Examining the Roles of Teachers and Students in Mastering New Technologies

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A volume in the Advances in Educational Technologies and Instructional Design (AETID) Book Series

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While the principles of the personalisation of study plans are now affirmed at scientific level and in the school world and while, at the same time, a sturdy current of educationalists sees in new technologies a "tool" that must be used appropriately, reflections on the personalisation of ICT in relation to different learning styles still seem scarce, particularly with regard to its use in differentiated teaching strategies, as a means of support for students with disabilities or learning difficulties as well as in ordinary teaching. In this chapter, the authors develop a thread of reasoning conducive to exploring the use of ICT in the more general context of pedagogy and teaching to promote a development that is integrated and not exclusive or alternative to methodologies that have already been experimented by teachers in their professional roles, focussing on the concept of differentiated teaching and giving some operational proposals of integrated learning environments by way of example.

The study aims to construct an innovation-based digital learning material (DLM) development ecosystem that penetrates and sustains within the school culture in order to diffuse and maintain DLM development. Sixty-two teachers from 21 different branches participated in this nested mixed design study. Data were collected through scales and interviews, and the study was based on the steps adopted by Rogers on the diffusion of innovation. Quantitative data were analysed with cluster analysis, logistic and multi-linear regression. Qualitative data were analysed with structural, in vivo, and axial coding in order to construct the ecosystem. The findings demonstrate that the main variables, which were determined to influence the adoption and sustenance of DLM development by teachers, were the support of administrators and colleagues, the willingness and need to develop DLM, computer knowledge, and DLM development self-efficacy.

With the advent of big data, the search for respective data experts has become more intensive. This study aims to discuss data scientist skills and some topical issues that are related to data specialist profiles. A complex competence model has been deployed, dividing the skills into three groups: hard, soft, and analytical skills. The primary focus is on analytical thinking as one of the key competences of

This chapter aims to shed light on university teachers' adoption and use of information communication technologies (ICT) at a university in its awareness/exploration stage of blended learning adoption. The goal was to identify how teachers' attitudes to innovation adoption influences the adoption of ICT for teaching/learning. An online survey showed substantial differences between first adopters and followers regarding the perceived importance of factors affecting ICT adoption ("financial support/stipend" and "the availability of online training for teachers"), and perceived usefulness of learning management system activities (quizzes, discussion boards, and assignments). Identifying first adopters and followers can assist universities in the awareness/exploration stage in recognizing the ways in which first adopters differ from followers and consequently help both groups to facilitate a strategic and optimal ICT adoption and implementation of blended learning.

Today's online world provides foreign language users and learners with a multitude of opportunities to engage in a variety of language activities. A social group that can derive major benefits from the availability of online resources in different languages is foreign language teachers. Based on an 'emic' approach, this study involves case studies of three experienced foreign language teachers that used diaries over a period of eight weeks to report on every instance of online use of their predominant foreign language and English. Semi-structured interviews were used to obtain insight into online behaviour that was not specifically related to the eight-week period of diary-keeping. The results indicate that the online uses of the three participants, although they belong to the same social and age groups, display great variety in terms of online activities and the predominant language used to perform these activities.

This chapter aims to explore the teacher´s role in foreign language instruction (FLI) supported by information and communication technology (ICT). The recent research on the impact of ICT on the teacher´s role in FLI indicates changes in the role of the teacher. However, there has been little empirical evidence on the nature of this change in foreign language classes. To fill this research gap, a multiple-case study of three teachers and 78 students in three secondary school classes in Slovenia was conducted. This chapter presents an in-depth analysis of sections of semi-structured interviews and class observations

Foreword

Driven by science and technology, the modern world is developing at a rapid, ever accelerating pace. In these circumstances, teachers at all educational levels are faced with new challenges. Our objective is to assist students to acquire new competences required in their future jobs. Many of these competences are closely related to scientific and technological progress; thus, many of these jobs have yet to evolve.

Modern education is faced with radical changes in various core concepts and practices. The consequence of this paradigm shift is reflected in the latest approaches to curriculum design and use of new technologies. The traditional approach, where the focus was on the teacher, is moving toward a more student-centered education. Yet in such a situation it is hard to secure the future of education, especially if both teachers and students are not willing to be part of these transitions, where the sole constant is change. The authorities responsible for education should be aware of these radical changes and properly support educators, managers of education organizations, and all other stakeholders.

