; and develop appropriate teaching aims and learning supports for the students. In addition to the theoretical lessons, they must implement practical applications in the classroom, using the available activities and scenarios or composing new ones with the help of the instructors in synchronous sessions, thus enhancing the development of their TPACK.

(iv) Enhancement of teachers' interest and active participation

In blended programs, such as this one, emphasis is given to having teachers participate and interact with one another, through the use of activities and support tools that will encourage them to be actively and continuously involved in the educational procedures using synchronous and asynchronous platforms to gradually constitute a learning community. Interest of teachers was prompted by contextualizing teaching of theories concerning, for example, contemporarily trends on science teaching such as inquiry-based learning as well as affordances of ICT for transforming scientific content and enhancing technology-mediated learning of science. Authentic problems were related to school curriculum and real student's difficulties. Besides, active construction of new knowledge was promoted by involving teachers continuously in individual and team tasks, their presentation on line to the whole group, discussion, and online feedback under the guidance of their instructors.

(v) Choice of a variety of appropriate tools and platforms

For the implementation of Meikto, we used the Moodle e-Learning platform (moodle.org) and supplementary tools to distribute the educational material and provide support for the asynchronous element of the model. For the implementation of the online sessions, we used Blackboard Collaborate (http://www.blackboard.com), a platform that provides tools for synchronous e-Learning/virtual classrooms, such as videoconferencing, application sharing, whiteboard, chat, and online voting. As appropriate, participants in the program could also use distance-learning support software (e.g., TeamViewer) or other distance communications software (e.g., Skype).

(vi) Provision and support for the teachers

The typical application of Meikto is carried out in a group of science teachers consisting normally of 10–12 participants spread out in a wide area who are taught and guided in their works by one or two experienced certified instructors and supported by one technician. For the face-to-face meetings, all participants have to travel and meet in special training centers (USE), which have the necessary infrastructure and provide technical and administrative support to the group.

Structure of Meikto Blended Learning Program

The material for Meikto was based on the material that was already used in the face-to-face program (B-Level 2010) but which was reorganized, adapted, and enriched so that the teachers could work with it with minimal assistance from the instructors and take advantage of the benefits of face-to-face and e-Learning. Each week includes a face-to-face or Blackboard-mediated synchronous session and asynchronous activities, using Moodle, which in principle should correspond to a roughly 3-h workload. The synchronous sessions were recorded and were immediately available so that teachers could review points and absentees could observe them. The asynchronous activities carried out by the participants individually or in teams included studying the teaching material or completing short exercises and tasks, designing and producing activities and worksheets.

All the educational material is stored on the Moodle platform and has been organized into weeks. Meikto has a total duration of (96) h. It has a two-part structure, with a general part (18 h) and a specific part (78 h), plus additional supported classroom applications totaling 48 h (CIT 2007). The program covers a total of 24 weeks, corresponding to 96 teaching hours plus additional supported classroom applications totaling 48 h. Week 1, in the beginning, weeks 7–8, in the middle, and week 24, at the end, are implemented in face-to-face sessions in which the teachers familiarize themselves with the material; new topics are introduced, and instructors and teachers discuss and reflect on the distance activities.

A brief description of the structure of the material appears in the introduction to the space, the "In-service TPD material: texts and software" file, from which the teachers can download the teaching material for each part. Figure 14.1 presents the initial page translated from Greek of the program for science teachers as uploaded to Moodle. Participants can download materials and tasks for each of the week separately right from the introductory space in the lines 1–24. The introduction to each week contains its title, learning objectives, and a brief description of its content. Each session consists of a title specifying the kind of session (face-to-face,

Fig. 14.1 Home page of the blended model for science teachers

synchronous, or asynchronous), the support material, and the suggested teaching approach, with guidelines for the instructor and the teachers for carrying out the activities, and links relating to the teaching material. The rest of the introductory page contains information about the program, rules to be followed, access to forum for discussion and access to virtual rooms.

Much of the specific part of the program as well as classroom applications facilitated collaborative learning on the part of the teachers through the required designing of innovative authentic teaching scenarios, which promote the development of TPACK by combining contemporarily approaches to science teaching such as inquiry with the utilization of ICT in thematic areas covering all branches of school science: physics, chemistry, biology, and geography (Maeng et al. 2013). The teachers were guided to navigate in the synchronous tasks focusing on familiarizing them with affordances of complex software, to analyze prepared scenarios from the accompanying material, design for example learning activities in chemistry with virtual laboratories such as iridium and hypermedia applications in biology for the circulatory system. They developed appropriate teaching objectives and designed student learning scaffolds via digital affordances such real time graphing in virtual laboratories. Coordination of the three forms of activities, face-to-face, synchronous, and asynchronous, was promoted by continuity and conceptual coherence of the on task work embedded in the distance sessions (Keengwe and Kang 2012). More specifically, these sessions included assigning of tasks to the teachers which started work at a synchronous session continued via asynchronous activities uploaded their work and/or presented it in the next synchronous session. The teachers studied the material on Moodle, uploaded and posted their work—individual or group scenarios—on Moodle and delivered virtual presentation to the whole group at the beginning of each synchronous session via Blackboard.

Pilot Research

(a) Sample and tools

The research was carried out with 20 secondary education science teachers, who participated in the pilot implementation of the blended model at two training centers during the winter of 2014. The researchers monitored their interest and their views as regards the appropriateness of the sessions, aspects of TPACK, and the role of ICT in the educational process, via written questionnaire. The questionnaire contained closed, Likert-type questions to be answered on a scale of 1–5 (very little, little, average, much, very much) as well as some open ones. For the development of the question relevant studies and proposed tools were taken into account (Lee and Tsai 2010). Content validity was established by two professors and two experienced instructors who carried out close examination of the structure of the program and the substance of the materials. In the present paper, we focus on questions regarding the interest demonstrated by the teachers, the knowledge and skills furnished and their views on the forms of the activities. Cronbach's alpha of the closed questions presented in this paper was 0.914 which is very satisfactory. The questionnaires were completed by the teachers using Survey Monkey. In addition to Likert-type questions, there was space for the teachers to express in free open format their perceptions about the program and its elements.

(b) Results

(i) Teachers' interest and participation

The focus of studies in blended programs is the interest and perseverance of the teachers and their continuous involvement in the suggested activities. In the pilot programs, there was only a single withdrawal, which occurred for personal reasons. The participants were actively involved both during the synchronous sessions, as attested by the recordings of their work and in carrying out the asynchronous activities, as attested by uploading of their tasks, which had to be posted and discussed at the next synchronous session.

When asked at the end of the program whether the program was interesting, 18 out of 19 answered positively or very positively, with only one giving an intermediate ranking. Besides, the teachers after experience of both face-to-face and distance sessions were asked if they would prefer face-to-face training; the preference (13 out of 19) was clear for the blended model. Only 3 participants would favor face-to-face TPD program instead of the blended one and 3 others were undecided, which confirms the appeal of the blended model to these subjects. In the open question concerning the reasons for such preference, they argued that the blended approach saved time and money, was convenient concerning timing, was an innovative intensive experience, and was feasible to attend. These results were corroborated by the teachers' comments. As one teacher puts it:

> (I would not prefer to be trained in a face to face program) I think that our "forced" familiarization with α Blackboard, Moodle, Virtual Box and the software by ourselves for making the e-presentations is the best education for understanding these tools.

(ii) Teachers' views of the sessions and their combination

At the end, the teachers were asked to rate the appropriateness of the activities in the synchronous sessions; 16 out of 19 rated them much or very much. The responses to another similar question concerning the asynchronous activities were in the majority also positive, with 14 out of 19 responding much or very much. The teachers were also asked to rate the appropriateness of the combination of face-to-face, synchronous, and asynchronous sessions; 18 out of 19 rated much or very much the overall mix. It is characteristic that only one of the teachers rated the combination of the three forms as only moderately satisfactory. In their free comments in the questionnaire, the teachers noted that the combination was appropriate. For example:

> … It was ok. Distance (synchronous) sessions are necessary because of time, space and traveling cost. Hopefully they are combined with asynchronous activities where you have peace and take as much time as you nee. In the face to face (sessions) live feeling is added which is missing in the distance sessions.

We may also note that several teachers mentioned that the sessions were intensive particularly at the beginning of the program and that the workload for the asynchronous activities exceeded the estimated three hours on task.

(iii) Teachers' views of the knowledge furnished by the blended model

At the end of the program, the teachers were asked whether the program provided them with what they needed to design activities and scenarios using software. The response was overwhelmingly positive, with 19 out of 19 responding much or very much to the question. Similarly, the response was overwhelmingly positive, with 19 out of 19 responding much and very much, concerning the provision of appropriate theory for employing ICT in their science teaching. Besides, they were asked whether the program provided them with adequate support along the way for their classroom implementation of innovative teaching activities/scenarios. The response was also positive 16 out of 19 teachers rating much and very much. Concerning the practical exercise with the taught software, 16 teachers rated much and very much while 3 rated average. In the open question for their overall experience, they argued that they learned about new software, how to use it in their teaching, how to design scenarios and innovative activities and experience up-to-date platforms. In a similar line were teachers' written comments. For example:

> … Certainly, yes it helped me a lot.. I did not know what was about. It was new for me. I just knew the software but I had never done a scenario. Where to rely upon in making a scenario

Conclusions

This paper discusses in brief the design principles, structure, and pilot implementation of a blended learning program called Meikto for science teacher professional development in the use of ICT in Greece. The sample of the pilot study was small, and only selected results are presented which allow us to draw cautious conclusions.

Overall, Meikto managed to draw the interest and active involvement of the teachers though it was demanding involving understanding of high complex knowledge, development of practical skills, and their interrelation. Most teachers were very positive about what they had gained from the program in relation to aspects of TPACK concerning the design, use, and integration of ICT in science teaching. We consider that one possible reason for such positive response by the teachers was that they were prompted continuously to be actively engaged in collaborative design of authentic activities and lessons involving integration of new ICT software and tools aiming at improving teaching of scientific topics. Besides, one feature of Meikto was that teaching practice was an integral part of this program, during which the teachers tried out the ICT-based innovative activities and lessons, which they had designed, in their own classrooms. In other words, teachers learned and taught with ICT and not simply about ICT. We take this as meaning that the implementation of Meikto did not fall short in its benefits for these dimensions of TPACK as well as in supporting classroom implementation. Such interpretation of the results is in line with reports in the literature about intervention studies concerning teachers' TPACK development which more or less required the teachers to plan or design lessons for ICT integration as an important part of the course (Chai et al. 2013).

Another feature of Meikto was the integration of face-to-face, synchronous, and asynchronous sessions, which was positively perceived the teachers for their professional development. As mentioned in the introduction of this paper, effective blended models have a transformative value taking advantage of both the richness of oral conversation and the thoughtful peaceful constructive writing of asynchronous fulfillment of assigned tasks (Garrison and Kanuka 2004). In face-to-face and synchronous sessions, the teachers were involved in rich conversations with their classmates and their instructors, for example in criticizing the suggested lessons plans which were assigned to and prepared by various teams within their group. There was a conceptual coherence and continuity between the tasks in the synchronous sessions and the tasks they had to fulfill in the asynchronous assignments almost every week (Berger et al. 2008). Although several tasks were intensive, particularly the asynchronous ones requiring some times more than the expected three hours workload to complete, intellectual involvement, and thoughtful reflection in carrying out the asynchronous tasks was complementary to rich and divergent exchanges in the synchronous sessions, was strong and motivating for the teachers. Blended learning is largely learner centered and features technology-mediated learning which focuses on knowledge construction, authentic activities, and social interaction (Gerbic 2011). We consider that by their nature the integration of well-designed face-to-face, synchronous, and asynchronous activities enhance constructive work, and ownership of the tasks to be fulfilled.

Provision of support in blended models is an important issue. The support the teachers received for the classroom implementation of activities and scenarios was provided through distant guidance and feedback synchronous and asynchronous (Alayyar et al. 2012). We consider that the positive response of the teachers in the relevant item of the questionnaire means that instructor support for classroom applications can be provided effectively not only face to face but online too. Having said this we also consider that the success of the pilot implementation was influenced by the properly trained instructors, whose role will be the subject of another study.

Meikto seeks to exploit the advantages of face-to-face teaching conducted in classrooms or laboratories and those of synchronous or asynchronous distance learning, and to avoid their problems (Gerbic 2011; Keengwe and Kang 2012). Taking into account the complexity of the TPACK knowledge which is the object of B-Level professional development program, the above initial results are encouraging for the acceptance and outcomes of Meikto. However, the workload of synchronous sessions and even more the asynchronous activities should be reduced. We may cautiously note, taking into account the differences between these two studies, that the results from the face-to-face version of the B-Level program, which are reported in another study in this volume show that teachers' perceptions of

Meikto are at least as positive as and even more positive than the face-to-face implementation (Psillos and Paraskevas 2014). The implementation of the nation-wide phase of the program, which is in progress, will contribute to extending professional development of (science) teachers concerning the integration of ICT who would have been excluded from it without the wide application of the blended model, as noted in the introduction to this article.

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Part VI
Teachers' Views Towards ICT

Chapter 15
Factors Affecting Greek Kindergarten Teachers to Support or Oppose ICT in Education

Nicholas Zaranis, Vassilios Oikonomidis and Michalis Linardakis

Introduction

Computers have taken a permanent place in all levels of education, but their appearing in the classroom has not been without some concern; the future is not without challenges for both kindergarten teachers and students (Chen and Chang 2006; Fisher et al. 2012; Livingstone 2012; Pelgrum 2001). The integration of ICT in the educational practice of teachers is a very difficult process that requires time and continuous effort (Baron and Harrari 2005). However, we should consider that a teacher shows a very positive attitude towards ICT, not only by the occasional use of technology with students, but also by the creative use of ICT capabilities; as a result, that educational environment, in which it acts, can be changed.

Although the kindergarten learning environment has many unresolved issues regarding the use of computers, the fact remains that the first formal contact with ICT for many pupils begins at this educational level (Hatzigianni and Margetts 2012; Lim 2013; Morgan 2010). It is important to examine this environment in terms of how kindergarten teachers and students learn about and use computers. Kindergarten teachers are an important group to study because they are among the first to have an influence on how a child learns in the classroom. As a result, it is interesting to investigate the factors affecting the profile of Greek kindergarten teachers towards computers. In this article, the term "computers" is used as a synonym for the term ICT (Information and Communications Technology). This

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decision was based on the fact that the terms ICT and computers are defined and correlated similarly by researchers in the field of early childhood education (Stephen and Plowman 2003).

Theoretical Framework

Only a small amount of research has been done about the attitudes of kindergarten teachers towards ICT in Greece (Tsitouridou and Vryzas 2003, 2004). Research shows that there is a relationship between the attitudes of kindergarten teachers towards ICT and the types of computer training they had received. The teachers who had received computer training from a college or university appeared to have a more positive attitude than those who had received only in-service training or were self-taught (Angeli 2004; Chen and Chang 2006; Zaranis and Oikonomidis 2009). In addition, another research conducted with elementary school children indicates that ICT can have a positive impact on student learning only when teachers know how to use ICT properly to promote student thinking, expression, and knowledge building (Loveless and Dore 2002).

The researchers Yildirim (2000) and Pelgrum (2001) stated that kindergarten teachers teach the way they have been taught and it is unlikely that computer skills will be communicated to students and promoted by teachers unless the teachers have positive attitudes towards computer use. However, students graduating from universities have a better understanding of computers (Angeli 2004; Angeli and Valanides 2005). They view computers as just another part of their world and everyday life assuming they can be in full control of them (Kalogiannakis 2010; Ma et al. 2005).

The primary educational system in Greece consists of some 10,000 kindergarten classes and involves approximately 13,500 kindergarten teachers. It is not organized in such a way as to ensure effective professional development opportunities for kindergarten teachers (Kastis 2004). The Greek education system does not seem much in favour of in-service teacher training. Since a large proportion of Greek primary school and kindergarten teachers share the view that an allowance for teaching duties would make training programmes more attractive, it is crucially important for the education of teachers to be promoted through the proper organizations of in-service training (Saiti and Saitis 2006).

A historical development of the in-service training of kindergarten teachers in Greece, which is optional, shows that in-service training courses did not meet the practical needs of schools (Saiti and Saitis 2006). Some recent research studies in Greece (Minaidi and Hlapanis 2005; Jimoyiannis and Komis 2007) ascertain that the problems of educational systems are largely problems of the educators themselves, relevant to their vocational development, the level of their further training and postgraduate courses as well as the drawbacks of their basic training.

As part of the continuous training of teachers, the Greek Ministry of Education implemented a national training programme in ICT is known as "In-service teacher training in the use of ICT in education." This programme has been developed during the years 2002–2008 and the Ministry of Education has conducted workshops for primary and kindergarten teachers to be trained and familiarized with ICT. Broad participation of teachers was achieved due to different motives such as the supply of appropriate ICT equipment, and the certificate offering extra points in the case of evaluation. Then, in 2008, the extension of the previous programme was applied and is still in progress to date. This programme covers the pedagogical use of ICT and the participants would be able to use ICT for educational purposes in their daily practice in the classroom. Generally speaking, we must deal with two categories of kindergarten teachers, those willing to move ahead and those who only implement marginal changes; in-service training must address both categories (Kastis 2004).

Based on various findings regarding the attitudes of kindergarten teachers about the use of ICT in the classroom, teachers may be more easily negatively or positively influenced by their basic and additional studies, by their teaching experience and by their knowledge of the ICT. From the above factors only, knowledge and familiarity with ICT seems to have always consistently positive impact on kindergarten teachers for the introduction of ICT in education (Tsitouridou and Vryzas 2004; Zaranis and Oikonomidis 2009; Aubrey and Dahl 2008; Gialamas and Nikolopoulou 2010; Jimoyiannis and Komis 2007). The analysis in Zaranis et al. (2014) showed that there were three clusters of teachers according to their beliefs towards ICT. In order to further examine the differences between the two extreme clusters, we use the two extreme groups, namely "negative attitude towards ICT" (NA) and "supporters of ICT in education" (S). This study seeks to examine the following research questions:

(1) Does the classification of kindergarten teachers include two extreme categories according to their attitudes about ICT use in the class?
(2) Does the kind of bachelor studies, the nature of additional studies, number of in-service years and/or the level of software and ICT knowledge of kindergarten teachers help classify them as supporters of ICT?

Indeed, the attitudes of kindergarten teachers towards computers may assist students in learning adequate computer skills and improving their education (Shields and Behrman 2000; Sime and Priestley 2005). As a result, a study of kindergarten teachers' attitudes and the main factors affecting them becomes more important and we expect to verify our research questions in accordance with similar researches (Tao and Rosa Yeh 2008; Tondeur et al. 2007). This research will help us better understand the variables that contribute to the formation of attitudes of two extreme opposing groups of Greek kindergarten teachers towards computers.

Method

The present research was carried out during the year 2012, used kindergarten teachers as participants and is an extension of the analysis of a previous survey (Zaranis et al. 2014). The purpose of the study was to find out which variables significantly influence the probability of a kindergarten teacher to belong to one of the two extreme groups: “negative attitude towards ICT” or “supporters of ICT in education”.

Research Design

The present research attempts to discover and understand in deep the main factors affecting the attitudes of Greek kindergarten teachers towards computers. It was performed through a quantitative research experiment carried out in 2012. The questionnaire was answered by kindergarten teachers who served in public kindergartens located in the areas of Athens and Crete (Greece).

In the analyses of a previous work, the study was performed on 678 kindergarten teachers from the areas of Athens and Crete (Greece) and their attitudes towards ICT were examined. Then, a factor analysis was used to extract the principal components of early childhood teachers’ attitudes on the 30-item questionnaire items. In the end, a total of five factors emerged, which together explained the 59.75 % of the total variance (Zaranis et al. 2014). In the sample of 678 kindergarten teachers, the k-means clustering algorithm was then applied to obtain three distinct classifications for kindergarten teachers which were further named according to the final cluster centre position. In the current analysis, the two extreme groups, namely “negative attitude towards ICT” (NA) and “supporters of ICT in education” (S), are used in order to examine the factors which classify kindergarten teachers as supporters or opponents of ICT. These two selected groups consisted of 418 kindergarten teachers from the areas of Athens and Crete (Greece), which is our sample size in the analyses thereafter, and their attitudes towards ICT were examined during the year 2012. All the kindergarten teachers served in public kindergarten schools during the year 2012 in the same areas (Athens and Crete). The vast majority of kindergarten teachers in the sample were women.