Mastering new technologies and determining their proper implementation in education represents an important prerequisite for educators. Modern technologies enable them to be part of this change. The role of the teacher is to prepare the teaching/learning environment where new technologies encourage students' learning and at the same time offer them new learning and other opportunities. No matter the degree of the shift towards student-centered learning, the teachers should be able to competently establish their new role. On the other hand, to be part of the teaching/learning environment, students should be able to effectively use these technologies and have a sufficient level of digital literacy. In fact, they should perceive these technologies as serious tools, relevant for the acquisition of knowledge. At the same time, they should acknowledge and accept the new role of the teacher in this environment. Furthermore, managers of educational organizations play a prominent role in these processes. Their task is to continuously encourage both teachers and students in this process by providing adequate support to both groups: to teachers by formally implementing lifelong learning education in the use of these technologies, and to students by providing additional assistance when required. Furthermore, management of these organizations should also establish a plan for implementation of these technologies in education; provide adequate financial and human resources, especially support for teachers as in many cases these technologies represent a substantial change in teaching/learning methodologies. Last, but not least, these technologies have an important role in inclusive pedagogy by providing a new communication channels that allows each individual to be present in their study and at the same time equally valued. In brief, relying on a chaotic instead of a systematic approach to implementation of modern technologies in education by relying only on the efforts of enthusiast teachers, or worse, leaving their development to coincidence, could represent a latent danger, potentially catastrophic. Finally, a systematic approach to implementation of new technologies in education can reduce the anxiety that many teachers and students have when working with these technologies.

The purpose of the book, *Examining the Roles of Teachers and Students in Mastering New Technologies*, is to raise the awareness of the importance of mastering new technologies in education by focusing on pedagogical, sociological, and organizational aspects rather than just a technical perspective. Hence, this book emphasizes the opportunities that these technologies provide by presenting to the audience (i.e., teachers, educational organization management, curricula developers, and other interested stakeholders) current studies as well as new solutions and recommendations to the problems that educators and management face when implementing new technologies. In other words, the goal is to assist the audience in bridging the gap between adding new technologies to the curriculum and practically applying in pedagogical and managerial practice. In fact, the readers of this book will gain insights into best practices of implementation of new technologies in real courses and real educational organizations.

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Preface

In the preface to the book, *Examining the Roles of Teachers and Students in Mastering New Technologies*, an overview of the subject is first presented. Next, the target audience is described. The majority of the preface concerns a description of the structure of the book. The last section addresses the relevance of the findings for the target audience.

OVERVIEW OF THE SUBJECT

The development of technologies, education and economy plays an important role in modern society. Technological literacy is important for someone's personal development as well as economic growth of the society. New technologies help individuals to develop their own capabilities and abilities to live in the modern society (Roberts, 2000), and to work and develop a career (Gray, 1999).

In the modern era the educational process can be defined as blended, combining face-to-face instruction with internet-based education (Khee et al., 2014; Dečman, 2015). Technological education and learning can be different from conventional forms of education, but they also share several fundamental features. Technological learning gives students specific knowledge – mostly the knowledge of using new technologies in their everyday lives and in their careers. Teachers use different technologies as tools during the educational process: iPods (Khee et al., 2014), blogs (Tajuddin et al., 2012; Ifinedo, 2017), communities of practice (Nistor et al., 2014), mobile phones and tablets (Sanchez-Prieto et al., 2016, Sanchez-Prieto et al., 2017; Briz-Ponce et al., 2017; Hsieh et al., 2017), interactive whiteboards (Šumak & Šorgo, 2016), social media (Acarli & Saglam, 2015), and others.

The emphasis of the modern educational system has to be placed on the sharing of knowledge, not just information. Teachers have to focus on the content, causes and implications of the shared knowledge. The student cannot be just the receptor of such knowledge but has to understand its importance. A bad school grade presents just a warning for the students and an indication that they have to apply themselves more. The students need to recognize the development that they have made in a specific topic during a period of time. The teacher has to understand which topics need more explanations.

To understand and enhance the effectiveness of technological education we need to distinguish between knowledge and information. The knowledge is defined as "a series of persons' stable and interconnected concepts" (Mohorič, 1999, p. 445), not just single pieces of information. Information does not present a sufficient tool to gain knowledge. Knowledge is divided into different parts. One of them is literacy, defined as the capability to sustain the major meaning of communication (Lee, 1999) or "a set of capabilities, knowledge and strategies that a person gains through experience in different contexts during the interaction with others and in the society they live in" (Kirsch, 2001, p. 4). People who have achieved a certain level of literacy can read information and have a critical view on the society.

A specific type of knowledge is technological knowledge or technological (or computer) literacy. Computer literacy is defined as "the ability to use the computers" (Lee, 1999, p. 137). Technological literacy is defined as "the ability to use the existing, new and emerging technologies in someone's professional and private life" (Dolničar et al., 2002, p. 6) or as "the ability and capability to use information technologies to in order to fulfill personal, educational and career goals" (Kirsch, 2001, p. 6). If a person understands the benefits of technological education, they will be more motivated to use the new technologies.