Materials

During the research, a questionnaire was generated to collect kindergarten teachers’ attitudes towards ICT in the classroom. The questionnaire consisted of thirty questions (Table 15.1). The questions were measured with a 5-point Likert scale ranging from 1 (extremely disagree) to 5 (extremely agree). Demographic data of kindergarten teachers such as educational background, training, gender and ICT

Table 15.1 Questionnaire items of the kindergarten teachers' attitudes

No	Question description
	2.1 ICT may be used in kindergarten for:
1	preparation and planning of teaching
2	creation of supervisory and teaching material
3	teaching process
4	performing administrative tasks
	2.2 The use of ICT in kindergarten affects the all-around growth of children:
5	undermining their social/emotional development
6	reduces psychomotor development
7	improves linguistic capabilities
8	improves concepts of space
	2.3 The use of ICT in teaching:
9	facilitates the conduct of teaching and the achievement of its objectives
10	renews the teaching process
11	can be applied to all areas of the curriculum
	2.4 The use of ICT by children in kindergarten:
12	enhances their imagination and creativity
13	provides possibilities for their own initiatives
14	respects their personal learning rhythm
15	promotes their active participation in learning
16	does not allow student cooperation
	2.5 The following objectives of the programme Children and ICT of the Cross-Thematic Curriculum Framework (CTCF) may be achieved in the kindergarten:
17	computers are a means of communication, work and entertainment
18	recognition of computer peripherals
19	the use of the keyboard and mouse
20	the creation of drawings and paintings
21	the use of CD-ROMs as a teaching material
22	the use of exploration games and problem-solving
23	the recognition of correct body position and rules when working with computer
	2.6 The introduction of ICT in kindergarten:
24	removes the dominant role from kindergarten teachers during the teaching process
25	reduces communication between other students and kindergarten teachers
26	reduces the prestige of kindergarten teachers towards students
	2.7 The introduction of ICT in kindergarten depends on the following factors:
27	adequacy of the kindergarten's area
28	appropriateness of technological equipment
29	interest of kindergarten teachers
30	training of kindergarten teachers

knowledge were collected through the same questionnaire, as well as their willingness to accept and to use ICT in education as an instructional alternative.

The questionnaire was answered by 678 kindergarten teachers in total, but as we mentioned above in our survey 418 questionnaires were used. The Cronbach's alpha was 0.922 for the questionnaire research, which demonstrates a high reliability. The questionnaire took about fifteen minutes to complete.

Results

This study took an exploratory approach to investigate the factors and the profiles of kindergarten teachers on various characteristics of their attitudes towards ICT in the classroom. Also, we examine the probability of a kindergarten teacher to belong to one of the two extreme groups: "negative attitude towards ICT" (NA) and "supporters of ICT in education" (S). This was done by using statistical tools of factor analysis to classify the corresponding attitudes of kindergarten teachers (Hair et al. 1998).

The factor analysis extracted five factors of kindergarten teachers' attitudes. Each factor was named to reflect a common higher level group constructed of those questions that related to the same factor. Factor one, which included 12 question items, regards to how computers help children universally in the teaching process resulted with a Cronbach's alpha of 0.895. Seven question items, in relation to the use of computers by the pupils as cognitive tool, made up the second factor which resulted in a high Cronbach's alpha of 0.908. The third factor included three question items concerning the changes caused by the computer on the role of the kindergarten teacher in the classroom; with a Cronbach's alpha of 0.844. Four questions examining whether kindergarten teachers use the computer only to organize their administrative work constituted the fourth factor; with a Cronbach's alpha of 0.754. The fifth factor had a Cronbach's alpha of 0.737 and was composed of four question items regarding the conditions under which the computer may integrate into the kindergarten classroom.

Moreover, cluster analysis was done in order to specify the type of kindergarten teachers towards ICT. The three clusters created from the cluster analysis for early childhood teachers were: (a) cluster one: the neutral early childhood teachers; (b) cluster two: the sceptic early childhood teachers; and (c) cluster three: the optimistic early childhood teachers (Zaranis et al. 2014). From these clusters, we use the two extreme groups, namely "negative attitude towards ICT" (NA) and "supporters of ICT in education" (S) in order to examine the factors which classify kindergarten teachers as supporters or opponents ICT.

Kindergarten teacher with negative attitude towards ICT (43.3 %): This type gives great importance to the conditions of introducing computers in the classroom, as shown in Table 15.2.

Table 15.2 Final cluster centres

Factor	Cluster	
	1	2
F1: how computer helps the child universally in the teaching process?	2.91	4.00
F2: the use of computers by the pupils as cognitive tool	3.81	4.58
F3: the changes caused by the computer on the role of the kindergarten teacher in the classroom	2.59	4.12
F4: kindergarten teachers use the computer only to organize their administrative work	4.11	4.61
F5: the conditions under which the computer may integrate into the kindergarten	4.38	4.66

The supporters of ICT in education (56.7 %): This type is the holistic model of kindergarten teachers in ICT. They are stronger believers and supporters of ICT in education. For the various statistical analyses required for this study, the SPSS Statistical Software, version 21, was used.

Descriptive Statistics

The vast majority of kindergarten teachers in the sample (418 participants) were women. Over 76 % of them had a second degree or formal training in educational methods. Also, less than 45 % of them graduated from public universities with 4-year studies and nearly 55 % received their first degree through 2-year non-university studies. In addition, more than 42 % of them have 1–10 in-service years, less than 28 % have 11–20 years, and less than 30 % have from 21 to 35 in-service years. Furthermore, approximately 21 % of them have higher levels of software and ICT skills, 53 % intermediate level and 26 % at the basic level or the lowest level of ICT knowledge (Table 15.3). Then, the logistic regression analysis was carried out in order to determine the factors affecting the kindergarten teacher belonging to one of the two extreme groups.

Binary Logistic Regression Analysis

It was mentioned above that the analysis of a previous study (Zaranis et al. 2014) showed there were three clusters of teachers according to their beliefs towards ICT. In order to further examine the differences between the two extreme clusters for comparison and prediction purposes, we used the two groups, namely "negative attitude towards ICT" (NA) and "supporters of ICT in education" (S), as the dependent variable in a binary logistic regression model. The explanatory variables of the model were (a) the kind of bachelor studies, (b) the kind of additional studies,

Table 15.3 Descriptive statistics of factors affecting kindergarten teachers to be supporters or opponents ICT

Factor	f	%
Kind of bachelor studies		
Two years degree	231	55.3
Four years degree	187	44.7
The nature of additional studies		
None	99	23.7
Additional educational training, seminars, etc.	179	42.8
Additional bachelor degree, MSc., PhD	140	33.5
In-service years		
1–10 service years	177	42.3
11–20 service years	116	27.8
21–35 service years	125	29.9
Level of software and ICT knowledge		
None	78	18.7
Basic	29	6.9
Medium	222	53.1
Advanced	89	21.3

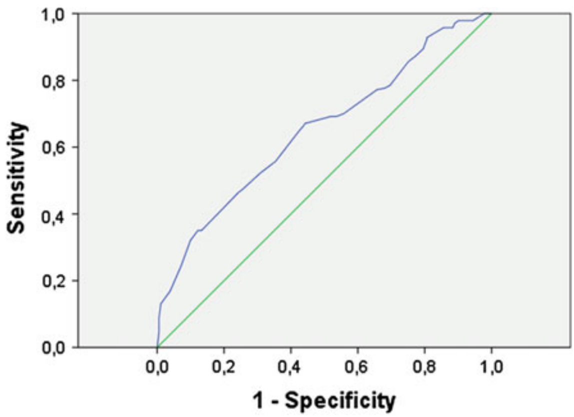

Fig. 15.1 ROC curve of the estimated probabilities that a teacher belongs to S group

(c) the number of in-service years (3 groups) and (d) the level of software and ICT knowledge (4 levels). The aim of the analysis was to find out which explanatory variables significantly influence the probability of a teacher to belong to one of the two extreme groups, NA and S (i.e. to find the profiles of the two groups).

The kind of bachelor studies was removed from the model as non-significant, based on a likelihood ratio backward stepwise procedure. The ROC curve of the estimated probability that a teacher belongs to S group, according to the final model, is given in Fig. 15.1.

Table 15.4 Parameter estimates, standard errors, Wald statistic and odds ratios of the logistic regression model

Variable	B	S.E.	Wald	df	p-value	Odds ratio
Additional studies			8.882	2	0.012	
Additional studies = 1 (ref. category NONE)	0.596	0.266	5.009	1	0.025	1.815
Additional studies = 2 (ref. category NONE)	0.852	0.291	8.544	1	0.003	2.344
In-service years			8.800	2	0.012	
In-service years = 1–10 (ref. category 21–35)	0.762	0.257	8.766	1	0.003	2.143
In-service years = 11–20 (ref. category 21–35)	0.474	0.274	2.990	1	0.084	1.606
Level of software knowledge			14.881	3	0.002	
Level = basic (ref. category None)	−0.432	0.461	0.879	1	0.349	0.649
Level = medium (ref. category None)	0.261	0.276	0.898	1	0.343	1.299
Level = advanced (ref. category None)	1.075	0.346	9.672	1	0.002	2.929
Constant	−1.040	0.330	9.952	1	0.002	0.353

The area under the ROC curve is 0.651 (p value < 0.01, under the null hypothesis that the true area is 0.5), indicating that the predictive strength of the model is significant. Table 15.4 shows the estimated coefficients and the odds ratios of the final logistic model.

The variables "additional studies", "in-service years" and "level of software and ICT knowledge" are statistically significant. According to the results, teachers with additional studies of category 2 (additional bachelor degree, M.Sc., Ph.D. studies, etc.) have 2.3 times higher probability, compared to those with no additional studies, to belong to group S than to group NA. In addition, teachers with additional studies of category 1 have 1.8 times higher probability, compared to those with no additional studies, to belong to group S than to group NA.

With regard to in-service years, those with 1–10 in-service years have 2.1 times higher probability, compared to those with 21–35 in-service years, to belong to group S than to group NA. Moreover, teachers with 11–20 in-service years have 1.6 times higher probability, compared to those with 21–35 in-service years, to belong to group S than to group NA.

Furthermore, higher levels of software and ICT knowledge increase the probability of a teacher to belong to S group than to NA group, as it was expected. In specific, an advanced user has 2.9 times higher probability, compared to a teacher with the lowest possible level of ICT knowledge, to belong to group S than to group NA.

Discussion

The result of the cluster analysis produced three level profiles of ICT with characteristics similar to our initial conceptualization from the literature review (Angeli 2004; Chen and Chang 2006; Kumar and Kumar 2003; Tao and Rosa Yeh 2008; Tsitouridou and Vryzas 2003, 2004; Yildirim 2000). Two of them have extreme characteristics:

The cluster of kindergarten teachers with negative attitude towards ICT was the smallest of the two groups (43.3 %). These teachers were aware of the major issues regarding ICT in education and were unsure of how these issues might play an important role in the future. These teachers were not exactly sure of the adaptation and administrative work of kindergarten teachers' challenges brought forth by implementing ICT in education. They do not care too much about the use of computers by students as a cognitive tool. Also, this group of teachers expresses high support on the conditions under which the computer may integrate into the classroom. These conditions are mainly the adequacy of space in the classroom, the suitability of technological equipment and educational software, technical support, their own knowledge about the introduction of computers in teaching process. The above terms are crucial for the integration of ICT in school (Aubrey and Dahl 2008; Hinostroza et al. 2013). Thus, this group was assigned to the sceptic kindergarten teacher profile. Moreover, they questioned ICT's ability to produce quality education and learning outcomes (Kalogiannakis 2010; Shade and Davis 1997; Tsitouridou and Vryzas 2004; Zaranis and Oikonomidis 2009).

The most considerable group of kindergarten teachers is the supporters of ICT in education (56.7 %). These teachers were stronger believers and supporters of ICT in education. This group is characterized by the fact that computers can be used by kindergarten teachers and children across the spectrum of activities in kindergarten and affects the teaching process and the role of kindergarten classroom. Thus, this category was assigned to the optimistic kindergarten teacher profile. They were positive about the changes caused by the computer on the role of the kindergarten teacher in the classroom and ICT's learning effect (Loveless and Dore 2002; Pelgrum 2001; Yildirim 2000). The above findings support the first research question.

Furthermore, the results of the factor analysis produced five factors of the attitudes of kindergarten teachers towards ICT as mentioned above (Table 15.2). In addition, we found that the kind of bachelor studies did not significantly positively or negatively affect the attitudes of kindergarten teachers towards ICT in the classroom. These findings suggest that the degree courses which have been taken many years ago did not affect the attitudes of teachers towards modern educational innovations. On the contrary, other factors that are closest in time strongly influence their attitudes. It also mentioned that ICT courses of undergraduate studies of teachers are often isolated from the application of ICT in teaching process and they do not affect them sufficiently positive towards this direction (Willis and Raines 2001; Tsitouridou and Vryzas 2004; Zaranis and Oikonomidis 2009). The additional studies of kindergarten teachers such as an additional bachelor degree, M.Sc. and Ph.D. studies significantly affect them to be supporters about computers in education. Obviously, during these additional studies, teachers acquired knowledge and experiences on the implementation of ICT in education, which led them to develop positive attitudes towards ICT. Also the kindergarten teachers with up to 20 in-service years have higher probability to belong with the supporters of ICT. These teachers obviously belong to the younger age generation and they have a better familiarity with computers, which explains their positive attitude towards the introduction of ICT into teaching process (van Braak et al. 2004; Bebell et al. 2004; Inan and Lowther 2010; Bingimlas 2009; Robinson 2003; Snoeyink and Ertmer 2001). Furthermore, kindergarten teachers with higher levels of software and ICT knowledge are significantly more likely members of the supporters integrating computers in the teaching process. It is obvious that this good knowledge of computer use gives confidence to kindergarten teachers to integrate ICT in the educational process, as has been confirmed in several studies (Petrogiannis 2010; Sorgo et al. 2010; Tsitouridou and Vryzas 2003, 2004; Yildirim 2000; Zaranis and Oikonomidis 2009). Generally, all the above characteristics are similar to our initial conceptualization from the literature review (Angeli 2004; Chen and Chang 2006; Kumar and Kumar 2003; Lim 2013; Tao and Rosa Yeh 2008; Tondeur et al. 2007; Tsitouridou and Vryzas 2003, 2004; Yildirim 2000; Zaranis and Oikonomidis 2009). If we disregard the kind of bachelor studies of kindergarten teachers, our findings show that the second research question was answered positively.

Overall, the findings of our research indicate on the one hand the variegation of kindergarten teachers in the introduction of ICT in education and on the other the different effects of various factors (degree, additional studies, in-service experience, ICT knowledge) to the formation of their attitudes (Tsitouridou and Vryzas 2004; Zaranis and Oikonomidis 2009; Aubrey and Dahl 2008; Petrogiannis 2010; Gialamas and Nikolopoulou 2010; Jimoyiannis and Komis 2007). We believe that the differences are presented on the effect of the above factors related to the quality of undergraduate and additional studies, and the experiences of innovation in their educational career. Therefore, future research should investigate the qualitative elements of these factors.

The above discussion should be referenced in the light of some limitations of this study. The first limitation of this study is that data were collected only from the cities of Athens and the island of Crete (Greece). The second limitation is the generalizability of this study which was limited specifically to participants attending public schools. Therefore, the results from this research can be generalized only to similar groups of kindergarten teachers. The results may not adequately describe kindergarten teachers from other regions of Greece.

We believe enhancing the knowledge and experience of kindergarten teachers in educational theories and practices could be an effective way to influence their attitude towards using ICT in education.

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Chapter 16
Differences in Attitudes Towards ICT in Education Between Freshmen and Senior Students of Department of Primary Education in Greece

Ioannis Vourletsis and Panagiotis Politis

Introduction

For more than a couple of decades, international and local authorities in educational planning have promoted the equipment of school units with computers. At the same time, they have encouraged the creative use of computers in the learning process. Their efforts have been endorsed by international organizations, such as the European Union, the Organization for Economic Co-operation and Development (OECD) and by international fora, such as the Lisbon Recognition Convention. All these organizations have provided relevant material and instructions. However, research data from various countries have shown that the incorporation of ICT in educational systems has been overfunded without bringing the expected results: it did not revolutionize education as anticipated, while in many cases, the relevant equipment remained underutilized (European Schoolnet and University of Liège 2013; Harrison et al. 2002; Lawless and Pellegrino 2007; Paraskeva et al. 2008; Weston and Bain 2010; Komis 1997; Tsivas 2011).

Despite the various educational policies and decisions, the educator plays a primary role in the adoption and development of any educational innovation; for this reason, she/he is considered to be the most important factor in educational reforms (Agyei and Voogt 2011; Albirini 2006; Teo 2008). It is not that she/he excludes ICT from the learning process, but she/he does not perceive it as “an empty vessel into which this externally defined innovation must be poured” (Watson 1998: 191, in Albirini 2006: 375).

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The attitude of prospective teachers towards computers influences to a great degree their willingness to incorporate ICT as a teaching tool. For this reason, the teachers' attitude towards computers has been characterized by many scholars as a "key factor" in the successful incorporation of ICT in the school classroom (Agyei and Voogt 2011; Meelissen 2008; Wang 2002). ICT is a rather particular case of innovation: its use requires more than a simple acquisition of technology-related skills on the part of educators; above all, it presupposes a change in the teaching process informed by the new pedagogical principles (Saye 1998; Woodrow 1987, in Sabzian and Gilakjani 2013: 70).

Attitudes Towards ICT in Education

The term "attitude" designates an individual's sum of views in relation to a specific subject. According to Georgas (1995), the attitude towards an object, an idea or a person is construed as a constant system with a cognitive and an emotional aspect, as well as with a tendency to behavioural expression.

Like any other set of views, attitudes towards ICT constitute a multifaceted variable. In 1993, Kay presented a theoretical frame for the assessment of the attitudes towards computers. His theory was based on a threefold distinction of attitudes that recognizes the cognitive, the emotional and the behavioural component. Kay's work, a host of other theoretical models developed for the assessment of attitudes as well (e.g. Christensen and Knezek 2002, 2008; Selwyn 1997; Van Braak 2001), study, in particular, attitudes concerning computer anxiety, the teachers' confidence in computer-related skills, the usefulness of computers in education, the knowledge around computer use, the negative effects, the general approval or disapproval and the teachers' intention of using technological tools. Last but not least, attitudes relate to various variables-demographic characteristics of the research subjects, such as the year of studies, their age, their gender and the years they have been exposed to computer use.

Research that has been carried out over the last years has indicated that a large amount of prospective teachers bears a positive attitude towards ICT in education. For instance, Yuen and Ma (2002) record positive attitudes towards computers and more specifically towards their usefulness in education. They also report an increased intention concerning the future use of computers. Similar conclusions have been drawn by Teo (2008) and by Sang et al. (2010) who carried out a large-scale research: All the above scholars confirm that prospective teachers not only display a positive attitude towards ICT, but also endorse modern views in teaching methods and a rather enhanced confidence in their ability to teach successfully using ICT.

Research has also shown that the teachers' opinion on the degree of usefulness of ICT constitutes a defining factor in the use of ICT as an educational tool (Al-Ruz and Khasawneh 2011; Cox et al. 1999; Smarkola 2008). Ma et al. (2005) have processed the questionnaires of prospective teachers in Sweden and have reached the conclusion—among others—that the subjects' perception of the usefulness of a technological means defines to a large degree their intention to incorporate it in their own future teaching.

According to Pamuk and Peker (2009), computer anxiety constitutes the most significant aspect of attitudes towards computers. These researchers also point out the tendency of teachers who experience this unsettling feeling tends to display an overall negative attitude towards computers and avoid their use. On the other hand, low levels of computer anxiety are associated with a large possibility of ICT incorporation in education, as recent research (Rogers and Wallace 2011; Rovai and Childress 2003) conducted on prospective teachers shows.

Other researchers, such as Al-Oteawi (2002, in Albirini 2006), contend that most of the teachers who exhibit a negative or neutral attitude towards the use of ICT in education actually lack the knowledge around computers and the relative skills that would allow them to incorporate ICT in the teaching process. The same conclusions have been reached by other scholars such as Looney et al. (2004) and Hernandez-Ramos (2005) who conducted research in a sample of prospective students in the USA. These studies have shown that confidence of one's skills in computer use wields decisive influence on the ICT incorporation in the teaching and learning process.

In addition, the views of prospective teachers have been found to be different towards the end of their studies from what they used to be at the beginning (Beacham and McIntosh 2012). In fact, they appear to be more positive at the end (Baron and Bruillard 1997). The most dominant of the various factors that either influence the formation or change of attitude is the presence of university professors as role models: Professors can impart knowledge to their students, enhance their confidence and, thus, contribute to the change or formation of their attitudes (Barton and Haydn 2006; Brown and Warschauer 2006; Bullock 2004; Kariuki et al. 2001, in Goktas et al. 2009; Zhao and Frank 2003).

The prospective teachers' mentors do also play a very important role in the process of attitude formation. These people are the actual teachers working in the line of duty and supervising the students during their period of practice. Mentors provide valuable instructions, advice and feedback on practical issues (Maphalala 2013; Philippou and Charalambous 2005). In any case, the period of practice—which functions as a preparatory stage for prospective teachers—may also affect the students' views on teaching issues: Grootenboer (2006) traces such influence in relation to the teaching of mathematics while Yilmaz and Huyugüzel-Çavaş (2008) trace it in classroom management issues.

The Current Research

The aforementioned significance of attitudes for the incorporation and use of ICT in education as well as the lack of relevant research on the specific subject in our country constitute the main reasons that have motivated the current study. The kind of approach followed is quantitative, and the research project has adopted the characteristics of a comparative study focusing on the comparison of attitudes towards the use of ICT in education between freshmen and senior students of the Department of Primary Education of the University of Thessaly in Greece.

The Research Objectives

The objectives of the research are the following:

1. The examination of possible differences in the degree the freshmen and the senior students deem ICT important as a teaching tool as well as the possible differences in their attitudes towards ICT in education.
2. The examination of a possible relation among the variables concerning the students' attitudes towards ICT in education.
3. The examination of the factors that influence the attitudes, feelings and kinds of behaviour of senior students as well as the exploration of the kind of change such influences have provoked.

The Research Sample

The research sample was collected from first-year and fourth-year male and female students of the Department of Primary Education of the University of Thessaly. The number of students who answered our call for voluntary participation in the research offered a sum of 186 valid questionnaires. A total of 158 of these questionnaires came from female subjects and the remaining 28 from male ones (a percentage of 85 and 15 %, respectively).

The Research Tools

A questionnaire based on existing tools was developed for the exploration of the attitudes of the students of the Department of Primary Education of the University of Thessaly. These supportive tools were first checked for their reliability and validity (Christensen and Knezek 1998; Sang et al. 2010; Teo 2008).

The question-suggestions of the questionnaire were rendered in a positive or a negative way. The participants were asked to express their consent or dissent with respect to each of the questions by rating them on a 5-rank scale. Number one of this scale denoted absolute disagreement with the content of the question, while number five stood for absolute agreement.

The employed tools related to a host of issues: the participants' attitudes towards the necessity of computers as teaching tools, the degree of control, anxiety and tension during computer use, the attitudes towards the importance and the role of ICT in contemporary education, the attitude towards teacher–pupil interaction and pupil–pupil cooperation in the classroom in the case of a consistent use of computers in the teaching and learning process and the intention of prospective educators to adopt ICT in their future teaching assignments. The tools displayed an increased degree of reliability in the current study as the values of Cronbach's alpha, as a tool for assessing the reliability of scales, were more than 0.8 for all the tools.

Last but not least, the questionnaires distributed to the senior students also included the assessment of factors that incited them to change attitude towards ICT in education as well as the direction this change was channelled to. The specific factors were defined by a team of students who did not participate in the research. This team consisted of eight students and the head researcher and took part in a focus group discussion that lasted 45 min. Generally speaking, a focus group discussion is a good way to gather together people from similar backgrounds or experiences to discuss a specific topic of interest or describe similar experiences using a common language. This particular discussion revolved around ICT and its use in education and was organized in accordance with a predetermined interview guide. Eventually, it led to the recording of a host of factors, the most important of which are presented below.

Results

Differences as to the Participants' Year of Study

The examination of the hypothesis based on the t value concerning the difference of the average rates in the variables of the attitudes between freshmen and seniors initially showed that the freshmen of the Department deem the contribution and the existence of ICT in education more important than seniors do. In fact, the latter do not consider ICT to be that significant [$t(184) = 6.327$, $p < 0.001$]. Both groups perceive computers as rather useful teaching tools, even though freshmen appear to believe more in the usefulness of computers in their teaching in comparison with their fourth-year colleagues [$t(184) = 5.286$, $p < 0.001$] (Table 16.1).

A not statistically significant result ensued from the examination of the difference of the average rates of the variable of computer control (perceived comfort level or difficulty of using computers) between freshmen and seniors [$t(184) = -1.387$, $p = 0.167$]. However, the examination of the difference of the average rates of the subscale of computer anxiety, which did not display an equal distribution for the two groups if assessed in relation to the Mann–Whitney criterion (U), has indicated that this difference is statistically significant [$U(94.92) = 3314.500$,

Table 16.1 Differences in the average rates between the two different groups (first-year and fourth-year students) in the variables of the attitudes

Variables	Year of studies	Mean	Standard deviation	t
Teacher–pupil interaction and cooperation among pupils	First	3.19	0.49	−1.163
	Fourth	3.27	0.53	
Control during computer use	First	3.34	0.69	−1.387
	Fourth	3.47	0.66	
Intention of ICT incorporation in their future teaching assignments	First	3.15	0.52	6.045**
	Fourth	2.67	0.56	
Usefulness/necessity of computer as teaching tool	First	3.69	0.53	5.286**
	Fourth	3.30	0.47	
Importance and role of ICT in education	First	3.73	0.42	6.327**
	Fourth	3.31	0.49	

Note $^{**}p < 0.01$

$p = 0.006$]. In this case, freshmen admit to being more "stressed" during computer use. In all the other variables of the attitudes, there were not statistically significant differences observed.

Differences have also accrued between freshmen and senior participants with respect to their attitudes towards the necessity of computer as a teaching tool. As it became obvious, a percentage of 62 % of the sum of seniors does not consider computer to be a useful tool for their teaching, while the same attitude is displayed by just the one-fourth of the freshmen sample (25.5 %). On the contrary, it is just a 3.3 % of the seniors that perceives the computer as an indispensable part of their teaching, while the relevant percentage in freshmen is 22.3 %. The examination of the independence of the variables with the χ^2 test has shown that the attitude towards the necessity of computer as a teaching tool differs in a statistically significant degree between freshmen and seniors of the Department [$\chi^2(2) = 30.494$, $p < 0.001$]. Moreover, the rate of Cramer's V value ($\varphi_c = 0.405$) has indicated that there is a strong correlation between the variables of computer necessity as a teaching tool and the year of the studies the participants were in.

In relation to the participants' intention to incorporate ICT in their future teaching assignments, the statistical analysis and the respective mean values have shown that freshmen are more willing to incorporate computer in their future teaching in comparison with their fourth-year colleagues. The latter appear to be rather negative in an average degree, and the difference of the two groups is statistically significant [$t(184) = 6.045$, $p < 0.001$].

Correlations Among the Variables of the Attitudes

Despite the fact that there have been quite a few statistically significant correlations among the variables, the rate of the Pearson (r) and the Spearman (rho) correlation

Table 16.2 Correlations between the variables of attitudes

Variables	1	2	3	4	5	6
1. Interaction	–	0.229^{**}	0.383^{**}	0.301^{**}	-0.257^{**}	0.424^{**}
2. Control	–	–	0.092	0.089	-0.586^{**}	0.020
3. Intention	–	–	–	0.521^{**}	−0.068	0.696^{**}
4. Usefulness	–	–	–	–	−0.029	0.528^{**}
5. Anxiety (*Spearman's rho*)	–	–	–	–	–	−0.126
6. ICT in education	–	–	–	–	–	–

Note $^{**}p < 0.01$

indicator has shown that the intensity of the correlation was not powerful enough in all the cases. Two of the most strong correlations observed are the ones between the variable of the participants' intention to incorporate ICT in their teaching and the variables of the usefulness of computer as a teaching tool [$r(184) = 0.521$, $p < 0.001$] and the role of ICT in contemporary education [$r(184) = 0.696$, $p < 0.001$]. The correlations were positive: high rates in the variables were coupled by a strong intention on the part of the participants to incorporate ICT in their teaching.

There is also a statistically significant correlation of a medium degree emerging from the variables of the attitude towards the usefulness of computers and the attitude towards the necessity and the role of ICT in education [$r(184) = 0.528$, $p < 0.001$]. The control variable has indicated a statistically significant negative correlation with the variable of computer use anxiety [$\text{rho}(186) = -0.586$, $p < 0.001$] to a rather satisfactory degree.

One last interesting point is the discovery of a statistically significant positive correlation between the variable of the inter-class interaction when ICT is consistently used in the classroom with all the other attitude variables (See Table 16.2), i.e. the usefulness and general opinions concerning ICT as a teaching tool, the anxiety and the control of its use as well as the intention of ICT incorporation in the teaching and learning process.

Factors Leading to Attitude Change

Reaching the part of the questionnaire that was intended only for them ($N = 92$), the fourth-year participants noted down the factors that had incited them to change attitude towards ICT in education during their years of studies. Moreover, they elaborated on the direction such changes were channelled to.

The statistical analysis of the answers (See Table 16.3) has indicated that the most influencing factor over the participants' attitudes towards ICT in education is associated with the viewpoints of the Department professors who teach relevant courses. The major part of the seniors (50 out of 83, that is a percentage of around 60 %) was influenced by the views of their professors and led to a less positive

Table 16.3 Factors that affect the attitude of prospective teachers and the direction of such changes

Factors	Frequency (relative frequency)	Increase in positive attitude	Decrease in positive attitude
Views of Department professors teaching ICT courses	**83 (90 %)**	**33** (40 %)	**50** (60 %)
Teaching experience I acquired in the process of teaching practice in the various schools	**71 (77 %)**	**49** (69 %)	**22** (31 %)
Instructions/advice by supporting teachers during my teaching practice period	**69 (75 %)**	**68** (99 %)	**1** (1 %)
ICT use by my professors in the teaching of their academic courses	**65 (71 %)**	**53** (82 %)	**12** (18 %)
Discussions with fellow students	**54 (59 %)**	**39** (72 %)	**15** (28 %)
Content of the official school curriculum	**51 (55 %)**	**39** (76 %)	**12** (24 %)

attitude towards ICT and the necessity of its use in education. At this point, we need to highlight that only two professors teach ICT-related courses at the Department from which the sample was taken and one of them adopts a more critical attitude towards the use of ICT in education. The statistical analysis showed that, compared to the other professor's students, the students of the professor who seems to foster more critical views display a less positive attitude towards the use of ICT in education to a statistically significant degree [$t(90) = 2.001$, $p = 0.048$]. That prospective teachers' "less positive attitude", therefore, is regarded as a "less uncritically positive attitude" which entails a "more critical attitude" towards the use of ICT in education.

Moreover, the teaching experience the participants acquired during their period of practice played also an important role in the formation of their attitudes. For the 70 % of the seniors, this experience led to a more positive attitude towards ICT in education. An equally important factor shaping the attitudes of the prospective educators was the sum of instructions and advice provided by supportive teachers–mentors during the seniors' period of teaching practice. In this case, the influence led almost exclusively to positive attitudes (99 %) in regard to the use of ICT in the educational process.

Similar conclusions were drawn regarding ICT use on the part of Department professors for the teaching of their academic courses. The frequency of this factor corresponded to an amount of 65 subjects in a sample of 92 fourth-year participants, while only one in every five seniors (18 %) formed a less positive attitude due to the influence of the aforementioned factor. The various discussions the 92 seniors had held with other students influenced 54 of them and enhanced the already positive attitude they had in most of the cases. In fact, only 15 prospective teachers out of the 54 (28 %) formed a less positive attitude after discussions with their colleagues.

The content of the Official School Curriculum constituted the less influencing factor for seniors since only half of them ($N = 51$) were affected by it in regard to their attitudes towards ICT. However, this influence led in most cases to a more positive attitude ($N = 39$ or 76 %).

Conclusions

The survey results presented above lead to a series of conclusions that answer the initial questions of this study to a satisfactory degree. Interestingly, they also raise new ones.

The attitudes of prospective teachers towards computer as a teaching tool definitely differ between freshmen and seniors. The former—in their biggest part—deem the computer an indispensable or very important teaching tool. With no intention to underestimate the usefulness of computers for the teaching of several subjects, the latter maintain that, in most cases, its use is not necessary for the accomplishment of teaching objectives. In addition, freshmen perceive the computer as a more useful teaching tool than seniors do. The difference between the participants of the two groups with respect to the importance and necessity of consistent ICT use in contemporary education was also statistically significant. First-year students displayed a much more positive attitude in comparison with their fourth-year colleagues who appear to have a more sceptical but still positive attitude on the relevant issue. The difference between the two groups corroborates various surveys which support that there is a difference between the attitudes of prospective teachers during the beginning and the end of their studies (Beacham and McIntosh 2012). At the same time, however, our results contradict studies which show that attitudes are actually more positive towards the end of the participants' studies (Baron and Bruillard 1997).

The participants' intention to incorporate ICT in their future teaching was also different between the beginning and the end of studies: the freshmen are more willing to incorporate computers in their future teaching in comparison with their senior fellow students. Actually, the attitude of the fourth-year students is considered to be more critical as it takes into account social, cultural and educational perspectives related to ICT use. Nonetheless, the first-year students appeared to a statistically significant degree to be more "stressed" when it came to computer use in comparison with seniors. This attitude probably accrues from the fact that freshmen have not been exposed to many chances to use ICT in the University up until that point.

The second research objective focused on the correlations among the variables of the students' attitudes. Strong correlations were observed between the variable of the participants' intention to incorporate computers in their teaching and the variables of the ICT usefulness as a teaching tool and the ICT role in contemporary education. This correlation has stimulated the interest of many researchers (Al-Ruz and Khasawneh 2011; Ma et al. 2005; Yuen and Ma 2002).

However, no correlation was recorded between the variables of computer anxiety and control and the one concerning the participants' intention to incorporate ICT in their future teaching, as evident from the findings of the various surveys (Hernandez-Ramos 2005; Looney et al. 2004; Rogers and Wallace 2011; Rovai and Childress 2003).

Moving on to the third objective, we can observe that the most powerful influencing factor over the attitude of prospective teachers towards ICT in education ($N = 83$ or 90 % of the participants) relates to the viewpoint of their department professors who teach ICT-related courses. A great influence ($N = 65$ or 71 %) was also wielded by the professors' use of ICT in the teaching of their academic courses. This finding underscores the significance of the role of university professors in the effective training of prospective teachers and the meaningful exploration of ICT potential in teaching and learning. The importance of the above factors was also highlighted by Barton and Haydn (2006), while other researchers also point to the prospective teachers' need to be exposed to appropriate kinds of behaviour—models during their studies (Brown and Warschauer 2006; Bullock 2004; Kariuki et al. 2001 in Goktas et al. 2009: 201).

Nonetheless, the fact that a big part of the participating students has been led to adopt a less positive and at the same time more critical attitude towards ICT use due to the influence of their ICT-course professors can be construed on the following basis: in these cases, the professors chose to foreground the possibility for accomplishment of the teaching objectives in most primary school subjects without the use of ICT and also discussed the risks involved in an uncritical ICT incorporation in the classroom which can be usually regulated by external factors. On the other hand, the students who were also influenced by ICT-course professors but adopted a more positive attitude towards ICT were exposed to less critical or absolutely non-critical opinions expressed by their professors.

The participants' teaching experience at schools during their period of teaching practice affected the 77 % of the seniors ($N = 71$) and contributed to the formation of more positive attitudes for the seven out of the ten subjects who noted down the specific factor. The same result is recorded in Grootenboer's study (2006), while, on the contrary, other researchers have observed that students' attitudes after their teaching practice period are not always more positive (Yilmaz and Huyugüzel-Çavaş 2008).

In the current study, such influences have enhanced to a rather overwhelming degree (99 %) the positive attitude of students, since the mentors possessed a large amount of teaching experience and were able to propose successful ways of ICT use for the accomplishment of teaching objectives, even in the cases when these objectives could have been reached without the use of ICT. Moreover, the participants have been found to exchange effective techniques and practices with their fellow students ($N = 54$ or 59 %) who function as "critical friends" and trigger creative introspective reflection (Day 1999; Franzak 2002).

Finally, we can conclude that in our case study, a more critical attitude towards the use of ICT in education adopted by one of the professors had as result a less positive attitude towards the use of ICT in education on the part of students.

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Chapter 17
Teachers' Views of Technological Pedagogical Content Knowledge: The Case of Compulsory Education Science in-Service Teachers

Dimitris Psillos and Apostolos Paraskevas

Introduction

Several studies have shown that, when teachers use ICT, they do so in ways that preserve their existing teaching practices, or use ICT tools to search the Web for support material for producing notes or creating worksheets, or for circulating exercises and tests (Tzimogiannis and Komis 2004; Kenneth et al. 2005). It has also become clear that the classroom integration of ICT as a means of making teaching practice more explorative, participatory and co-operative often requires changes in traditional forms of teaching and professional development of teachers in their pedagogical use of ICT (Zhao et al. 2002; Tzimogiannis and Komis 2004; Kenneth et al. 2005; Bikos and Tzifopoulos 2011).

The knowledge that teachers need in order to be able to integrate ICT into the educational process is complex. It has to combine (scientific) content, technological means and educational theory, and if it is to affect their teaching practices it has to be functional. One widely used model that blends content, pedagogy and technologies in a system of interactions defined by these three parameters is the Technological Pedagogical Content Knowledge (TPACK) model (Mishra and Koehler 2006; So and Kim 2009; Doering et al. 2009; Alayyar et al. 2012). The basic components are knowledge of (scientific) Content (CK), Pedagogical Knowledge (PK), which embraces contemporary pedagogical theory and strategies, and Technological Knowledge (TK), which refers to features of technological environments.These three factors are interrelated and interact. As a result, they shape complex knowledge: that is, Pedagogical Content Knowledge (PCK), which

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among other things includes knowledge of strategies and representations that are suitable for teaching the subject, Technological Content Knowledge (TCK), which includes knowledge of the software packages and their possibilities, and Technological Pedagogical Content Knowledge (TPACK), which includes knowledge of how ICT can be used to support the planning and implementation of specific teaching strategies in the classroom, e.g. to encourage explorative or co-operative learning through the use of ICT. Mishra and Koehler (2006) have shown that teachers have to understand how the three components of TPACK are interrelated if these technologies are to play a real role in classroom practice.

In Greece, teacher's professional development (henceforth TPD) in the use of ICT in compulsory education known as B-Level (and we shall use this term hereafter for the sake of brevity) includes an integral approach to the pedagogical utilisation of ICT in science teaching. The programme is part of the broader, multiyear programme of PDT in the use of ICT that is being implemented, with the support of the Ministry of Education, by the "Diophantus" Computer Technology Institute under the supervision of a scientific committee. This is a two-part programme, with a total duration of ninety-six (96) hours (CTD 2007). It comprises a general part (18 h) and a special part (78 h), with teaching material for both parts, to be implemented by the instructors at each training centre as they see fit. The programme is carried out in special training centres established which have the necessary infrastructure. Each group of trainee teachers consists normally of 10–12 participants taught and guided in their works by one or two experienced certified instructors who have been educated in a special TPD programme.