A main issue regarding the introduction of new technologies in education lies in the fact that teachers and students need to accept and use new technologies for educational purposes. Davis (1989; Davis et al., 1989) introduced the Technology Acceptance Model (TAM), where he states that different factors influence the use of new technology. Among those the perceived usefulness, perceived ease of use, attitude towards use, behavioral intention and actual use play the most important roles. As external factors, self-efficacy, subjective norm, enjoyment, computer anxiety and experience are the most commonly mentioned (Abdullah & Ward, 2016). The model has been used by several researchers, especially in the acceptance and use of technology in education. On the basis of TAM, several other models have been developed, such as the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2000, 2003) that links gender, age, personal experience and voluntariness of use with behavioral intentions and use behavior.

New technologies have brought a new dimension to the society – the digital divide that brings new barriers among different strata of the population (Kwak, 1999). The population with a higher socioeconomic status is more prone to gain computer literacy than the population with a lower socioeconomic status. The characteristics that divide the population are gender (Hawkridge, 1985; Sexton et al., 1999; Natriello, 2001; Wright, 2001; Bonfadelli, 2002; Crosier, Cobb, & Wilson, 2002; Dolničar et al., 2002; Hildenbrand, 1999; Singh, 2001; Lavrič, 2000; DiMaggio et al., 2001; Dečman, 2015, Šumak & Šorgo, 2016), age (Chung et al., 2010; Šumak & Šorgo, 2016), education and intellectual capabilities (Borghans & ter Weel, 2001, 2002; Selwyn, 2003; DiMaggio et al., 2001; Dečman, 2015), home and school technological equipment (Becker, 2000; Sandham, 2001; Sternad, 2001; Wright, 2001; Mavers, Somekh, & Restorick, 2002; Sexton et al., 1999), and the use of technologies by teachers (Attewell, 2001; De Moura Castro, 2000; Jereb, Jereb, & Šmitek, 1999, Šumak & Šorgo, 2016; Sanchez-Prieto et al., 2017).

TARGET AUDIENCE

The book is written for a target audience that uses (or wishes to use) new technologies in education: students, teachers and policy makers. In the book, different approaches that use new, especially developed, teaching techniques are described in detail: their benefits and their shortcomings, with clear support from actual data.

The target audience can easily understand the need for using new educational techniques. The classroom, where the teacher is the speaker and the role of the students is limited to that of recipients of teacher information, no longer exists. The modern teacher has to understand that the new generations of students effectively use new technologies in their everyday routines. Therefore, policy makers and teachers have to understand the role of new technologies and try to incorporate them into educational practices.

This book presents an excellent opportunity to illustrate how new technologies can be successfully mastered in order for the educational process to benefit from them.

STRUCTURE OF THE BOOK

The book is divided into three major parts. In the first part, emphasis is placed on understanding the importance of the use of new technologies in education. The second part addresses digital literacy and digital competences. The third part aims at understanding the role of the teacher in technological education. In the following the detailed structure of the book is presented.

The first section of the book concerns the presentation of the use of new technologies in education and the importance of adapting to these technologies. In the first chapter titled "Peer Learning and Peer Assessment to Enhance Participation in Online Courses: A Brief Theoretical Overview of Research Findings and Strategies", written by Pierpaolo Limone and Giusi Antonia Toto, the emphasis is placed on the importance of peer and self-assessment in learning. The authors present its characteristics and benefits but also disadvantages, using a critical thinking approach. Next, the steps that a teacher has to undertake in order to achieve peer learning are described. The focus here is put on online training. The authors present a case study of 200 Italian teachers enrolled in the SLD (Specific Learning Disabilities) initial training course. During a three-week period the teachers were engaged in different activities that measured their involvement in the training. In the last phase of the study students were asked to evaluate their satisfaction and effectiveness of the e-learning that was conducted by the teachers who were part of the case study. Overall, the students were satisfied with the e-learning. The authors of the chapter have demonstrated that teachers need to be properly educated to use peer and self-assessment.

The second chapter, "The Educational Research Flipped Inclusion Between Social Metamorphosis and Technocratic Hybridizations", written by Tonia De Giuseppe, Annalisa Ianniello Eva Podovšovnik and Felice Corona, focuses on a new type of education, flipped inclusion. The authors explain, through an exhaustive literature review, the foundations of the idea of flipped inclusion. In order to present the outcomes of this new approach, a complex study was conducted in Italy. Students were asked about their computer and internet use for educational purposes. They were also asked about their experience with flipped inclusion, used as a teaching method during their classes. The results show that the interviewed students confirmed the effectiveness of flipped inclusion, explaining that during the classes that use this teaching approach, their study method, their communicative skills, their cognitive and meta-cognitive competences and their social and pro-social competences have significantly improved. The authors of the chapter presented a new teaching approach that can be successfully used, especially in e-learning or learning with new technologies.