The science programme is designed to stimulate the interest of the teachers, impart knowledge and skills, and encourage positive views and attitudes towards integrating ICT in science teaching. The material, and presumably therefore its utilisation in the training centres, applies elements of the TPACK model. For example, Pedagogical Content Knowledge (PCK) includes topics such as pupils' ideas about natural phenomena and concepts, pupils' cognitive difficulties and teaching strategies such as the constructive and the exploratory approach to school science (B-Level 2010). Technological Content Knowledge (TCK) covers, besides the basic approved ICT tools, such as Interactive Physics and Iridium VLab, matters relating to content transformation, such as the visualisation of concepts in specific technological environments and the representation, description and transformation of scientific concepts and processes. Technological Pedagogical Knowledge covers the gains from software and Internet applications, such as the use of ICT in the modelling of concepts. Technological Pedagogical Content Knowledge (TPACK) includes knowledge of how ICT can be used to support specific science teaching strategies, for example designing experimental procedures in virtual environments and promoting collaborative activities using Google docs, as well as theoretical knowledge about ICT in education, contemporary theories of learning, models integrating ICT into education, and the characteristics and handling of basic computer tools.

It has been shown that, as adults, teachers are ready to learn and develop new skills relating to their profession through involvement in the designing of genuine learning activities, that is, activities that lead to classroom applications and are incorporated into classroom reality (Kalantzis and Bill 2010). Much of the special part of the programme focuses on designing activities, worksheets and innovative authentic teaching scenarios, which promote the development of TPACK by combining aspects of science teaching with the utilisation of ICT in thematic areas covering all branches of school science: Physics, Chemistry, Biology and Geography. The teachers are taught to analyse prepared scenarios from the accompanying B-Level material, design innovative activities and scenarios, e.g. developing learning activities with virtual laboratories and hypermedia applications for specific units of physics, chemistry or biology, develop appropriate teaching aims and design learning supports. In addition to the theoretical lessons, since 2010, the training centres have required in-service teachers to implement practical applications in the classroom, using the available activities and scenarios or composing new ones designed to make use of ICT. The total duration of this part of the programme is 42 h, which includes trainee support sessions at the training centres as well as the classroom applications. Design and classroom implementation are the main aim of in-service training.

The present research investigates how compulsory education science teachers who have had B-Level training see the programme and its benefits in terms of TPACK, and their own readiness to apply what they have learned in the classroom. More specifically, it looks at their views of the pedagogical and technological knowledge furnished by the programme, whether they feel themselves to be familiar with the environments and able to design scenarios using software programs, whether they can implement them in the classroom and whether the training was on the whole interesting.

Sample

The research was carried out with a total of 69 in-service compulsory education, physics, chemistry, biology and geography secondary science teachers who had B-Level training in seven (7) training centres in Northern Greece.

Tools

In the framework of applications of the programme in in-service teacher training centres, the researchers studied teachers' views of aspects of TPACK through written self-report questionnaires and interviews. The questionnaires contained closed, Likert-type questions to be answered on a scale of 1–5 (very little, little, average, much, very much). The content of the questions took into account other studies and proposed tools, the structure of the programme and the PE04 B-Level material (Lee and Tsai 2010). In this study, we refer to a total of 11 questions, which are tabulated in the Results section.

(Cronbach's alpha is 0.793, Cohen and Manion 1997). Part I, containing Questions 1, 2 and 3 (Table 17.1), asks about teachers' views of the pedagogical technological knowledge furnished during the course: that is, the appropriateness of the theoretical knowledge for understanding principles of integrating ICT into the educational process, the usefulness of the educational material (texts, software, scenarios, bibliography and on-line resources) and the practical exercises with the software. Questions 4, 5 and 6 deal with Technological Pedagogical Content Knowledge: that is, information about integrated lesson planning incorporating ICT and how to apply this knowledge. In Part II, Questions 7 and 8 (Table 17.2) concern their Technological Knowledge, and specifically skills relating to software installation and solving technical problems. Questions 9 and 10 (Table 17.2) ask about aspects of their Technological Pedagogical Content Knowledge, and specifically how well prepared they think they are to design and implement teaching scenarios using software. Finally, Question 11 asks how interesting they found the training programme. Sampling took place towards the end of each programme. The questionnaires were completed anonymously in the presence of the researcher.

Table 17.1 Teachers' views as regards the benefits of the programme

	Very little, little (%)	Average (%)	Very much, much (%)	MV	SD
1. Did it provide you with appropriate theoretical knowledge for understanding the basic principles for integrating ICT into the educational process?	17	37.3	45.8	3.32	0.973
2. Did it provide you with useful educational material and software for implementing scenarios using software?	1.7	32.2	66.1	3.80	0.714
3. Did it provide you with practical training with the software?	13.6	16.9	69.5	3.71	0.892
4. Did it provide you with appropriate knowledge for designing scenarios using ICT?	5.1	30.5	64.4	3.73	0.762
5. Did it provide you with suitable support, during the programme, for implementing teaching activities and scenarios in the classroom?	13.6	20.3	66.1	3.73	0.944
6. Do you think that the activities and scenario applications you carried out in the classroom during the training course were important?	8.5	16.9	74.5	3.80	0.961

Table 17.2 Teachers' views concerning the integration of ICT (TPACK)

	Very little, Little (%)	Average (%)	Very much, Much (%)	MV	SD
7. Do you feel ready to install the educational software successfully on your school's computers?	20.4	25.4	54.2	3.46	1.10
8. Do you feel ready to solve possible technical problems with the operation of the educational software you have been taught?	45.7	32.2	22	2.63	1.12
9. Do you feel ready to design teaching scenarios using the software you have been trained on?	10.2	23.7	66.1	3.75	0.883
10. Do you feel ready to implement teaching scenarios using the software you were trained on?	11.9	33.9	54.3	3.53	0.838

We also conducted semi-structured personal interviews for a more in-depth investigation of the teachers' views. The interview questions were related to the questionnaire and provided clarifications of the answers given in it. The answers were transcribed, analysed and discussed by two researchers, for consensus on their meaning. A total of 59 questionnaires were completed, due to absences on the days they were distributed, and 8 interviews were conducted with a random sample of teachers of different subjects from different training centres.

Results

The questionnaire results are tabulated by frequency of answer, mean value and standard deviation, with the two negative and the two positive categories compressed into single ones to show the main tendencies. A summary of the answers to the corresponding interview questions is also given.

Teachers' Views as Regards the Benefits of the Programme

Most of the sample gave a positive response to Questions 2 and 3 on the questionnaire, concerning technological pedagogical knowledge, particularly with respect to the practical, hands-on work with software, that is, the technology they would be using in the classroom. The rest (16.9 and 32.2 %, respectively) answered average, and a small fraction recorded negative views. We observe that the teachers were comparatively less positive about the provision of theoretical knowledge

(Question 1), with 45.8 % declaring themselves satisfied or very satisfied; this question also had the highest number of average answers.

In order to get a better and more fully elaborated notion of these views, similar questions were asked in the interviews. It emerged that the theoretical part was presented in several cases in a traditional manner, in the training centres, with the use of PowerPoint by the instructors. When the participating teachers had some prior knowledge, this was followed by real dialogue and discussion. When this was not the case, the instructor merely presented the theoretical part and went on to the next unit, or gave the participants the material to study on their own. Their opinions show that the theoretical part was glossed over in favour of closer study of the software.

As regards the third question, the majority of the interviewees felt that they were helped by actually using the software, that they learned about software previously unknown to them and that they afterwards selected and used in the classroom software that had either been taught or selected from the Web during the course of their hands-on practical work.

Besides, we note that the majority of the teachers (64.5–74.5 %) replied positively to the next three questions (4, 5 and 6), most of the rest pointed average (16.9–30.5 %), and a few were negative. Notably, the classroom applications were the most appreciated element (74.5 %).

The answers to the interviewer's questions show that the teachers had indeed dealt with the use of software in the classroom and using worksheets, but what the instructors taught was the framework and methodology for integrating the software into their teaching. They declared, however, that the theoretical knowledge was of less help to them in designing material than the practical implementation, presentation and comments of scenarios by the instructors, which served as frameworks for designing their own scenarios.

Teachers' Views Regarding the Knowledge and Skills Needed for Integrating ICT into their Teaching (TPACK)

In Part II of the questionnaire, the answers to Question 7 show that the majority think that they have the know-how to install and operate the software taught. From the interviews, it became clear that while the teachers had used software in the classroom, they felt more confident about installing software after taking the course. The respondents were less confident about their ability to solve technical problems that might occur with the software on their school computers, as the quantitative results show, with only 22 % answering positively.

The percentage of positive answers was much higher for Questions 9 and 10 (59.2 and 64.3 %), which asked about two dimensions of TPACK. A percentage of the teachers (24–34 %) felt themselves to be moderately well prepared to design material, while a minority (10–12 %) rated their skills as limited.

The participants interviewed said that during the training programme, they had learned a lot about the framework and methodology for using prepared scenarios, using software to design new ones, and preparing better worksheets than they had been able to. They found the classroom implementations of activities and scenarios very helpful, which matches the results of the questionnaires. They all agreed, however, that they encountered difficulties with colleagues over their implementation in computer laboratories.

Interest in the Programme

A question concerning one of the pillars of adult education is whether a programme attracts the interest of prospective participants and engages them actively in it (Rogers 1999). The answers in our case are presented in Table 17.3 and show that most teachers found it very interesting; a small minority (11.9 %) expressed the opposite view.

The answers given in the interviews showed that in general the participants found the TDP programme interesting as it was structured, that is, with the theoretical part first, then the digital tools and the practical application last. When asked whether they would encourage or discourage their colleagues from attending a B-Level programme, they made it very clear that they would advise others to take the course, confirming both the importance of the training programme and the fact that they found it interesting.

In addition to the above, an initial analysis of possible considerable differences in the views of the groups of teachers from different training centres was carried out. Since the samples from each training centre were rather small, varying between nine and eleven teachers, we applied the nonparametric Kruskall–Wallis test for each question separately. Results showed that in most questions apart from three, there were not significant differences ($p > 0.5$). Differences were noted in Questions 1 and 4 (Table 17.1) and Question 5 (Table 17.2).

Discussion and Conclusions

This paper explores the views of compulsory education science teachers following a B-Level TDP course as regards aspects of the TPACK gained from the programme, whether they now believe themselves to be familiar with the digital environments

Table 17.3 Interest about the programme

	Very little, Little (%)	Average (%)	Very much, Much	MV	SD
11. Was it interesting?	11.9	27.1	61 %, 71	3.73	1.01

and with using software to design scenarios, and whether they can apply what they learned. The sample was drawn from a limited number of in-service teacher training centres in Northern Greece, which means that more general conclusions for B-Level professional development as a whole cannot be extrapolated from the results. On the other hand, the fact that the sample was drawn from a fair number of training centres, with potentially different methods of teaching the same training material and programme, should permit certain trends to emerge.

Within these limitations, most of the teachers were positive about aspects of the Technological Pedagogical Content Knowledge (TPACK) model provided by the programme. The results were much the same for their views of the skills they had acquired, save for technical knowledge. One particular important finding is that they found the programme interesting, which is a prerequisite for acceptance by an adult audience. The results of the questionnaires show minority varying between 17 and 33 % indicating a moderate degree of satisfaction with the TPACK gained from the programme, save for the practical exercises with the software, while the percentage of who were not satisfied was much smaller (8–13 %).

It is clear from the responses to the written questions as well as their interviews that the participants were relatively less positive about the provision of basic theoretical knowledge relating to the use of ICT, which means that they had some problems understanding and using it. The question was general, and the answers cannot show whether these views resulted from the teaching of the learning theories or other aspects of the general part. From the interviews, it appears likely that the theoretical content was taught in a traditional manner and not made interesting. Alternatively, lack of familiarity and basic pedagogical knowledge may have created comprehension problems for these secondary science teachers, or the widespread view that only science content (and not pedagogical theory) is important may have been an impediment. This issue requires further study and improvement. A second point concerns the skills necessary for solving technical problems, but this was not unexpected since B-Level does not focus on those matters. On the other hand, the teachers were very satisfied with the practical classroom exercises, which for several of them were the first time they had used ICT in a standard or innovative lesson in many subjects.

The average answers, which as a rule represented 20–30 % of the total for both knowledge gained and skills acquired, show that a segment of the group was not particularly satisfied and remains sceptical with regard to the ICT incorporation skills they acquired. From another point of view, however, in an adult education training programme where the audience is made up of teachers with very different backgrounds, it is not possible to fully satisfy the resulting multilevel range of needs. For example, this group of teachers included teachers with considerable experience in the use of ICT, or with post-graduate degrees, who considered themselves familiar with the theoretical part of the content of the B-Level programme or the software, and who by their own account would have preferred to take part in a programme with a more advanced ICT content, which in the present educational reality is not feasible.

Within the context of our research, we note in brief the following points about the features of the TPD programme that may have contributed to the positive views reported by the majority of the teachers. Mishra and Koehler (2006) claim that although the TPACK model appears to be a logical theoretical construct, simple in its conception, it is nonetheless hard for teachers to understand and even harder for them to apply effectively in educational practice. The designers of the B-Level material for compulsory education science teachers thought, as the package was being worked out, that explicit reference to modelling of the knowledge imparted in TPACK terms would probably create conceptual problems for teachers of that category in professional development training centres, who as a rule have little or no pedagogical knowledge since their basic professional training deals solely with the cognitive aspect. The B-Level material includes elements of TPACK, as we noted in the introduction. But, the TPACK model per se, its construction and terminology are not expressly mentioned in the material in the period covered by our research and consequently were presumably not taught by the instructors in the training centres. We think that this approach made it harder to engage the interest of the teachers and elicit a positive response from them.

Another characteristic of this programme is that the material and the proposed teaching processes are based on learning through designing and implementing applications in real situations, as we noted in the introduction. Learning through designing offers many ways of creating learning activities and situations and encourages varied higher-level thinking skills and cognitive processes: experiential, conceptual, analytical and application. In this context, the teacher becomes a reflective designer of teaching processes (Kalantzis and Bill 2010). In addition, as well as furnishing theoretical and practical knowledge, the programme also provided support for the application of the knowledge acquired. The instructors as a rule conducted many support sessions with groups of teachers to help them design classroom lessons.

Finally, we may note that though the purpose of this study was not to investigate in-depth variation in teachers' views studying in different training centres, the initial quantitative analysis showed that there were not considerable differences between the various groups in most questions. However, there were significant differences in questions concerning the benefits of the programme and specifically provision of appropriate theoretical knowledge for integrating ICT and for designing scenarios using ICT. It is possible that the educational process was variable in some centres concerning the treatment of theory and this is in line with the problems identified above in handling the theoretical aspects or the programme. Besides, there was probably differential support in the various groups for implementing teaching activities and scenarios in the classroom. Alternatively, the groups could consist of teachers with various experiences, knowledge and attitudes towards ICT implying that some teachers would need more support than average for applying ICT in classroom. This is an issue which needs further investigation.

In conclusion, and within the limits of our research, we feel that the positive response of the majority and the small size of the unsatisfied minority indicate that the structure and implementation of the B-Level TPD programme for compulsory education science teachers promotes the development of their knowledge and skills while there is room for improvement of the programme, aiming always at high-quality professional development for teachers in the pedagogical use of ICT.

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Part VII
ICT for Specialized Uses

Chapter 18
The Use of Information and Communication Technologies for Inclusive Education in Greece

Maria Gelastopoulou and Vassilis Kourbetis

Introduction

Contemporary educational approaches draw on the principles of inclusive education that promote equal learning, participation, and opportunities for all students, including students with disabilities (Booth and Ainscow 2011; UNESCO 2007). In this context, educational systems design and develop policies, practices, and educational environments that offer access to all students (Barton and Armstrong 2007). The design principles follow the guidelines of Universal Design for Learning (UDL) and the strategies of differentiated teaching (Tomlinson 2001; CAST 2011).

At the same time, the rapid development of Information and Communication Technologies (ICT) has significantly affected the field of education providing a new dimension to the learning process in both general and special education (Burnett 2010). The stimulating innovative products of ICT have enabled changes in education and as such have attracted the interest of the educational community. Educators feel the need to incorporate ICT in their educational practice and generally in the learning process (Zaranis and Kalogiannakis 2011; Hartley 2007). Research results demonstrated a significant contribution of ICT use in the classroom as a learning tool (Vernadakis et al. 2005; Clements and Sarama 2003) and specially in the education of disabled students as it helps to ensure accessibility and active participation for all students (Istenic Starcic and Bagon 2014; Drigas and Ioannidou 2013; Passey 2013; UNESCO 2011). The use of ICT in education is among the key objectives of the Strategic Framework for European Cooperation in

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Education and Training ("ET 2020") (CEU 2009), the guidelines for Education for All by 2015 as well as in the Millennium Development Goals (MDG).

Within this framework, the present paper presents a project run by the Greek Institute of Educational Policy that aims to implement inclusive educational practices. The project's title is "Design and development of accessible educational materials and software for students with disabilities."

Theoretical Framework

Inclusive education is a fundamental part of European and international educational systems (Ferguson 2008). Institutional documents, declarations, and UN policies (UNESCO) promote inclusive education and personalized learning through appropriate support, early identification of special educational needs, and appropriate services (UNESCO 2007). In the context of inclusive education, all students are accepted and have the right to attend their neighborhood schools. Students are also supported to learn, contribute, and participate in all aspects of school life. Inclusive education is about how we develop and design our schools, classrooms, programs, and activities, maximizing opportunities, instruments, resources, and technologies so that all students learn and participate together (Booth and Ainscow 2011; UNESCO 2009). Inclusion can be implemented through the differentiation of instruction, the use of the UDL framework , and the utilization of ICT tools (Izzo and Bauer 2015; Istenic Starcic 2014; Mavrou and Symeonidou 2014).

Differentiation of instruction is considered a promising educational process for the removal of barriers of homogeneous curricula and traditional teaching approaches. Curriculum differentiation is a key component in creating adaptable learning environments that encourage inclusive practices in general schools (Fox and Hoffman 2011; Alberta Education 2015). The principles of differentiated instruction require variations and adaptations of the teaching content, instruments, procedures, and materials, resulting in the creation of flexible educational and learning environments allowing each student to follow their own learning path and direction while developing personal strategies for the acquisition of knowledge (Fox and Hoffman 2011; Valiande and Tarman 2011). Thus, in doing so, they respond to the heterogeneous composition of modern schools.

UDL refers to a process by which a curriculum is intentionally and systematically designed from the beginning to address individual differences. UDL principles promote and provide multiple means of information presentation, where instruction is accessible and engaging, and students acquire skills and enthusiasm for learning. The design and development of curricula, methods, materials, evaluative procedures, and training in different and multiple ways meet the challenges of diversity and the needs of all students, including the disabled, turning the school, and the learning environments into a flexible one. The UDL principles build on the diverse types of learners as well as the potential of new technology to provide multiple ways of dynamic interaction with and between learners (Izzo and Bauer 2015; Mavrou and Symeonidou 2014; CAST 2011).

The dynamic relationship between universal design and ICT becomes a powerful tool toward inclusive education (Smith and Throne 2007). ICTs are technological tools and resources used to communicate, create, organize, disseminate, store, retrieve, and manage information and learning. ICT support personal access to information and knowledge, learning and teaching situation, personal communication and interaction, and access to educational administrative procedures (UNESCO 2011). The new concepts of literacies (multiliteracies) demand that ICT, by supporting teaching and expanding assessment methods, provides alternative means of delivering literate practices. ICTs as multimodal tools also expand the transmission of information in multiple ways, not only through enhancing language development, knowledge and thinking, but also by allowing the acquisition of other multifaceted cognitive skills. In addition, with appropriate use, they encourage dialogue and argumentation, the opportunity to formulate a variety of questions and the development of social networking and collaboration. All in all, the use of ICT increases the participation of all students in the learning process and as such it expands their cognitive horizons (Ghaznavi et al. 2011; Burnett 2010; Hartley 2007).

Research data also demonstrate that ICT practices contribute to better comprehension, assimilation, and consolidation of school subjects such as mathematics, science, and languages. Moreover, what has also been of importance is ICT contribution to acquiring skills such as reading, writing, and visual-motor coordination (Zaranis 2014; Zaranis and Kalogiannakis 2011; Clements and Sarama 2003; Vernadakis et al. 2005).