The third chapter, "Pedagogy and ICT: The Principles of Differentiated Teaching and New Technologies", authored by Raffaele Ciambrone, places the emphasis on integrated learning environments and differentiated teaching. In the new classroom, the roles of the participants are not clearly defined: the seats or the roles are no longer fixed. Students use tables, portable computers and other new technologies. The dynamics in this classroom is very intense. With the introduction of new technologies into the classroom, the educational process needs to become differentiated. The teacher has to focus on individuality and personalization. They have to adapt to the new student and their individual needs and type of study. At this point the author points out potential forms of misuse or incorrect use of new technologies for educational purposes. He also mentions that new technologies play an important role in the process of inclusion. The chapter presents a clear view on the modern educational process that should focus on the individual student, incorporating the use of new technologies and inclusion, and be very dynamic.

In the next chapter, titled "An Ecological Approach to Technology Appropriation: A Sustainable Digital Learning Material Development Ecosystem", written by Tugra Karademir Coşkun and Ayfer Alper, the focus is placed on the importance of digital learning material. The authors begin with a presentation of different digital materials that can be used as powerful educational resources for teachers. In addition, they present a brief comparison of different digital content by teachers in selected countries. Next, the concept of sustainability and its importance in the modern era is presented. The aim of this study is to construct a sustainable ecosystem for teachers in order to propose solutions to maintain such ecosystems. Their study demonstrated the importance of the support of administrators and colleagues, the willingness and the feeling of a need to develop digital learning materials, computer knowledge and self-sufficiency for the appropriation and sustenance of digital instructional material development by teachers. When the variables were analyzed based on sustainability, it was observed that these variables could contribute to the economic, environmental and social dimensions, the three principal dimensions of sustainability. The authors highlighted that new technologies and sustainable ecosystems can work well together in the modern educational process.

The second section of the book analyses digital competences and skills. In the first chapter of this section, titled "Data Science Is Here: Are We Ready to Benefit From the Opportunities It Provides?", authored by Dimitar Christozov, Katia Rasheva-Yordanova and Stefka Toleva-Stoimenova, the main topic is the importance of collecting and using big data. Today companies are collecting large amounts of different types of data. However, the main problem is how to successfully analyze and use all these data. The authors stress the importance of the new divide, among those capable of benefiting from Big Data ("Big Data Elite") and those relying on intermediaries in order to "study" data. Moreover, the authors present the characteristics of the data scientist and their competences and skills in order to complete a profile of the data scientist. In the following, the need for data scientists in Bulgaria are mentioned and the possibilities to acquire necessary competences and skills in the Bulgarian educational system are highlighted. At the end of the chapter, clear recommendations for the higher educational area to obtain the title of data scientist are presented. The authors develop a very useful and practical curriculum that can be adopted to obtain a degree in data science that enables graduates to keep pace with the amount of data available.

In the second chapter of this section, titled "Digital Skills and Behaviours of Youth Relevant for Digital Culture: A Two-Country Self-Evaluation Perspective", authored by Miroslav D. Vujičić, Uglješa Stankov, Sanja Kovačić, Đorđije A. Vasiljević, Tatjana Pivac, Jana Čarkadžić, Dino Mujkić and Marija Cimbaljević, the focus is placed on computer literacy and the necessary skills to obtain it and use it effectively in the modern society. In order to achieve computer literacy, educating the young generation is a necessary step. The digital culture is defining every aspect of our lives. The cultural society needs to adapt to the new technologies and we need to implement the digital skills into our routine. The authors pay special attention to the acquisition of the necessary digital skills in the cultural sector. They claim that young people need to learn about cultural heritage, using new technologies to achieve this purpose. The digital skills of youth that are relevant for their employability in the cultural sector are then identified. A study was made in Serbia and in Bosnia and Herzegovina in order to illustrate the use of new technologies. The results show that the young generation claims to be well-acquainted with computer literacy. The results show clear directions for updating educational programs in the cultural sector, which should be addressed by the policy makers in the cultural field.