The contribution of ICT is manifold as it supports students, teachers, and generally all those involved in the educational process (Passey 2013; Alberta Education 2015; Burnett 2010; Smith and Throne 2007).

In the case of students with special educational needs, the utilization of ICT in a variety of cases is the only way to access knowledge, information, the curriculum, and learning in general. The valuable contribution of ICT to education of students with disabilities in shaping accessible practices and appropriate learning environments is now well supported (Istenic Starcic 2014; Passey 2013; Drigas and Ioannidou 2013; Brodin 2010; Coleman-Martin et al. 2005).

In particular, the use of practices in educating autistic students has been proven to be a key element in offering alternative means of communication; in the way, language is perceived and comprehended in anxiety management, in acquiring reading and writing skills, and in the development of communicative and social skills (Lucas da Silva and Goncalves 2016; Obiyo et al. 2013; Tanner et al. 2010). In the case of deaf children, research data confirm the benefits that result from giving the children the opportunity to access the curriculum. In general, knowledge can be accessed through the visual channel where they can exploit the existing interactive video applications with the support of sign language (Kourbetis 2013; Nordin et al. 2013; Fajardo et al. 2010; Easterbrooks and Stephenson 2006). In addition, when teaching students with visual impairments the use of ICT has offered many solutions, particularly either through enlarging teaching material such as the magnification of the computer screen, or with the use of the text-to-speech method and tools, and the development of visualized material or text (Soderstrom and Ytterhus 2010; Presley and D'Andrea 2008; Papadopoulos and Goudiras 2005). Visualizing information and developing simplified texts by using the method easy to read and also by employing digital educational applications to students with intellectual disabilities have been proven crucial for their education (Nabil 2013; Ribeiro and Moreira 2010; COI 2010; Standen et al. 2001). Moreover, digitalizing educational material and using technological means and aids for the students with mobility problems is another field that research data support (Lidström et al. 2012; Murchland and Parkyn 2011). The use of appropriate (ICT) digital applications plays also an important role in the education of students who have attention and concentration problems as they allow students to focus more and engage themselves creatively (Solomonidou et al. 2004). Finally, e-books and digital educational applications and programmes can really support the teaching and education of disabled students as they show more interest, attention, concentration, and enthusiasm (Lidström and Hemmingsson 2014). However, regardless of the valuable contribution of ICT to promote inclusive learning if not used appropriately and is not accessible to all students the risk of widening social inequalities is evident.

Method

This project follows the methodological principles of qualitative research and content analysis (Mason 2002; Creswell 2012). Institutional and disciplinary European and international texts and research data related to inclusive education and disability, to the contribution and use of ICT in the learning process and contemporary teaching methodologies, were analyzed. This methodological approach was used for the development of material specifications and evaluation criteria.

We also have utilized principles of emancipatory methodology as the involvement of people with disabilities, especially in the development process of the material, have played a leading and decisive role (emanating from disability studies) (Barton 2005; Danieli and Woodhams 2004). In order to finally publish the educational material, the teachers used a pilot sample with students of every disability category and recorded their comments and willingness to respond. This material was then distributed to the working groups who corrected and reviewed it adding any necessary information and changes until the final publication. It should be added that in the case of deaf students, wanting to reassure the effectiveness of the developed material, sign language translation was carried out by natural sign language users.

For the development of specifications and evaluation criteria of the material, we established a group of twenty-one (21) experts—specialists (in-service teachers, researchers, school counselors, and university professors) for each of the disabilities mentioned above. These specifications concern the educational material and specialized software that will be used in order to differentiate and integrate the educational content into digital environments.

Such specifications take into account the learning and the general characteristics of the students of each disability and involve (a) text adaptations, (b) the selection of suitable images, (c) the adaptation of software interface, and (d) the creation and use of specialized educational material, for example, alternative communication systems such as pictograms or the particular educational resources needed for the translation of the Greek Sign Language.

The methodological approach of the project includes the evaluation of the produced material by a second group of fifteen (15) experts, in three phases:

1. Evaluation of a sample of the material using the developed evaluation criteria.
2. Evaluation of the final material and its pilot implementation.
3. Formative assessment of the overall project to ensure its quality and effectiveness.

In addition, regarding the use of accessible materials in schools, training is provided (in-service, face to face and distance learning) for those involved in the educational process (teachers, school counselors, evaluation staff, etc.). Specific information is available on the use and utilization of the digital and printed materials for each disability.

The Project

The implementation of this project resulted in the following questions and concerns:

1. What kind of training materials could be developed to address and benefit the largest possible number of students? How can universal access to educational and learning processes be provided while at the same time enhance the existing resources?
2. What are the most appropriate technologies to be utilized?
3. What adjustments need to be made in order to establish the appropriate principles, characteristics and procedures that govern the accessible educational materials so as to ensure the maximum participation of students with disabilities in the educational process?
4. How to maximize the design of the learning environment in order to achieve the best use of the educational material, so that all students benefit?

Resulting from the above questions, the goal of the project focused on the adaptation and digitalization, through the use of ICT principles, of the elementary grades A and B textbooks for students with autism, hearing impairments, visual impairments, motor disabilities, intellectual disabilities, and attention deficit hyperactivity disorder (ADHD). The educational material targets students aged between 4 and 8. It is important to note that textbooks in the Greek education system are the key teaching tools that enable access to the curriculum and knowledge, since they are used in schools nationwide.

Accessible Educational Materials and Software for Students with Disabilities

The development of accessible educational material and software for students with disabilities concerns the adaptation and digitalization of textbooks for the first two elementary grades. The repository of the developed material and also of the existing is hosted in the project's Web site (http://www.prosvasimo.gr) and can be accessed by everyone involved in the learning and teaching process since it is being constructed and designed within the philosophy of Open Educational Resources (Tuomi 2013). Part of this project is the existing educational materials developed by co-financed projects in Greece and it is hosted in this Web site.

The digitized accessible textbooks are no different in content from those used by students without disabilities. What the student with a disability sees on their computer screen is a virtual book corresponding to the identical book used in the general school. All the material will be accessible in multimedia electronic format with printing capabilities. The interface presentation aims for a better understanding of the content and is geared toward encouraging the development of cooperation between students, teachers, and the computer (Nabil 2013; Standen et al. 2001). The material, especially the presented texts, is simultaneously read aloud by a native Greek speaker. This presentation format expands the benefits to students who are not disabled but may have learning difficulties or are auditory learners. The texts are also differentiated to match the different needs in order to be accessible by everyone. Moreover, accessibility-supported material includes features like deaf native signers, interpretation by certified GSL interpreters, and the use of computer-assisted training materials to cater for all disabilities. In addition to accessible text books, special educational materials were developed for language readiness in Greek Sign Language (GSL), alternative communication systems (image, sketch, and pictograms), tactile material for the blind, teaching Greek Braille code, mobility, and orientation (Lidström and Hemmingsson 2014; Fajardo et al. 2010; Kourbetis 2013).

More specifically, with respect to students with visual impairments, accessible educational material using ICT has been developed facilitating the integration of blind students into the general educational system (Soderstrom and Ytterhus 2010; Presley and D'Andrea 2008). The educational materials (textbooks) have been developed in Greek Braille and recorded in natural human voice. The supporting material is proposed to be raised for tactile use, including three-dimensional images, such as maps, figures, clocks, and flashlights. This process is designed to aid in improving mobility and orientation skills for the blind and partially sighted students.

The digitized textbooks for partially sighted pupils have been enlarged in various font sizes (Arial bold 18, 28, and 22 font size) in order to address students with varying degrees of vision loss. All textbooks are available both in digital and printed format, including Braille. All textbooks required in compulsory education have been completed (Presley and D'Andrea 2008; Papadopoulos and Goudiras 2005).

For the deaf and hard of hearing students, the accessible digital educational materials include (a) all the textbooks of the first two grades of elementary school, developed by using written and spoken Greek Sign Language (Fig. 18.1) and (b) the development of special educational material for language readiness (Kindergarten) and for using and learning Greek Sign Language (GSL) as a first language in the first two elementary grades. These materials have been designed by deaf native signers in collaboration with certified interpreters of GSL. In particular, the implementation of GSL material includes the creation of multimedia electronic and printed educational materials on two levels:

1. Basic GSL vocabulary and
2. Basic phrases for teaching GSL in kindergarten.

The presentation of GSL is video format, and the accompanying text is read aloud by a native Greek speaker. The sign language is presented via interactive video streaming technology providing the user access to a video sign language library, which stores recordings of "text" or "phrases" in GSL (Kourbetis 2013).

Fig. 18.1 Screen from an accessible interface presenting the text with the use of Greek Sign Language for the deaf and hard of hearing students

Fig. 18.2 Screen from an accessible interface presenting the text with the use of easy to read for students with intellectual disabilities

The accessible educational materials for students with intellectual disabilities are designed to meet the needs of these students. Differentiating textbooks include the adaptation of the text in an "easy to read" format (COI 2010). Educational content will be simplified with a focus on presenting concepts using images and providing the text in print and digital format (Fig. 18.2). The simplified version not only contributes equal content to the education of students with intellectual disabilities and other special educational needs, but also combats functional illiteracy in non-disabled students.

For students with motor disabilities of the upper limbs, textbooks are accessible by using a single keyboard key. Access to the textbook content can be achieved by simply scanning the screen using touch-screen technology (Murchland and Parkyn 2011).

The accessible materials for students in the autism spectrum are presented in the following ways: (a) with the alternative language and communication programs best suited to Autism Spectrum Disorders (ASD) (Picture Communications Exchange System, Pictograms, etc.) and (b) using the appropriate educational approaches suitable to autism, such as the structured teaching approach of TEACCH, the use of ICT, and interactive teaching approaches. The special software for accessing text (basic vocabulary, pictures, drawings, pictograms) will be widely available using a free, online digital library (Tanner et al. 2010).

Table 18.1 Evaluation of the sample and the final material

Disabilities	Deaf and HH	Deaf and HH	Intellectual disabilities	Autism spectrum	Motor disability	ADHD
Subjects	GSL (N2)	HB (N4)	Easy read (N4)	ACS (N1)	ILS (1)	EF (1)
Sample	109	109.4	106.2	104.40	103	107.7
Final	110	109.5	107	105	106	109

Evaluation Results

The evaluation of the sample of the material was based on the evaluation criteria developed by the expert committee and resulted in the above mean results. The evaluation scale was developed to either decline the deliverables if they were rated below 80, accept them if they were rated from 80 to 100 and strongly accept them when the deliverables where rated from 100 to 110. All the accepted samples were rated from 103 (Motor disability) to 109.4 (Signing books for deaf and hard of hearing), and all the final materials were rated between 105 (Alternative Communication Systems for the autism spectrum) and 110 (Teaching Greek Sign Language for the deaf and hard of hearing). Similar, as expected, were the results of the evaluation of the final material as seen on Table 18.1. This high rating of the final material is very encouraging and in line with the overall evaluation.

Evaluation of the pilot implementation is currently underway and will be completed by the end of the school year 2015–2016. The accessible educational material was presented in four regions of Greece (Ioannina, Alexandroupoli, Volos, and Rhodes) with impressive quantitative and qualitative initial results. More than 2000 in-service teachers are currently evaluating the material.

A formative assessment of the overall project was implemented to ensure its quality and effectiveness when put in proper practice. The project and its deliverables were evaluated by the European Union (European Social Fund—ESF). As a result of this evaluation, the project was rated as the best of the IEP, one of the 11 best of the Ministry of Education and one the 30 best in Greece. These results are very encouraging, particularly for continuing the development of accessible educational material for students with disability and special educational needs.

Conclusions

The contribution of ICT in supporting inclusive practices and ensuring accessibility is undeniable (UNESCO 2011). Given the rapid development of technology and its increasing utilization in schools, conditions must be created to enable every student to have equal access to technological innovations. The use of this digitized material creates opportunities for training teachers in the appropriate instructional practices, resulting in better accessibility and more effective education.

This innovative adaptation and digitization of textbooks, in order to be accessible by all students, with or without disabilities, have to be implemented on a national level. Therefore, the needs of all students are met by creating equal opportunities for learning, classroom participation, and equal access to the curriculum.

The broad applicability of the accessible educational material is ensured and can be used by students, teachers, school counselors, parents, and others for teaching and training purposes.

In conclusion, access to the curriculum through ICT with accessible digitized textbooks promotes respect, acceptance of diversity, and expansion of differentiated pedagogy, thus improving the quality of education in Greece. This material helps to remove obstacles to the education of students with disabilities, meet the objectives of the curriculum, foster a sense of competence, and increase self-esteem in students. Finally, what has become feasible is the possibility of integrating ICT into classroom practice, including learning and teaching, curriculum and instructional design, learning media and environments, and finally teacher education and professional development.

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Chapter 19
Dyslexia in Primary School: A New Platform for Identifying Reading Errors and Improving Reading Skills

Eleni Chanioti

Abstract The educational application “Evglotton” is designed by the Institute for Language and Speech Processing to improve the reading ability of children with dyslexia aged 8–13. This application could be used both as an additional diagnostic tool for reading and as an individualized program of rehabilitation. When it is used independently, the system monitors the learner’s progress continuously providing a full report of his performance. Moreover, it is possible for the user to enrich the system with additional texts using the admin page on the Internet. This pilot program was tested with 6 children in the inclusion class of the 5th Primary School of Kifissia during the period 2013–2014. The initial results were very encouraging, showing that the learners were highly motivated with a gradual improvement in their reading capacity. In addition, it allows the special educator to better organize his work. Consequently, he/she saves time and gains a better understanding of the learner’s reading capacity.

Introduction

Dyslexia is a specific learning disorder, which affects the development of language skills. It is characterized by difficulties in phonological processing, immediacy in recalling of words, working memory, speed of information processing, and automatic development of skills. These difficulties are not consistent with the person’s chronological age, educational opportunities, or intellectual abilities (DSM-V 2013). The prevalence of dyslexia ranges from 3 to 10 %, and it depends upon the criteria used for its diagnosis (Snowling 2013).

In general, children are expected to learn how to read by third grade and by fourth grade to read for acquiring new information (Meisinger et al. 2010). However, the dyslexic reader might encounter some obstacles that fall into two

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broad categories: (a) difficulties of visual recognition (such as difficulties in recognizing words, letters, and numbers) and (b) phonological and orthographical difficulties (correspondence of a grapheme with its specific sound, phoneme) (Schiavo and Buson 2014). These difficulties vary from individual to individual, and students with dyslexia have disparate and complex needs, as reported in a great extent in the literature (Björklund 2011; Markou 1998).

Since students with dyslexia constitute a high variable of today's classroom, the necessity of assistance technology tools becomes clear. According to the British Dyslexia Association, dyslexia tends to be resistant to conventional teaching methods (these do not generally use technological tools), but its effects can be mitigated with appropriate individualized intervention, including computer technology along with counseling (British Dyslexia Association 2013; Leeds City Council 2013).

In a study of Torgesen et al. (2010), the researchers proved that students (of the two experimental groups), who received an intervention model supplemented with two different computer-assisted programs, showed reliably stronger outcomes in phonological awareness, rapid naming, phonemic decoding, word reading accuracy/fluency, spelling, and reading comprehension at the end of first grade than the control group who did not use any assisted technology program. The effects of this model of intervention lasted 1 year after, at the end of the second grade. Along the same lines, many studies (Galuschka et al. 2014; Biancarosa and Griffiths 2012; Saine 2010; Lewis 1998) claim that assistant technology aims at helping students to deal with their reading difficulties effectively and with self-reliance. When students with learning difficulties have the means (computer) to overcome their reading and writing weaknesses at their disposal, then motivation increases, learning competency becomes higher, and performance improves (Hannus-Gullmets 2014; Martin 1998).

In context with motivation, as factor contributing to efficient reading, studies have shown that concept-mapping skills and strategies also enhance reader's use of reading strategies and text comprehension (Biancarosa and Griffiths 2012; Sung et al. 2008). These *metacognitive* strategies help students to "think about their thinking" before, during, and after reading (Boulware-Gooden et al. 2007). The completion of a mental map[1] (see Fig. 19.6) along with the Evglotton application serves this purpose; this mental map was tested for a better identification of the words difficult to read and understand.

Taking into consideration all the above facts, the goal of the proposed system is to assess the specific reading difficulties of the user and to enable access to the reading materials in line with the user's reading profile. Additionally, the system employs dyslexia-sensitive user interface (combination of pictures of animals for the password and stars as a reward system for a number of texts read) in order to motivate the user.

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[1]A mind map is a diagram used to visually organize information so that it is easier to use or remember (British English Dictionary and Thesaurus 2016).

"Evglotton" as Assessment Tool

[2]Evglotton may be additionally used in terms of reading assessment, offering to the special educator valuable assistance in the identification of possible types of error, typical of dyslexia. Evglotton displays originality regarding assessment of reading difficulties since from the literature review in the specific field derives no previous use of the system of speech recognition (Athanaselis et al. 2014). In particular, three types of assisting programs, mainly to students of middle to higher grades of elementary school, have dominated: (a) synthetic speech software (Chouliaros 2008), (b) organization of ideas software, and (c) speech recognition software (Schiavo and Buson 2014; Forgraves 2002).

Although not a standardized tool,[3] Evglotton contributes to the identification of specific reading difficulties. It contains a wide range of sentences, placed under specific categories, according to the type of error. In the end of every assessment, the educator has the possibility—through the page of the instructor—to retrieve students' recordings, scores, and overall performance graph in terms of each type of error separately or all types as a whole.

More specifically, the operational system of the application focuses on dyslexia indicators (specified types of errors) to automatically evaluate student performance in words sensitive to those indicators (Athanaselis et al. 2014). Evaluation is based on technology of automatic voice recognition. The process consists of recording, storing, and processing the student's voice (see Fig. 19.1). Thus, for each child, a purely personal and unique profile is shaped.

Criteria of Evaluation—Indicators of Dyslexia

The educators who cooperated for the creation of Evglotton left some types of error for the Greek language, practically identifiable without ambiguity. These types of error lie in accordance with bibliography. Alexandrou (1995) identifies three phases of dyslexia symptomatology. In the first phase, children encounter difficulties in consonant compounds and diphthongs. In the second phase, they reverse consonants and, particularly, those displaying a sound relation in Greek language, such as g-k, v-f, t-th, t-d, p-b, k-gk, g-h, and k-h. In the third phase (mostly relevant to students of 5th and 6th grades of elementary school) are observed letter omissions and grammar errors.

[2]Project co-financed by the Operational Program "Digital Convergence" (OPS 303630).

[3]The electronic address of Evglotton for educators is http://evglotton.ilsp.gr/admin/ and for students is http://evglotton.ilsp.gr/.

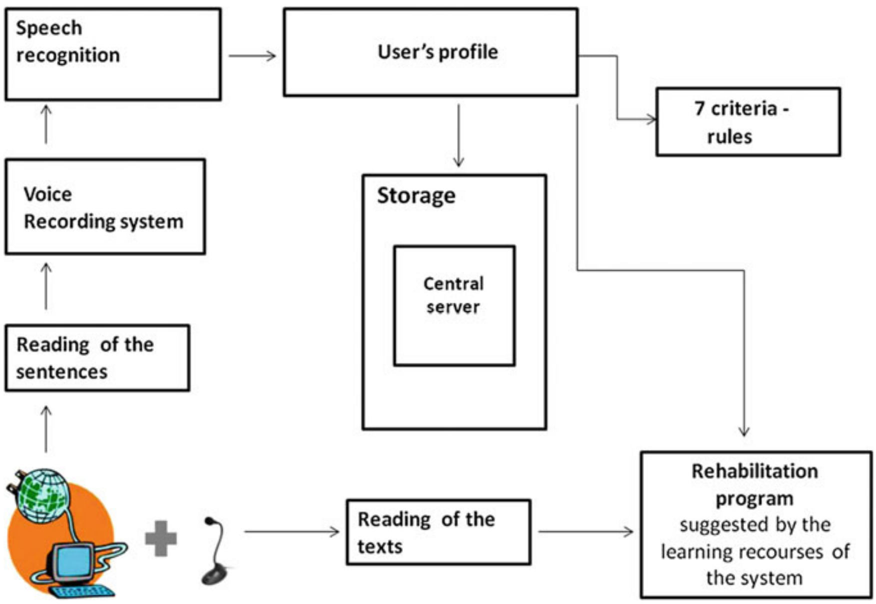


Fig. 19.1 Flowchart of the system's architecture

The types of error used are the following:

- Frequent phonemes and optical confusion. The confusion of letters of similar shape constitutes a frequent error as well as dyslexia "indicator." In this case, the system is programmed to identify the following error types: *"θ" or "δ", "χ" or "γ", "φ" or "β" or "ψ", and "ξ" or "ζ"*. For example, the word theama (=spectacle) may be read as deama (pseudo word)
- Errors in words of many syllables. A word of many syllables in Greek is characterized as one with at least four syllables. Such an example is the word "po-di-la-to" (=bicycle);
- Errors in compound words. Compounds are those words, which have as first part prefixes such as hypo-, hyper-, pre- in words like **hypo**thetic, **hyper**active, **pre**paration, etc.;
- Errors in complicated words. Complicated words are the ones, which present a complicated syllabic structure, defined by a sequence of consonants and vowels. On the basis of the above descriptions, a word is characterized as complicated if a number (of vowels or consonants) bigger than two appears in its coded depiction while there are at least two appearances of two in one word (Institute for Language and Speech Processing (ILSP)/Athena Research Center 2012).

Formation of Reading Profile

The user's reading profile is formed according to 7 criteria (rules) as follows:

1. The user commits errors in the letters *"θ" or "δ"* sounding in Greek th (like **th**ink) or th (like **th**e).
2. The user commits errors in the letters *"χ" or "γ"* sounding in Greek h (like **h**ello) or w (like **w**indow).
3. The user commits errors in the letters *"φ" or "ϐ" or "ψ"* sounding in Greek f (like **f**ive) or v (like **v**ery) or ps (like u**ps**ide).
4. The user commits errors in the letters *"ξ" or "ζ"* sounding in Greek x (like ta**x**i) or z (like **z**ebra).
5. The user commits errors in words of many syllables.
6. The user commits errors in compound words.
7. The user commits errors in complicated words.

The grading scale ranges from 0 to 10. Grading toward the lower end means deterioration, while grading toward the higher numbers of the scale means improvement. Number 5 means a medium condition, and it is a starting point for users whose reading performance is not initially known (ILSP 2012).

"Evglotton" as Individualized Reading Program

It is generally acclaimed that reading improves through reading, through material of personal importance and meaning for the child. What children with dyslexia need, therefore, is targeted practice (Tzouveli et al. 2008) on texts close to their interests, which will allow them to improve skills of phonological segmentation, which may be applied to learning the grapheme–phoneme correspondence (Korat 2010; Gabrieli 2009; Fleischer et al. 1979).

During the pilot usage of Evglotton, those skills of grapheme–phoneme translation were practiced since this translation allows for minimization and improvement of errors, especially in older ages (Mauromati 2004).

Furthermore, what played a major role in the program of reading improvement was the nature of the tool. Specifically, through Evglotton, the user is able to read texts adjusted to those difficulties, which are registered by the system in the user's profile. For example, if the system determines that the user finds it difficult to read words that include θ (th/theory) and δ (th/the), which are letters of visual resemblance, then, based on this specific characteristic of the user's profile, the system proposes texts, in which this phenomenon dominates (see Fig. 19.1).

An additional characteristic is the electronic form of the text. Research is particularly positive to students with dyslexia using texts of electronic format. The idea of a supportive electronic text was initially developed by Anderson et al. (1997, 2007), who expressed the opinion that the electronic text may be modified or enriched in such a way that it will lead to an increase of reading comprehension and promote content learning.

Students with learning difficulties must effectively deal with specific obstacles set through printed material. Technology may positively contribute to such challenges. The advantage of an electronic text over a printed one is that the former provides the possibility of modification regarding the line, the size, and the color of the letters as well as the background (Zorzi et al. 2012). Generally, an electronic text is far more malleable, and this malleability functions positively in terms of reading for students with difficulties (Anderson et al. 1997, 2007). The option of modification is provided in the text format of Evglotton application.

Recently, Schneps et al. (2013) have examined 103 high school students with dyslexia and arrived at the conclusion that several of them displayed significant improvement in reading speed and comprehension whenever the texts given were of electronic form and of small line length. The difference was more obvious to those students who had bigger problems in phonemic decoding and limited visual dictionary. This lies in agreement with what previously Torgesen et al. (1988) used in their research: the idea of increasing students' visual dictionary through electronic text. A reduced number of words per line helps the reader retain in memory whatever exists in the text. For those students, the usage of an electronic book (kindle, i-pad, or similar) may be beneficial, but it is limited.

Evglotton has been adjusted to those principles. Its texts have been divided into smaller units so that to not only motivate students but also lighten memory load. In the format of the application, there is the option of higher visibility through an increase of margins, letter size, and type of line. The arrangement of letter size makes possible the change of word number per line.

Pilot Application—Methodology

The research plan used during the pilot application of Evglotton is the pre-experimental plan of a single group with precontrol and after control. This plan lies in comparing a group with itself and is broadly used in psychopedagogical research (Vamvoukas 2002). The pilot application was selected in view of examining the functionality of the plan and its acceptance from students.

Sample and Duration of Research

The pilot use and adjustment of Evglotton was applied to 6 students of the inclusion class of the 5th Primary School in Kifissia. From these students, four are girls and two are boys. All six students have major reading difficulties. One student is placed in 3rd grade, two in 4th grade, and three in 5th grade. The application takes place individually throughout the scheduled program of the children in the inclusion class and in separate hours (within the school program) on an average of three times a week.

Research Tools

The tool used for assessing students' reading ability before and after intervention was the Evglotton system of voice recognition. During individual intervention to each student's reading difficulty were used the texts of the application. In parallel, students were trained to conclude the parts causing difficulties and report them with the help of a mental map designed for the specific purpose. The recording of voice during the phase of assessment and intervention was achieved through a microphone connected to the computer.

Research Questions

1. Did students improve their overall reading ability through using "Evglotton"?
2. Did each student improve at the criterion practiced?
3. Do students of higher grades face problems different from those of lower grades?
4. Did students acquire motivation to improve their reading?
5. Did the completion of a mental map during rehabilitation contribute to a better usage of Evglotton?

Procedure

Evglotton was initially given to students attending the inclusion class (with diagnosed difficulties) and to some others not attending. The purpose was to record students' first impressions regarding the specific application and to identify its operations in action. For a period of about 2.5 months (December 2013–mid-February 2014) were held adjustments deriving from interactions between the children and the network service of Evglotton. This period was essential in familiarizing both sides (children and special educator) with the application. After this period of trial, the six subjects were selected for systematic usage of the application on basis of their reading difficulties.

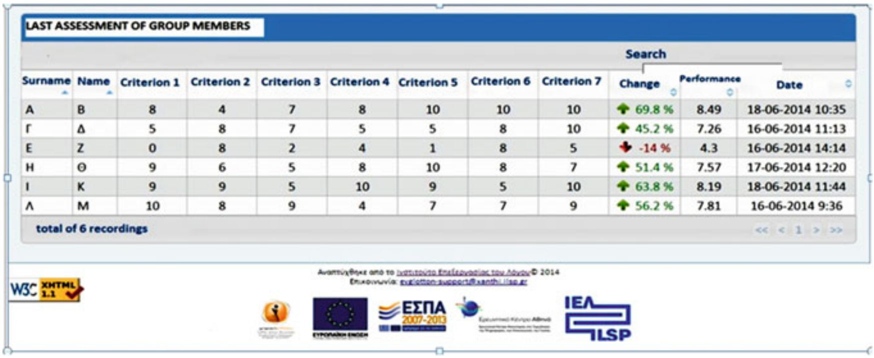
At first, the students were assessed via the system of voice recognition in ten sentences from each criterion and then followed the phase of rehabilitation. Students loaded the network service Evglotton, read the texts, which belonged to the category of their personal difficulty (ex. complicated words, criterion 7), and then heard the recording of their voice with the aim of recognizing the errors they had committed. Afterward, they completed a mental map, where they reported the difficult parts of the reading. In parallel, during this phase, students were trained to apply the program at home while most of them (four out of six) began to integrate it into their study. For this purpose, they received instruction manuals, microphones to record their voice, and copies of the mental map. Through the instructor's page, it was possible to receive information about which texts were read as well as the time they were read. After a trimester, students were assessed in the same way.

Results

The results have derived from measurements conducted by the system in the initial and final stages of evaluation of reading ability. Current measurements are not sufficient to generalize our results. Nevertheless, helpful conclusions arise as follows:

1. Overall, all students[4] except one improved in the criteria practiced. Figure 19.2 shows student's performance variability between initial and final assessment. In four student cases, improvement rate has been over 50 % and in one case close to 50 %.
2. Overall, all students individually displayed improvement respective to indicator of difficulty. In the diagram (Fig. 19.3) appears such an example. This student was assessed on the basis of criterion 1 (errors referring to θ or δ) and was then subjected to a program relevant to the specific difficulty. In the initial assessments, her performance is below average (5). It can be seen, however, that her performance tends to be increasingly higher as a period of individualized interventions regarding the specific phenomenon has occurred.
3. For students of higher grades (here students of 5th grade of elementary school), it is observed that reading errors refer to sentences of criteria 6 and 7. In the example provided (Fig. 19.4), the 5th grade student in the initial assessment displays an average reading performance in all "indicators" of dyslexia, apart from the last one, which seems to have a downward inclination.
4. (i) Although there was no formal assessment (see Appendix 1) with regard to how appealing the specific process was in follow-up discussions between students and educator, it was confirmed (Fig. 19.5) that all students found it appealing to work on the computer in order to improve their reading. Almost all (except one) confirmed that they could read a text better on screen than in print. What they liked most was assessment because they received immediate feedback on their performance (Institute for Language and Speech 2014).

[4]The students' names have been codified in alphabetical order in order to secure protection of subjects' personal data.



LAST ASSESSMENT OF GROUP MEMBERS

Search

Surname	Name	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 7	Change	Performance	Date
Α	Β	8	4	7	8	10	10	10	69.8 %	8.49	18-06-2014 10:35
Γ	Δ	5	8	7	5	5	8	10	45.2 %	7.26	16-06-2014 11:13
Ε	Ζ	0	8	2	4	1	8	5	-14 %	4.3	16-06-2014 14:14
Η	Θ	9	6	5	8	10	8	7	51.4 %	7.57	17-06-2014 12:20
Ι	Κ	9	9	5	10	9	5	10	63.8 %	8.19	18-06-2014 11:44
Λ	Μ	10	8	9	4	7	7	9	56.2 %	7.81	16-06-2014 9:36

total of 6 recordings

Fig. 19.2 Variability of students' performance

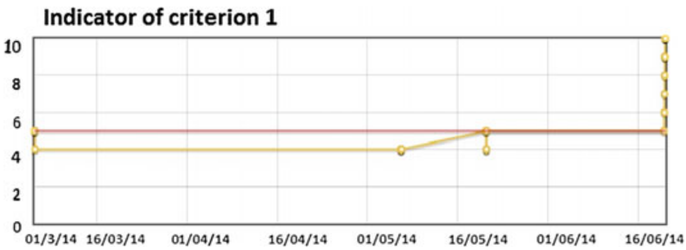


Fig. 19.3 The case of a 4th grade student: an upward trend in progress

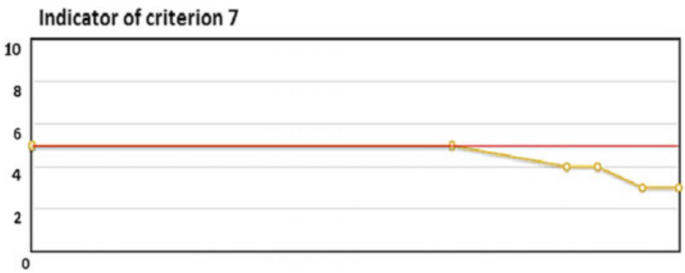


Fig. 19.4 The case of a 5th grade student: performance in complicated words

(ii) Students' parents expressed a high interest in the application. In combination with a counseling seminar held for parents in the inclusion class at the same period, feedback on usage of the application at home was immediate and positive. Parents were pleased to see their children motivated to use the computer in order to "read better" as they mentioned.

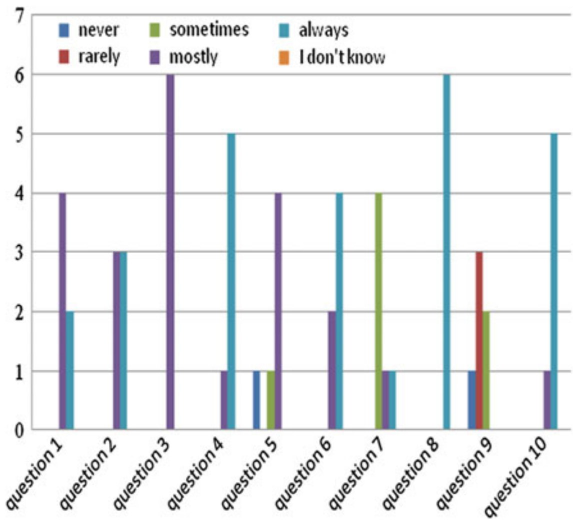


Fig. 19.5 Students' motivation in using Evglotton platform

5. From observation of mental maps (Fig. 19.6) which students had been trained to complete, two categories of reading errors were identified. The former category referred to errors of decoding in words known to the students—obviously existing in their visual dictionary—and the latter referred to errors of decoding in words unknown to the students.

Discussion

The results of the pilot application are subject to limitation due to small numbers of student samples. However, there is research based on small samples of dyslexic students, such as studies conducted by Gasparini and Culen (2012) on a sample of two dyslexic pupils, Lorenzi and Odegard et al. (2009) on a sample of 6 children with dyslexia, and Lorenzi et al. (2000) on a sample of 10 children, respectively.

Evaluation of the final learning result may be the most important and complicated. However, this is hard to estimate currently not only due to the limited period of pilot practice but also due to adjustments made throughout the process so that Evglotton to be more functional and to meet more students' needs. Of course, for the experimental plan chosen, the short duration of intervention eliminates the effect of parasite variables of time and student maturity. However, the general tendency is positive.

Another limitation derives from the system itself and is associated with voice recognition. Performance of all voice recognition systems is a statistical size. Certainly, as technology advances, systems of voice recognition become more and more reliable. Consequently, in the future, there will be higher reliability in this respect.

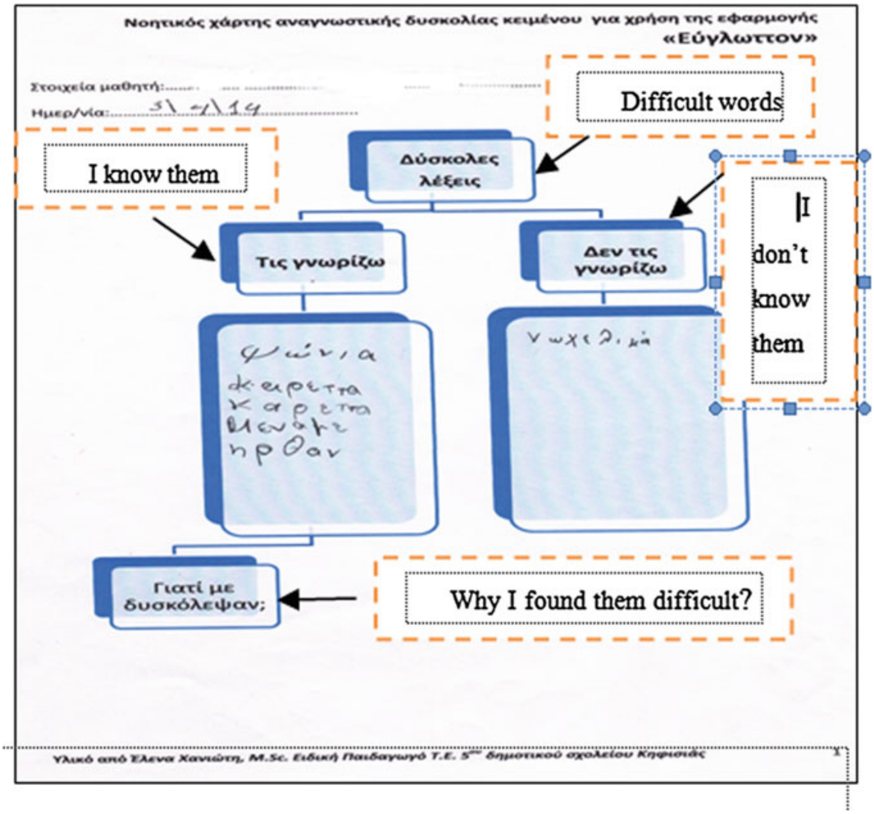


Fig. 19.6 Example of a mental map

The results of the three 5th grade students lie in accordance with existing bibliography. As it is observed, students with dyslexia in higher grades have resolved most issues of phonemic and optical confusion, while their main difficulties involve decoding extended sentences with complicated and relatively unknown words (Spear-Swerling 2010; Alexandrou 1995; Markou 1998).

The basic idea behind the didactic intervention followed was to motivate students to undertake responsibility for their learning through contact with the computer. In the specific case, this idea was verified. This means that software should be attractive for students to use and that the educator should include the software within his/her teaching in such a way that motives for learning will be created (Lundberg 1995). This advantage is given by computers, which constitute a motivation for students per se.

The process of identifying errors, their conclusion through a completion of a mental map, and the immediate teaching of decoding strategies constituted the three principle axes of "Evglotton" approach, which lie in accordance with bibliography

(NICHD 2000). A mere textual reading would not have the same value without being accompanied by a corresponding student training in a metacognitive level of thought.

Finally, the educator who participated in the process strongly supported that "Evglotton" facilitates the work of the educator in the inclusion class and also the work of any educator working with children with dyslexia or mild reading difficulties. Specifically, "Evglotton" has a user-friendly interface, which motivates the students to overcome their reading difficulties. Moreover, while most systems up to now have not been designed to respond to feedback from the learner and to personalize the system in line with the user's performance, Evglotton evaluates the reading ability of the learner quickly and adapts the results of the evaluation to the specific needs of the learner providing him with rich material in texts placed under specific categories according to the types of errors typical in dyslexia, which does not exist in the field of special education in Greece. Currently, there is no official institution to propose something similar.

In conclusion, the special educator gains time, organizes his/her work more effectively, and has at all instances a clear picture of student's performance and recordings. Consequently, the rehabilitation program of a dyslexic student becomes more efficient in terms of time and less tiring for the specialist. The same concept is supported by Biancarosa and Griffiths (2012). In their study, they report that e-reading technology offers to educators time-efficient tools for gathering, accessing, and interpreting data needed to produce suitable rehabilitation programs. Of course, all these positive aspects directly depend on educator's teaching approach and attitude toward international computer technologies (ICT) and desire to implement them.

Recommendations

For the future, in a second phase of Evglotton application is proposed an enrichment of the electronic text with functions, such as synthetic speech, references with determinations of difficult words, and connection to useful resources (notebook, creation of mental map through kidspiration). Additionally, it would be good for the educator to define the number of words per line through text format since research has shown that small number of words per text line facilitates decoding and reading comprehension (Schneps et al. 2013). Finally, assessment should be expanded and should include, along with sentences, texts that will contain words sensitive to "dyslexia indicators."

Furthermore, the use of interactive games as training tools for exercising basic attention and reading skills is recommended. Using specific computer games which demand from the user to read stories about the game, children will develop their reading skills. Technology definitely has to be an organic part of the lesson plan. Learning difficulties must be faced in the general class, not in inclusion class. The advanced technologies can contribute to this vision.

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Appendix 1

The Motivation for using Evglotton Questionnaire:

1. I prefer to read texts on the computer.
2. I like to use the program.
3. I use the program at school with my teacher.
4. I like watching my performance on reading via the Evglotton.
5. I use the program at home with my parents.
6. I like reading texts on the computer.
7. I use the program myself at home.
8. I believe that this program will help me in my difficulties.
9. I prefer to read texts in a book.
10. It is important for me to get reading awards from the program.