The next chapter, "Digital Literacy in Special Education: Preparing Students for College and the Workplace", authored by Patrick R Lowenthal, Gina Persichini, Quincy Conley, Michael Humphrey and Jessica Scheufler, addresses the importance of digital literacy for career readiness. The focus of the chapter is placed on the students entering the college educational system. Digital literacy plays a crucial role during tertiary education. The main question is how to obtain the digital skills necessary for education and the workplace. Students with disabilities have special needs, also for acquiring digital literacy. The authors stress the newly emerging disability digital divide. In order to overcome this new phenomenon, educators need to develop special curricula for students with disabilities. In this chapter such a curriculum is presented and justified. The authors have addressed a very important issue and found a solution on how to overcome the differentiation in achieving computer skills among students with disabilities and those without disabilities.

The following chapter, titled "That Was Then, This Is Now: Literacy for the 21st Century Student", authored by Miles Madison Harvey and Rick Marlatt, focuses on the evolution of literacy, comparing print and digital texts. The authors seek to advise educators on how to make the transition into the new, digital classroom. They also emphasize that the classical print texts and media are still a very important part of the modern society and therefore students need to master traditional literacy. Today both literacies (digital and traditional) complete each other. One does not exist without the other. Teachers have to instruct their students on how to create meanings with both types of literacy. These skills need to be used in the digital classroom. In the following, the authors highlight the necessary skills for the traditional, print literacy, and for the new, digital literacy. At the end of the chapter trends in both literacies are presented. The authors make a very important point: they claim that the teachers need to use digital texts. If they refuse to do this, they have a huge negative impact on students, depriving them of the possibilities to be up-to-date with the rest of the population that has mastered new technologies. Therefore, the authors strongly advise policy makers and teachers to adapt to the digital era.

The next chapter, with the title "Contemporary Archival Description as Required Digital Competence of Today's Archivists", written by Arian Rajh, addresses the issue of mastering new technologies in order to get the necessary skills and competences for archivists. The author first describes the national standards used by archivists. Later on, the emphasis is put on describing the necessary competences for archival description, supported with actual evidence and examples. For the purpose of the study an extensive case study was made, comparing the higher educational system in Croatia regarding the programs that different faculties offer to their students. The author examined the programs that provide students with digital competences needed for archivists. In the following, recommendations for updating educational programs with emerging competences are presented. In the discussion, there is a clear presentation of the past, the current, and the plausible future regarding the archival description practice in Croatia. This chapter is a good reference for policy makers and educators who wish to educate archivists.

The third section of the book focuses on the teachers' perspective while integrating new technologies in education. The first chapter, "Use of Smartphones for Self-Regulated Foreign Language Learning Activities", written by Violeta Jurkovič, focuses on the importance of smartphones that are becoming an increasingly powerful tool among the young generation. In this chapter the author presents an example of the use of smartphones for studying English as a foreign language. The study was conducted among undergraduate students in Slovenia. The results show that the interviewed students do not use smartphones in ways that would facilitate their language learning and that some participants mentioned engaging in language acquisition activities but with conscious language learning in mind as a secondary aim. The author identified psychological, pedagogical and technical barriers for not using smartphones for language learning. The results also show that the interviewed students mostly use smartphones for entertainment and communication purposes. In addition, the respondents pointed out that the applications designed for language learning are mostly written for beginners, thus not providing any additional content to students at an advanced level. Since smartphones are becoming very important tools for the young generation, teachers and technicians need to take into account the development of applications that would facilitate language learning using smartphones.

The second chapter of this section, with the title "CLIL Approach and Educational Technologies: ClassLabs, Teachers' Digital Literacy, and High School Students' Opportunities", authored by Assunta Tavernise, presents Content and Language Integrated Learning (CLIL). The author starts with defining CLIL and presenting its development. CLIL is based on a 4Cs framework embedded in a relevant context or enriched framework: content, communication, cognition, and culture. Later, the role of the teacher in this type of classroom is presented. Then, the responsibilities and duties of the student are taken into account. The author discusses the advantages and disadvantages of using new technologies while engaging with CLIL. This chapter makes an important contribution regarding the use of new technologies for language learning.

The next chapter, "Exploring the Challenges of ICT Inclusion in Teaching Learning Process", written by Atul Bamrara, addresses the importance of new technologies in the modern educational system. The author presents a study among Turkish teachers. The results show that an individual's confidence, competence, and access to ICT resources have a significant impact on ICT use in the classroom. In the conclusion, the author clearly presents the results of the study, using a SWOT analysis. Its results show that the main barriers for the incorporation of new technologies in education are poor infrastructure, financial barriers, cyber threats, and lack of technical support. The main strengths for using new technologies in education are presented in the form of availability of new technologies to teachers. The author reminds us that the possession of new technologies still is an important factor in the modern era. Not all students and teachers have enough financial resources to purchase new technologies and relevant applications required for educational purposes.