This 10-item questionnaire is designed to assess the motivation of students who participated in the study. Children answered each item on a 1 to 6 scale, with 1 = never, 2 = rarely, 3 = sometimes, 4 = mostly, 5 = always, and 6 = I don't know. For example, in the second question, all students (6) like use the program (Evglotton), 3 of them always, and the other mostly.

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Part VIII
European Education Policy and ICT

Chapter 20
Parallel Association Between the European Educational Policy on Lifelong Education and the Introduction to Information Society (1995–2010)

Evaggelia Kalerante and Theodoros Eleftherakis

Introduction

A discourse has been established upon a European educational form that would encompass member-states' ideological frameworks since 1995 (Tsatsos 2005). These would be in line with the general idea about the modern effective education (Cremona 2003; Hingel 2001; Pantidis and Pasias 2004, Passias 2002, 2006). Regulating education-related issues was considered necessary to compose the European Union. Emphasis was placed on the European citizen modelling in terms of a cultural entity based on an unifying culture. The aim was to surmount differences among European nation-states (Caporaso 1996; Dagtoglou 1998; Eleftherakis 2011; Oikonomidis and Eleftherakis 2011). At the same time, there was concentration on the economic development. In this respect, education could contribute to unification and the resulting specialised economic development tied to capitalist system functionality (Decision No 791/2004/EC of the European Parliament and of the Council 2004; Pollack 1998).

A new dynamics has been established within the European Union by the information society, and it has been based on information organisation and dissemination. Knowledge is transformed, and its content is enriched along with the generation of specialised developing educational models which shape new conceptualisations of the "new educational system" which has also been rapidly transformed in a technology-evolving society (Publication by the Eurydice European Unit with the financial support of the European Commission 2004). Thus,

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the individual is re-integrated into new technology-developing conditions. Lifelong education is a necessity which supports people to become part of the new systems in the various domains of economic, political and cultural life (Commission Report based on the work of the Working Group on Quality Indicators 2002). Education is conducted by the European Union on the basis of a re-adjustments and arrangements policy which stems from the technological developments. At the same time, different forms of education or training are aligned in favour of broader population strata (Nikolaou 2008).

The purpose of focusing on the period 1995–2010 was to depict the initial approaches tied to the necessity for a lifelong educational policy in association with the information society. Interest is placed on the theoretical, political and cultural framework, within which a lifelong educational policy with the integrated ICT is shaped. Time distance from the specific period provides the possibility of conceiving and evaluating the intention for a generalised European educational policy centred round lifelong education and training. The historic saliency of the educational policy about lifelong education–information society is part of the authors' intentions. This way, it is made clear that it is not a policy formed in the past period of 2013–2015 (Nordin and Sundberg 2014), but rather a consideration, intention and argumentation rooted back in 1990 under different social, political and economic conditions. Therefore, the originality of the present research lies in this particular aspect, that is, the European Community anticipated a form of educational policy propelling lifelong education and actually making proposed issues emerging from social, technological and cultural development. Moreover, throughout this article, it is made obvious that lifelong education is a dynamic process that meets the demands of the economic, social and political system, reflecting the functionality of post-modern conditions.

European Educational Strategy 1995–2010

Education has been associated with economy since 1995. Even when human adjustment is instrumentally referred to market demands, and not the individual's personality, is the focal point of lifelong education. In other words, this education is considered to contribute to the broader economic development. The text of the European Council of Luxembourg (1997) is representative of this consideration. Furthermore, employment and education are underpinned as a necessity. The consideration is further elaborated throughout 2000–2001 when the form of lifelong education is analytically highlighted (European Commission 2000), resulting in European policies aligned with a lifelong learning strategy, information technology and skills development, in particular (Commission Staff Working Paper 2000).

As foretold by the European Union Council (Lee et al. 2008), education should be further reinforced, yet not through the traditional education aspects, but through informal supplementary lifelong education and training aspects (Conclusions of the Council and of the representatives of the Governments of the Member States 2004).

The knowledge society is defined and attributed to the content of a learning environment in economic terms. Consequently, the concepts of skills acquisition and training are highlighted as a necessity within an administrative educational model (European Commission 1996a, b). In the political text established by the Stockholm presidency (2001), education is underpinned as a necessity towards a competitive European Union. Therefore, lifelong learning, as an administrative operation, is strongly tied to the economy of knowledge.

Further specialisation of economy- and technology-based lifelong education was observed, and the efficient investment in education was emphasised in 2003. In this respect, efficient education is based on training and skills acquisition with the concurrent investment in ICT. The period 2004–2007 is characterised by readjustments as the basic principles of lifelong education, and its association with information society, in economic terms, was a reality. A gradual shift from the policy of intentions of the former texts to the implementation of the European Union principles and standpoints is noticed. However, there is limited argumentation, and the texts forwarded to nation-states mostly include guidelines about the issues to be implemented. They are tied to the already shaped adjustments of nation-states to the unified educational model (Hoodge 1996).

Nation-states have been systematically reporting their action plans, since 2004, which concentrate mainly on quantitative data, depicting the performance or non-performance of the unification plan. Appraisal reports of nation-states about lifelong education and new technologies promotion are of special interest. On the basis of the progress reported in the action plans, nation-states are informally grouped along with their articulations about the necessity to achieve the goals set for lifelong education and ICT access.

Nation-states' non-conformity is characteristically deemed undermining of the European Union viability. Moreover, any disagreements, the different national cultures or peculiarities of the states' economic development are not utilised at all.

Lifelong Education as a Dynamic Form of Education

In 2000, lifelong education is particularly highlighted with the extended reference to its definition as an informal education. It is noteworthy that the individual is deemed educable in all life stages conducive to establishing a dialogue about the content and quality of the education provided. According to the special texts of the Memorandum on lifelong education (2002), priority lies on skills and knowledge acquisition. As a result, knowledge is manageable and, at the same time, forwarded to the economic system by people themselves. In other words, the technological and economic changes point at the modification of people's knowledge, cast of mind, behaviour and values.

This way, they would be in an endless process of acquiring "knowledge packages" (Kalerante 2012, 2013) in order to achieve their integration into the professional mainstream and get prepared for new labour conditions. Traditional educational grades have been characteristically integrated into the rationale of knowledge management. Thus, a new educational culture has been shaped according to which learning or knowledge is tied to labour. Overall, emphasis is eventually placed on skills acquisition or training.

The restructuring of national and social programmes was particularly put forward in 2006. Despite the fact that new generation is referred to in the introductory part in terms of complete actions, emphasis is placed on special forms of education and training in order that individuals' training takes place within a competitive environment. Moreover, no reference is made to different labour relations and the ineffective policy of labour rights. In this framework, the notion of lifelong education, being a form of training corresponding to changing economic conditions and an outcome of political choices and ideological frameworks, is eventually withheld. Therefore, the restructuring represents a general ineffectiveness in the management of the recently formed economic conditions within the European Union.

Lifelong education was associated with new technologies, e-Learning in particular, as an open educational system, which, based on limited costs, would readjust to a type of training for larger groups. e-Learning was expected to generate an educational environment based on effective educational forms by familiarising people with the digital culture in a society of intensified dependence on network spaces (Commission Staff Working Paper-An Interim Report as requested by the Council Resolution 2001).

From 2001 until 2004, e-Learning was systematically put forward in an attempt to associate lifelong education with it in the form of a European educational plan in order that working individuals be familiarised with new skills acquisition (Commission Communication 2001; Commission Proposal for a Recommendation of the European Parliament and of the Council 2005). The development of digital "mentality" within a European culture of educational means was emphasised. In this respect, both digital technology and lifelong education are considered to contribute to unifying experiences among European citizens conducive to supporting the economic development model. Qualitative education is tied to e-Learning and lifelong education. At the same time, it is disconnected from the traditional conceptualisations of knowledge, built upon a humanistic content. Therefore, the principles of an economic model based on adjustment and discipline are underpinned.

Educational Culture Within the Changing Information Society

A gradual orientation of European education towards an unifying educational form was noticed throughout 1995–2010. At the same time, the concepts of progress and prosperity were included in its argumentation aiming at an educational model that would take into consideration the rapid changes in the information and communication technologies within the society. This was based on a democratic principle about social inequalities shrinking (Gottfried 2011). This issue is tied to technical and cognitive transformations of knowledge within a changing labour market in which organised societies are affected by the cognitive capital. Thus, new environments are mapped due to deconstructions or changes within broader re-organisations. As a result, the role of education is differentiated from traditional schooling which defines the beginning and completion of studies (Wingard and LaPointe 2015).

Lifelong education has been established both as a system and condition tied to formal and informal education and training due to the economy-related transformations in the technological field. These are based on the supplementary nature of knowledge conducive to re-integrating individuals into the economic, social and cultural environment (Kalogiannaki 2002; Nikolaou 2006). Opportunities equality along with enhanced lifelong education and training was underpinned in liberal terms. Consequently, people are not marginalised, and knowledge redistribution leads to a reformulated dialogue, while individuals are introduced to novice environments.

Theoretically speaking, the European Union was considered to be capable of managing cognitive and technological fields towards the generation of new educational models in terms of a lifelong process (Maloy and Verock 2013). In this respect, the receivers of knowledge were expanded beyond the common young age groups. The content, quality and carriers of knowledge have gradually undergone a change due to instructional shifts. Thus, a new school culture has emerged in which both technology and lifelong education are portrayed rather as symbols and values within a unifying European society. Its members are prepared to live and create within a multiplicity of objectives.

Solitary nation-states' discourse seems to be enfeebled due to rapid economic changes because of the fear of either rejection and marginalisation or the consequent insecurity and uncertainty. Therefore, more favourable conditions emerge towards an unifying lifelong education model in which the information society is both highlighted and utilised leading to homogeneity on the basis of an intensified form of education and training. As a result, ideas, considerations, attitudes and behaviours are integrated into a system of meanings which is part of the evolving educational culture. A shift from the nation-states' historical interpretations to the corresponding European Union approaches is noticed, and it is orientated to new educational technocrat models.

Conclusions

The effective integration of ICT and lifelong education is underpinned by the unifying European education (Tsaousis 1994, 1996). The adult population should be familiarised with new learning environments and virtual networks in their attempt to acquire more skills on e-Learning (Communication from the Commission to the Council and the European Parliament 2001). In 1995, the first references were made to an unifying educational system. However, this has become more systematic since 2000, with strong emphasis on lifelong education. It is explicitly stated that individuals with or without professional roles should be initiated to new economic demands in order to be part of the European economic development system (Council Resolution 2002).

The European Union committees have gradually shifted from articulating simple proposals or intentions to a more systematic establishment of educational standpoints. Conformity is the basic prerequisite so that nation-states integrate into new information environments and into the lifelong necessity of training within insecure and uncertain labour environments in which labour or legalised rights stability belongs to the past. This policy primarily addresses lower social strata that should continuously manage new “knowledge packages” and skills acquisition within changing labour conditions pointing at a continuous exchange between unemployment and flexible forms of labour.

It is noteworthy that terms such as social cohesion, solidarity and mobility are the focal points in the theory of the European texts about education which have been issued by the special committees. Moreover, the unifying European citizen model is emphasised (Hantrais 1995) by withholding any emerging differentiations in the European people’s economic situations. Additionally, limitations in mobility are dissimulated within a policy of isolation or marginalisation on the basis of which nation-states and citizens are gradually excluded. As a result, social inequality is maximised within them, whereas leading groups and authority centres emerge. The people’s education based on humanitarian learning and using information networks to spread real-life problems could operate as a counter-paradigm to the established European policy. In this respect, new prerequisites could be created by the actual deliberation in social networks and on the basis of new technologies.

All in all, the policy about lifelong education and information society depicted throughout 2014–2015 and integrated into the Greek reality, as well, is not a new issue. On the contrary, it is a continuation of a planned policy about lifelong education and its association with information society. It is important to mention that lifelong education has been put forward as a European educational policy under different economic and political conditions. Furthermore, it has been gradually enriched with different themes tied to theoretical approaches and practice since 1990. The commencement of a European educational policy about lifelong education with the simultaneous development and integration of new technologies into the educational environment is established by the historic flashback. As a result, the educational and European policies dynamics are elevated as functional requirements interconnected with the future of European citizens (Keating 2014).

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Chapter 21
Teachers' Professional Development in the Theme of Competence-Based Learning—Impact and Lessons Learnt

Katerina Riviou and Sofoklis Sotiriou

Introduction

Key competence acquisition (KCA) is one of the long-term objectives of the updated strategic framework for European cooperation (Official Journal of the European Union 2009). The concept of key competence originated with the adoption of the Lisbon Strategy in 2000, and it resulted in the European Reference Framework (European Commission 2006). Key competences in the EU framework are those that "all individuals need for personal fulfilment and development, active citizenship, social inclusion and employment". The framework identifies and defines eight key competences among which the five are considered transversal. Most of the EU Member States are beginning to implement policies that move their school systems from being predominantly subject-oriented towards curricula, which include competences, as well as active and individual learning. One such example is Greece, where in the school year 2011–2012, pilot curricula for competence-driven education have been introduced. In other countries (e.g. France, the Netherlands), innovative policies are already embedded in national strategy documents, and in some cases, these have already led to major structural changes, such as the introduction of new qualification frameworks or the reform of the curriculum around the key competences (European Commission 2009a). In general, there is a variety of different models of competences in European countries (European Commission/EACEA/Eurydice 2012). Yet, these developments do not necessarily result in

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significant, widespread changes in practice—that is, in how schools actually organize and provide learning experiences for pupils. The difficulty is in all cases translating these policies into practice. One of the core problems for the effective implementation of the above policies is the lack of initial education and training, as well as systematic support of teachers. One more obstacle regarding KCA is the lack of effective assessment practices. Assessment of competence is one of the vehicles that can be used to support teachers in making this paradigm shift (Black and William 1998). This places new demands on the competences of teachers and trainers and therefore on the structure and content of initial and continuing teacher education (European Commission 2009b). To this end, an intervention has been designed in the context of European-funded projects (see section on Current Initiatives) aiming to support teachers at bridging the gap between policy and practice on a European scale.

In this chapter, we present the current state of competence-based learning (CBL) policy and practice in Greece, an overview from the needs analysis study, the design, and localization of the training framework and environment based on the collected responses and the specifications set from the Greek curriculum, with the goal to deliver a CPD programme for teachers. Results are presented regarding the effectiveness of the design of this programme by data collected from participants. Moreover, in order to support the CPD effectively we developed online communities of practice, as well as community support services. The impact of these services/events is measured based on qualitative and well quantitative data. Lessons learnt, as well as recommendations for the design of further CPD programs, are presented.

Background

The term "community of practice" (CoP) is a social networking term developed by Etienne Wenger to describe groups that form among peers for sharing knowledge and information about their professional interests and activities (Wenger 1998). The first applications of CoPs have been in teacher training and in providing isolated administrators with access to colleagues. There is a wave of interest in these peer-to-peer professional—development activities (Domingo et al. 2015). While there is a wealth of literature in exploring the conceptual and theoretical issues related to CoPs, empirical studies have only just started to emerge that show how CoPs can work and be sustained in the educational community (Kirschner and Lai 2007). Studies such as the ITCOLE project (Leinonen et al. 2001) show that sharing past experiences leads to innovative future practices and furthermore that community members were more likely to develop a more conscious involvement in the activity and create knowledge (Printy 2008; Barwick et al. 2009). The CoPs can be deployed to effectively support and nurture innovative teachers in schools across Europe. Innovative strategies will be strengthened within the CoP framework (Sobrero and Craycraft 2008). According to McLaughlin and Talbert (2006) in all instances of significant school culture change, leadership from within or outside the school was involved in getting the community development process started. The active involvement of school leaders in the change process is crucial (Fullan 1997) as it gives encouragement to the change instigators as well as to the change adopters. Leadership can then be distributed, and the person who undertakes the role of the community manager needs to identify important issues to focus the community's work; plan and facilitate community events; foster the development of community members as individual learners; help build the practice of group learning—including the knowledge base, lessons learned, best practices, tools and methods, and learning events; and assess the health of the community and evaluate it. According to Sprague (2006), there is a variety of models for CPD, but further research is needed on the themes of their effectiveness and their impact on teachers' practice. These questions have been dealt, and outcomes are presented. Below follows a short description of the two initiatives in the field of teachers' CPD under which the specific research has been undertaken. In the following sessions, we will present the concrete actions implemented in order to implement the aforementioned steps, as well as the impact and effectiveness of the interventions.

Current Initiatives

In line with the EU objectives, the improvement and quality of teacher education can have a positive impact on the development of students' competencies (Official EU Journal 2007). In order to achieve this, a pilot teacher training methodology was developed. The TRANSIt approach is founded on a holistic view of students' learning, going beyond subject boundaries. The project aims to contribute towards the improvement of the quality of CBL by improving teachers' awareness and skills regarding the didactics and e-assessment of the key competences with the use of e-Portfolios. The overall approach taken towards delivery of the training is based on the methodological principles of participatory design with the user groups. To this end, stakeholders' needs analysis was performed. In parallel, the main aim of open discovery space (ODS) (Athanasiadis et al. 2014) is to engage teachers, parents, educational content designers, and policy makers in numerous online communities of peers who create, share, discuss, and rate resources in a way that fosters innovation in the classroom.

Current State of Competence-Based Learning in Greece

CBL activities are defined in the present study as educational activities aimed to foster students' KCA. The method by which competences have been introduced in the education system varies among countries. Some have introduced these approaches through adaptations of the curriculum, while others have done it through legislative change (Gordon et al. 2009). In order to identify the profiles of the possible participants in training activities, their current implementation of CBL in class, and their needs, an online questionnaire has been circulated and 648 responses were collected in Greece (Riviou and Sotiriou 2013).

Training Framework

The TRANSIt Teacher Competency Framework defines the criteria from which it will be possible for a teacher to determine how competent they are in didactics and e-assessment of transversal key competences with the use of rubrics. A competence framework is a model that broadly defines the blueprint for "excellent" performance. The frameworks that influenced its design were the UNESCO ICT Competency Framework for Teachers (UN 2011) and the Western Australia Teacher Competency Framework (2009). The TRANSIt Competency Framework comprises of four dimensions and three stages. The four dimensions are as follows: (1) facilitating student learning, (2) assessing and reporting student learning outcomes, (3) engaging in continuing professional development, and (4) establishing partnerships and collaborations. Each dimension describes the generic characteristics of teachers' work that are central to their professional effectiveness. Within these dimensions are indicators of effective practice, which are competency-related professional actions. Based on the needs analysis survey, the training framework (http://transit.cti.gr/moodle/) has been designed following a social constructivist approach and in a modular format, so that it could be localized among the different partner countries. To this end, a combination of open source tools has been chosen: Moodle for delivering the training resources and Mahara as e-Portfolio tool. Teachers taking the course or course modules are handled as learners participating in authentic activities and creating and using e-Portfolios as part of their learning process. In order for assessment to be authentic, the proposed approach is the use of e-Portfolio combined with rubrics, in two levels, in teachers' training/competence development, as well as for the classroom practice. The approach towards supporting teachers in designing learning scenarios is to provide exemplar templates or descriptions which can be shared, reused, and adapted to different contexts. Below follows the description of the didactic approaches, suggested to be used by members of the online community in order to design and share their resources.

Didactic Approaches Promoting Competence-Based Learning

According to the literature findings among the didactic approaches that promote competence acquisition are project-based learning, the storyline approach, guided discovery, action learning, problem-based learning, and inquiry learning. A review by the EPPI-Centre at the Institute of Education, University of London (2005), found that collaborative professional development was linked with a positive impact upon teachers' repertoire of teaching and learning strategies and their commitment to continuing development. They also found evidence that such professional development was linked with a positive impact upon student learning outcomes. Additionally, recent studies highlight the value—in terms of professional development—of engaging teachers as learning designers (Sagy and Kali 2014; Voogt et al. 2011). To this end, in order to support the design and sharing of scenarios designed by teachers, suggested templates describing the above-mentioned pedagogical approaches, as well as specific scenarios and lesson plans, have been developed as demonstrators for teachers.