In the following chapter titled "The Processes of Appropriation of Technological Tools in the Classroom: Teachers' Perspective", authored by Stéphanie Boéchat-Heer, Maria Antonietta Impedovo and Francesco Arcidiacono, the emphasis is placed on the advantages of using new technologies in a professional secondary school, as seen from the teachers' perspective. The authors focus on iPads and tablets. Their study was conducted among teachers in Switzerland, using focus groups. Their findings show that teachers like to use new technologies for their private use, prior to start using them as teaching tools. They were especially concerned with the technical features of applications. Hence, teachers suggested having full-time technical support at their disposal and creating professional networks, in which they would be able to share their experiences using these devices. Some of the teachers expressed their concerns that iPads could be seen as toys and not tools by students. The authors suggest that there is a need for teachers to be familiarized with new technologies. This is an important implication that should be taken into account by policy makers. They have to make the new technologies available to teachers and they have to provide them with proper training.

The next chapter, with the title "Scaffolding Children's Participation in Schools' Environmental Health: The Role of Teacher Mediation and Digital Tools", written by Maria João Silva, Eduarda Ferreira, Alexandra Souza, Ana Rita Alves and Susana Batista, addresses the use of new technologies in education in order to enhance the school environmental health. Students have to be aware of sound pollution and they need to help their environment to reduce such risks for health. The authors present a study conducted in Portugal, constructed of two case studies and centered on discovering the sound level and the concentration of carbon dioxide in the air. In both cases teacher mediation was measured. Children gave practical advice to researchers on how to help solve the school environmental health. The chapter stresses the importance of a healthy environment and highlights the fact that teachers and students are aware of the dangers of sound and chemical pollution.

In the following chapter, titled "Teachers' Attitudes Towards the Use of Tablets in Six EFL Classrooms", written by Aysegul Liman Kaban and Isil Boy Ergul, the focus is placed on the use of tablets for educational purposes. The authors state that tablets are becoming a teaching tool and as such are frequently used in the modern educational process. As a result, educators have to be aware of the possible advantages but have also to consider problems associated with their use. Teachers themselves are the ones who decide how to conduct their lessons. Their attitudes play a crucial role in determining which new technology they will use for teaching. The authors used semi-structured interviews to identify how teachers in Turkey perceive the importance of new technologies for teaching, their needs regarding the use of new technologies in the classroom, their perception of students' reactions, and opportunities and limitations of such teaching. The results support the presented theoretical background: teachers need to have a positive attitude towards new technologies, and they need proper training prior to their use of tablets for teaching. A significant finding is that tablets can be used for children with special needs. This chapter presents important information for teachers who would like to start using tablets in their classrooms.

In the following chapter, titled "ICT Adoption Among Higher Education Teachers: A Case Study of a University in the Awareness/Exploration Stage of Blended Learning Adoption", authored by Patrik Pucer, Šarolta Godnič Vičič and Boštjan Žvanut, the focus is placed on the adoption of new technologies by universities in order for them to maintain competitiveness. To do so, blended learning is recommended. The authors begin with a presentation of theories regarding the acceptance of new technologies. They continue with a presentation of the adoption of new technologies among teachers and the definition of blended learning in higher education institutions. They support their case using a survey, conducted among university teachers in Slovenia. The authors divide teachers into first adopters and followers of new technologies. The results of their study show that educating university teachers in ICT use for teaching/learning and providing adequate technical support are potential determinants of ICT adoption in teaching/learning. This chapter is a report of a study that can help policy makers understand the role of blended learning in higher education.

The next chapter, with the title "Online Informal Language Learning Among Foreign Language Teachers: Activities and Purposes Analysis From a Complex Dynamic Systems Perspective", written by Violeta Jurkovič, Vita Kilar, Nives Lenassi and Darja Mertelj, emphasizes the possibilities that new technologies offer to language learning. The focus is placed on online learning of foreign languages among language teachers. The authors supplement their literature review with a case study of online learning of foreign languages among foreign language teachers. In order to do so, diaries were used and three in-depth interviews with foreign language teachers in Slovenia were conducted. The results show some important implications related to the use of online resources by teachers: they differ in terms of their preferred language for teaching, research and entertainment purposes. The authors provide the readers with an understanding of the preferences of online resources among teachers of foreign languages other than English.

The next chapter, "The Changing Role of the Teacher in ICT-Supported Foreign Language Instruction: A Multiple-Case Study", authored by Saša Podgoršek, deals with the use of new technologies for foreign language teaching. The author is interested in the role of the teacher in technology-based teaching. The literature review shows different classifications of the roles of teachers in technology-based teaching. The main challenge for teachers while using new technologies for teaching is the problem of integration of new technologies in their classes. On the other hand, the main challenge for schools is how to introduce new technologies in the educational system. The author conducted a survey among foreign language teachers and students is Slovenia. The main result of the study shows there is a shift from teacher to student-centered teaching. The teachers have developed a very positive relationship with students. The main disadvantage reported by teachers was that the preparation of materials for classes took longer if compared to traditional teaching. They were also in constant need of technology training. The importance of the chapter lies in the presentation of advantages and disadvantages of technology classes for foreign language teachers.

In the last chapter, titled "Teacher Technology Education for Spatial Learning in Digital Immersive Virtual Environments", written by Flavia Santoianni and Alessandro Ciasullo, the emphasis is placed on the importance of new technologies for teachers. The authors claim that teachers in modern schools need to have technology skills and competences in order to be able to keep pace with the increased students' technology competence. After a taxonomy of teachers' knowledge, the chapter presents the case of spatial education. In the recent years there has been a shift in the user experience in educational settings towards immersive synthetic learning environments. The authors then present the case of a 3D virtual learning environment. In the following, digital and spatial interactive and interaction skills are defined. The chapter ends with recommendations for a digital and spatial curriculum. This chapter presents an interesting point of view for policy makers and educators in the field of spatial education.

THE IMPACTS OF THE BOOK

The target audience can find interesting chapters in this book. Practitioners are recommended to read the book and find a chapter (or chapters) that most suits them. The chapters have been carefully selected to reflect the most important issues while using new technologies in education.

The first part of the book is designed for those readers who wish to understand technology-based educational practices. The authors of the chapters in this section present new techniques, some in an experimental phase and some already being slowly accepted and established. They all agree that the modern school system has to adapt to the young generation, especially regarding their use of new technologies for learning and entertainment.

The second part of the book deals with new forms of competences and skills that are necessary in order to be up to date in the modern society. In this part of the book, readers cannot just find different competences and skills that the students need to master but also different approaches on how to manage them. Policy makers can find suggestions on how to readapt different curricula for the new generation of students, in order for them to be competitive in the modern society.

The last part of the book has a practical importance for teachers of different subjects. In this part of the book readers can find out about different practices used in different regions for different teaching classes. The importance of new technologies for teachers and the most common obstacles to their introduction as well as advantages are presented. Teachers are the ones who should benefit most from this part of the book since the chapters deal with the biggest fears of teachers while introducing new technologies into their classes.

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Section 1

The Use of New Technologies in Education

Chapter 1
Peer Learning and Peer Assessment to Enhance Participation in Online Courses:
A Brief Theoretical Overview of Research Findings and Strategies

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ABSTRACT

The chapter discusses the development of a peer assessment approach in an online learning community. Peer assessment is an important construct because it is connected with self-regulated learning and correlated with the use of feedback, two of the most effective issues in facilitating online learning. The aim of the research is to demonstrate the innovative value of peer assessment and peer learning in new tech through a literature review and an analysis of a practical application to show future development in this field.

INTRODUCTION

The course was conducted on an e-learning platform developed in a Moodle environment and active since February 2012. Two hundred teachers participated in this specific edition of the course, in the context of a wider initiative that involved almost two thousand teachers and was generated in virtue of following collaboration between the Regional Scholastic Office of Apulia and the ERID Laboratory of the University of Foggia. A web portal and an e-learning platform were created with the educational

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objective of offering basic competencies regarding Specific Learning Disabilities in order to improve the quality of teaching oriented toward individuals with SLD and to reduce scholastic failure. The scientific objective, on the other hand, arises from the need of developing an on-line community of teachers that would use the digital resources also after the end of the course in a self-sustaining repository of good practices and learning materials.

ERID laboratory's expertise in the design and management of e-learning courses for teachers, and generally for adult professionals, proved difficult to achieve the goal in such a compulsory educational setting, based mostly on the external motivation of some kind of certificate to be obtained, valuable for their career development. In other similar experiences, a firm resistance against communication and interaction was observed via online learning environment tools (forums, chats, messaging) and a general lack of interest in building collaborative practices.

A set of strategies were then experienced to facilitate the participation of this particular kind of adult students in on-line communities. The most efficient proved to be the constructivist pedagogic approaches oriented toward the cooperation and co-construction of knowledge and meaning. Significant improvements in community participation and learning outcomes were observed specifically after transforming all the processes related to learning assessment from a set of final summative assignments to an activating lever for internal motivation and a collaborative learning tool. Commencing from assessment the whole learning experience was progressively re-designed; hence the following case study was set up to observe more closely the phenomenon.

The following are the goals of this intervention research:

- To foster interaction and communication within an online learning community.
- To train educators to use an innovative pedagogic model and an alternative assessment method that may be applied in their professional practices.
- To confirm that through innovative teaching strategies centered on the user and based on collaboration, such as peer learning and peer assessment, meaningful learning is promoted (Jonassen et al., 2008).