Supporting the Professional Development Community on the Thematic Area of CBL

The key to effective professional development is finding a way to organize qualified teachers, so they can collaborate with their colleagues. Collaboration and exchange of practices need to be encouraged through training. To this end, a parent community has been created in English and then multilingual subcommunities for users' support (EL, NL, ES, FR). Moreover, with an aim to support the engagement of teachers as learning designers, a series of online and offline events have been delivered along with support via online resources provision. A short description follows, as well as the dates of the events delivery, since these events have been found to have an impact on the community. Moreover, newsletters have been circulated through already established affiliated networks, such as eTwinning. The dates that these newsletters have been circulated are as follows: 17/6/2014, 6/8/2014, 4/9/2014, and 19/11/2014. On the latter date, an invitation from the Institute of Pedagogy has been circulated to schools to participate in the implementation activities.

Resourcing the Community: Development of Online Resources

Templates developed describing the CBL approaches have been populated with resources leading to the production of model learning scenarios and lesson plans, e.g. "3d printing of a minoic vase" (http://portal.opendiscoveryspace.eu/node/689951) associated with the national curriculum. These scenarios have been available online in the community as demonstrators with an aim to motivate users to contribute their own scenarios, resources, and experiences.

Events as Community Support Mechanisms (Face to Face and Online Ones)

In the case of Greece at the time of writing, the following programme has been designed and delivered: provision of the online pilot course, as well as face-to-face training workshops that took place in Athens, Patras, and Heraklion in 24/6/2014, 1/7/2014, 3/7/2014 and 19/9/2014. Each time instructions have been provided online on the Greek community. After implementation, all materials have been uploaded on the community so that all members could have access. The number of registrations has been huge, even 15-fold the number of people that could be facilitated. Moreover, a series of webinars has been delivered in Greek: “Evaluation and TEL integration in project-based learning” (23.6.2014); “I will facilitate a project this year, what do I need to know?” (15.9.2014); and “Authentic evaluation: Use of e-Portfolio tools in projects”, (23.10.2014). The recording of the webinars was available after the conduction as videos on YouTube. The webinar recordings have in some cases more than 1.600 views demonstrating the value of sharing events in the context of an online community.

Data Collection Methods

Underpinning the evaluation strategy, two key performance indicators (KPIs) have been defined to assess the success of the CPD programme, effectiveness, and usefulness (Alcaraz-Domínguez and Barajas 2014). These indicators have led to the use of a combination of quantitative and qualitative data collection instruments (Riviou 2014). The questionnaire for participants in the implementation phase (two pilots) has been designed on the basis of existing, validated data collection tools. The first part of the questionnaire has been adapted from the Constructivist On-Line Learning Environment Survey (COLLES) introduced to assess the postgraduate distance education for teachers (Taylor and Maor 2000). The second part of the questionnaire focuses on participants’ experience with the e-Portfolio assessment method. Previous studies have shown correlations between learning motivation and e-Portfolio satisfaction (Huang et al. 2011). In particular, Jun et al. (2007) has developed a survey to assess an e-Portfolio-based professional development programme for teachers. In order to obtain a deeper understanding of the learning outcomes and the feelings that participants have experimented, qualitative data collection instruments have been designed. Moreover, an event satisfaction form has been designed for participants to express their opinion about the content, organization, and other practical aspects of the activities in which they have participated. The following tools have been used: e-Portfolio assessment method, interviews, and skills check/monitoring competence profile development. Additionally, analytics data from the online community have been collected with use of the ODS Analytics tool.

Seventy (70) education stakeholders have participated in the three face-to-face workshops; a much bigger number (N = 256) has participated synchronously on the online activities (webinars), whereas a much bigger number has been involved indirectly in the activities, based on the number of views and members that the online community has attracted ($\sim$2500 views of the webinars; 748 registered community members). In the following subsections, an overview is presented.

Qualitative Indicators

The learning artefacts uploaded on the community such as learning scenarios and assessment plans have been compared with the success criteria stated in the training framework, following the e-Portfolio assessment method. Moreover, teachers participating in the training had the chance to review and rate learning scenarios produced by colleagues in multiple ways and in a number of occasions such as the contest about design of educational activities that took place in the community. Participants in trainings (and registered members of the community in general) had the chance to invite others in order to coauthor their learning scenarios. Outcomes of the peer review are a positive indicator regarding the efficiency of the training programme.

Interviews conducted allowed gaining deeper knowledge on specific aspects of CBL, as well as a way to record the impact of the community supporting events. Moreover, the attitudes of participants regarding the exploitation of the ODS portal resources, as well as their feedback regarding the community mechanisms, have been surveyed. Participants value the knowledge they gained on European and local policies regarding student acquisition of transversal key competences. They are rather satisfied about the best practices/scenarios demonstrated, as well as about the skills they developed regarding planning, structuring, and sequencing cross-curricular learning activities with ICT tools. In particular, the interviewees highlight the value of learning how to share resources and practices and collaborate with other teachers. All participants (100 %) would recommend the events to colleagues, a fact that shows the overall satisfaction from them. Regarding the exploitation of the application of what has been learnt 65 % claims that they will implement it in their classrooms the upcoming school year.

All interviewees state that as a result of the events, they have participated in their awareness on transversal key competences, as well as the ways that transversal key competences affect their current practice in class have been increased. They can see how educational practices based on project-based learning can help them to design and implement learning scenarios that foster students' competences. One teacher more specifically mentions that now her interest would be to focus not only on general aims set for every scenario or project but also on the specific competences/skills that students need to acquire so that they become active and responsible citizens. Two teachers believe that e-assessment of competences is a difficult task and ICT tools are a means for focusing and aiming at competence acquisition for twenty-first-century citizens. Six teachers mention the benefits of keeping electronic records from their students' achievement in the form of e-portfolio. One teacher mentions that strategies need to be set for assessing the themes crossing competences: creativity, critical thinking, initiative, etc.

The training has been also assessed from the scope of usefulness, i.e. to what extent the training design, the assessment system, and the learning processes satisfy teachers' needs and expectations. Regarding training, design teachers were satisfied to a great extent, and they state that the training module design reflects accurately the activities included in their teaching practice (4.4 out of 5). Participants are also satisfied with the training materials provided (4.3 out of 5). Teachers value the practical knowledge gained, by an average of 4.0 out of 5. Regarding assessment approaches, participants' opinion about the e-Portfolio and the evidence-based assessment approach has been gathered with 4 items from the questionnaire for participants. Items have been graded on a scale between 1 and 5 (see table below).

Item	Average
I would recommend to my fellow teachers that they use the e-Portfolio to demonstrate fulfilment of national teacher quality standards	4.4
I have spoken to colleagues about my use of the e-Portfolio	3.6
I have found it easy to communicate with administrators and mentors about the materials I have collected in my e-Portfolio	3.6
My head teachers have been supportive and helpful in my use of the e-Portfolio	2.2

Results show that generally, teachers are satisfied with the learning processes taking place in the training activities because their actual experience is almost equal to what they usually prefer. Mean values of all the statements in each of the 6 scales of the questionnaire have been calculated as such: relevance (M = 0.7); reflection (M = 0.6); interactivity (M = 0.2); interpretation (M = 1.2); tutor support (M = 0.4); and peer support (M = 0.8). Mean values demonstrate that generally, the result of the subtraction is close to zero. This suggests that community members are satisfied with the learning processes taking place because their experience is close to what they usually prefer.

According to findings, 77 % of the participants use digital resources in a regular basis, 69 % of the participants have expressed the desire to visit ODS regularly to search for reliable content and scenarios, and 55 % claim that they would contribute and share their resources with the community. Such findings are in full agreement with what is expected in the early phases in the life of an educational portal. More specifically, those that have been interviewed are generally in favour of participating in an online community in which teachers share and collaboratively design learning scenarios and resources. An interested outcome of the survey conducted with participants in pilots is that on the possible conduction of further CPD activities, 32 % of the participants would prefer them to be face to face, 24 % would prefer them to be online/distance only, and 45 % would prefer a blended learning approach (25 % face to face, 75 % online). This outcome confirms the importance and value that online learning in dedicated communities has for teachers and is a positive factor for the community support events/activities in Greece where a blended learning approach has been followed.

Quantitative Indicators

In the following section, indicators about the Greek community currently counting 748 members (July 2015) are presented with the use of the ODS Analytics tool. The progress in registrations of new members took place highly connected with the professional development activities and events. The Greek community on the theme of CBL is a public one, allowing access to its resources to all ODS members. There are about 15,000 page views over the period June 2014–July 2015. As it is clearly evident, there is a considerable increase in interest, as the number of page visits demonstrates, especially on the dates that community support events took place such as circulation of the aforementioned newsletters and workshops (marked with asterisks) (Fig. 21.1).

Figure 21.2a presents the use of social data (comments, bookmarks, followed users, followed, shares, and followers) in the community, as well as social tagging of the educational resources. Again, it is evident that there is a considerable online activity around the dates that the aforementioned events took place (marked with asterisks).

In Fig. 21.3a, the community members' progress versus new resources progression is depicted. These findings are aligned with literature findings that most of the website users (as high as 80 %) who log onto a site are "lurkers"—they will take an occasional look at a website but will not participate in it; the participants, also called "posters" or "contributors", are in the minority. According to Widenman (2010), members of newly built CPD communities tend to avoid sharing their own material, before establishing a sense of trust that separates true communities of peers from pseudo-communities of members with assumed profiles. As depicted in

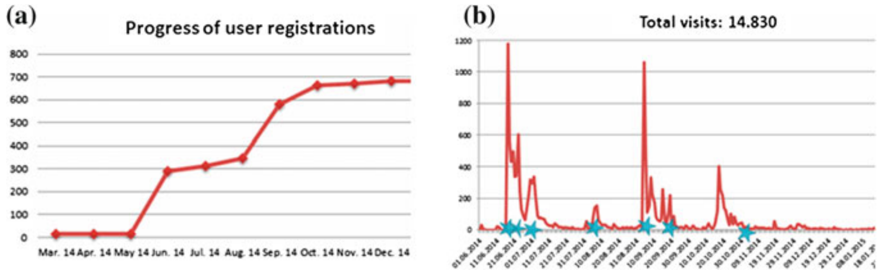

Fig. 21.1 **a** Progress in registration of new users in TRANSIt community (*left*). **b** Total visits of community (*right*)

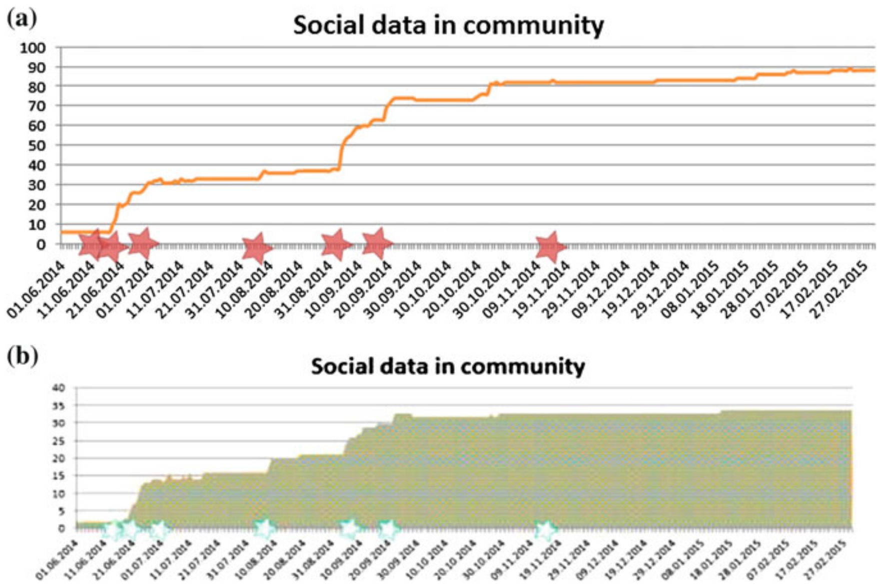

Fig. 21.2 **a** Social data in Greek TRANSIt community (*left*). **b** Social data on the resources of the community (e.g. tags, bookmarks, comments) (*right*)

Fig. 21.3b, almost one in ten users create and contribute resources on the portal. One of the challenges is therefore fostering such a culture to participants in sharing their educational resources and deploying the proper tools in order to engage them. In Fig. 21.3, the community members' contributions on the portal are presented and thus their engagement. As we can notice, there is a considerable difference between contributions in general (activity in the communities) versus the creation and sharing of new resources. Participants are quite hesitant in sharing their educational resources; therefore, such culture needs to be promoted. From the number of users, 90 % are considered as "old" users, more than 3 months, and contributors are all old users (not newcomers in the portal). Moreover, most of the contributors feel that are competent having self-assessed their competences on level 3; they feel confident about their competences based on the UNESCO ICT Competence Framework (Fig. 21.4).

Community Members Competence—Monitoring Competence Development

When teachers register in the portal, they have the opportunity to monitor competence development by completing or updating their individual competence profile, based on the self-assessment tool created following the UNESCO ICT

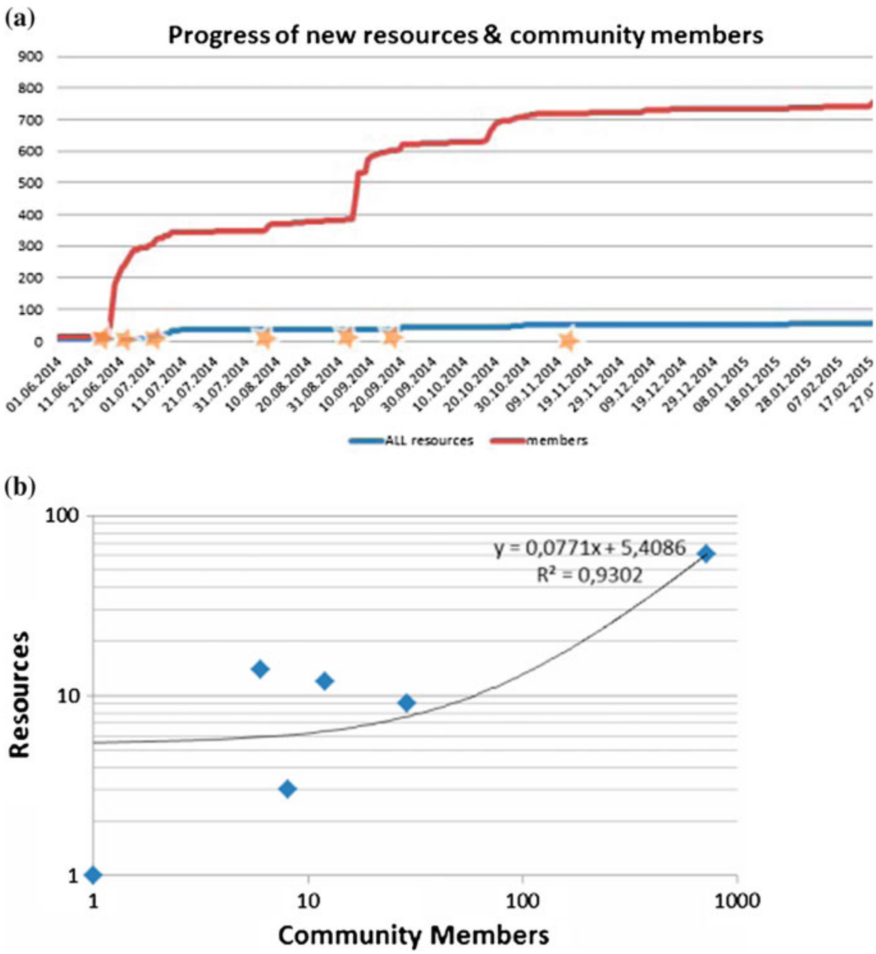

Fig. 21.3 **a** Progress in new resources and community members (*left*). **b** Percentage of users that contribute resources on portal (*right*)

Competency Framework for Teachers (2011). Figure 21.4 depicts the distribution in the three levels on all six aspects of the competence profile among the teachers/contributors on the community. Although there is a significant number not having completed their profiles (self-assessed), we can see that most of the contributors feel who are competent to have self-assessed their competences on level 3. This is of importance regarding the profile of users that contribute the most in the online communities; they feel confident about their competences.

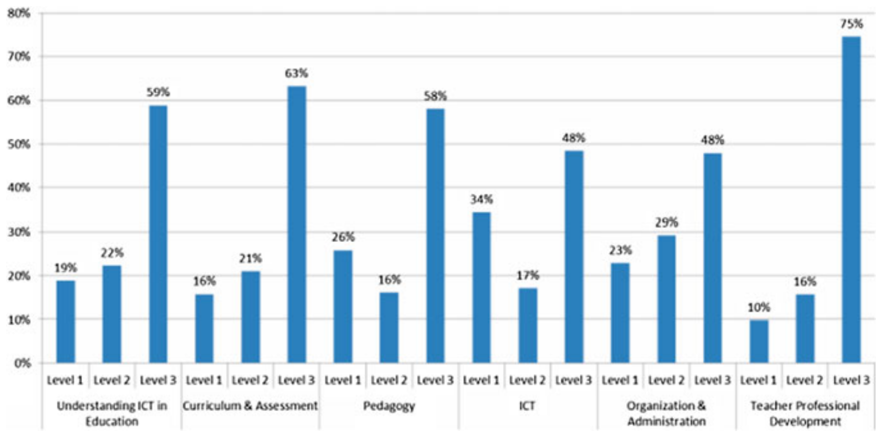

Fig. 21.4 Community members' competence profile of contributors in the community (as completed during registration on the portal)

Conclusion and Recommendations

In general, the EU is prioritizing the improvement of the quality of teacher education so as to have a direct effect upon levels of students' acquisition of competences. Therefore, the professional development of teachers and their training is a key requirement for the way forward (European Commission 2010). Our needs analysis and participation in training events confirm that given the limitations imposed by the official curriculum in Greece, teachers are generally motivated to make a paradigm shift towards CBL. The profile of the participants demonstrates that there is a strong interest especially by secondary education teachers to get trained and exchange practices within peer networks and communities of practice. This is aligned with the literature findings that the situation is even worse for teachers of secondary education since their training has not prepared them for the most part for holistic methods and cross-curricular teaching (European Commission 2009a). The preference of teachers to learn primarily from the demonstration of tools and instruments, practical assignments, and examples of good practices demonstrates the need of stakeholders to undertake hands-on training and that teachers need support in their everyday practice.

TRANSIt training framework and environment have been presented. The training content includes good practices and tries to address the training needs with an emphasis on assessment methods and tools, taking also into consideration European reports (Redecker 2013), as well as the national context requirements. The key to effective professional development is finding a way to organize qualified teachers, so they can collaborate with colleagues. Collaboration and exchange of practices need to be encouraged through training, let alone since participants refer to the benefits of collaboration with colleagues. Events such as contests and webinars and wide dissemination of such activities have proven to be a valuable tool for the support and population of these communities. Time is needed so that a new user proceeds from the basis of consuming content to the process of contributing. The feedback we got through the interviews conducted so far is that teachers would be eager to contribute their resources on the portal. As shown by contributions per user, participants are quite hesitant; therefore, such a culture needs to be fostered. To this end, some activities preparing participants so that they feel confident with their ICT skills would be useful towards their sharing of resources with the community. In this context which is also based on our results, particular support needs to be provided to the leaders in CoPs, since it has been found that team leaders play a central role in determining team performance (Wen et al. 2015). Moreover, it has been proven combination of top-down with bottom-up approaches (involvement of the Institute of Pedagogy), and affiliations with already established networks could be possibly helpful towards attracting members in training activities. The possible ineffectiveness of top-down approaches in providing support and training for teachers makes the support and role of online communities such the ones presented in the current study even more crucial.

Further work remains support and monitoring of the community under study in order to increase its users' engagement. Further step could be taking teachers' CPD to scale, taking also under consideration the fact that massive open online courses (MOOCs) present a potentially useful approach to professional learning (Milligan and Littlejohn 2014). Thus, an upcoming delivery of the training would possibly take the format of a MOOC following the connectivist approach (Siemens 2004), where networking of people, resources, and repurposing and reuse of resources would be the target. The same principles could be followed (social constructivist approach) so that participants could work in small, collaborative groups. Groups of participants could be formed based on some social networking analysis (SNA) techniques to diagnose learners and automatically cluster them according to the most suited subcommunity in MOOCs (Zhuhadar and Butterfield 2014).

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