In short, a course that fostered participatory and shared assessment procedures among the participants was designed, like the co-construction and sharing of assessment indicators, the promotion of communication aptitudes, as well as, the creation of a community of learners. The online course discussed in this article represents an attempt at designing an educational experience based on peer learning and peer assessment that is intended to teach teachers, in regard to not only the principal educational objective of the course (Specific Learning Disabilities), but also at a meta-level to offer basic abilities in teaching methodologies for a learner's centered approach. The active involvement of the teachers in training became a key element in the co-construction of knowledge during the development of the course (Guile, 1998). Another area of analysis is the evaluation in online courses. MOOC providers worldwide are examining new assessment systems based on peer assessment (Teixeira de Sampayo et al., 2014). New Intelligent peer assessment systems are being studied for online training: through a social network, for example, it is possible to assess the quality of the courses and the preparation of the exams automatically. This system focuses on peer review and reputation and uses reputation as a benefit in terms of performance, compared to the average score systems.

PEER ASSESSMENT AND SELF-ASSESSMENT (PSA) IN ADULT EDUCATION

Participatory assessment (Sluijsmans, Dochy, & Moerkerke, 1999) can stimulate the development of a competency-based curriculum, instead of generating what is otherwise known as inert learning, thus favoring the education of responsible and reflective professionals.

Peer assessment is a specific form of the broader universe of participatory practices in education and it consists of an iterative process of continuous revisions aimed toward providing constructive feedback (Ertmer, et al., 2007). It may require the involvement of the group of students in the co-construction of assignment criteria also related to the marking and decision-making in regard to the evidence of academic success. Beside self-assessment, peer assessment allows students to develop reflective and self-managing competencies, which in turn permit them to acquire awareness of their own proficiencies and eventual blind spots, in order to operate from the educational perspective of learning to learn (McConnell, 2002).

When these two strategies, that is, peer and self-assessment, work well, their effects are particularly valuable for all of the involved actors (instructors and students), allowing them to address numerous issues distinctive of an efficient educational processes:

- To help students understand and share the efficacy and validity of these approaches.
- To guarantee reliability of student judgment.
- To optimize the students' opportunities to learn from peer and self-assessment.

Table 1 portrays a brief summary of the leading benefits and advantages that may be obtained by the use of such evaluation techniques. Multiple studies (Dochy, Segers, & Sluijsmans, 1999; Topping, 1998; Candy, Crebert, & O'Leary, 1994; Williams, 1992; Bangert- Drowns et al., 1991; Slavin, 1990; Crooks, 1988) attest the efficacy of peer and self-assessment, especially with regard to the development of critical thinking, communication, lifelong learning and collaborative abilities. However, it must be specified that self-assessment is a method often unknown to adult students and less accurate than peer assessment (Stefani, 1994), as self-esteem generally plays a decisive role in self-assessment (Hewitt, 2002); thus, low self-esteem may have negative effects on one's own evaluation and excessive self-esteem may entail an overestimation of the work's value.

The abilities developed thanks to peer assessment may also be used by students to critically analyze their own work, and such technique may thereby serve as an incentive to improve their individual performance levels (Searby & Ewers, 1997).

Mentkowski writes (2019, p.48): "Much research on self- and peer assessment appears to be obsessed with the reliability of student marking in the hope that student-generated grades can substitute for teachers' grades and save the teacher a great deal of work. If you go to enough trouble, students are indeed capable of reliable marking (or, rather, as reliable as the rather low-level teachers usually achieve)… What is required is not more grades but more learning. The value of self- and peer assessment is that students internalise academic standards and are subsequently able to supervise themselves as they study and write and solve problems, in relation to these standards. It is the act of students making judgement against standards that brings educational benefits, not the act of receiving a grade from a peer". To achieve this goal, sometimes it is required peer assessment, along with collaborative learning through social interaction or group work. In this way, it is possible to strengthen relations between students rather than classify them with a score. Having to reach common goals, class work - even a virtual one - keep students together to achieve educational success rather than mutual evaluation. The technology-supported peer

Table 1. The benefits of peer and self-assessment

Benefits	Characteristics
They support independent and autonomous learning	The students gain awareness of their own performance through the assessment of their work and that of their peers.
	The self-assessment of one's learning process enables the development of meta-cognitive competencies that encourage profound, not superficial, learning.
They enhance the evaluative competence	Permanent assessment and analysis skills are developed and evaluation criteria and parameters are clarified and co-constructed.
	By reducing the quantity of assessments on the part of the teachers, the quality of the same is improved.
	By considering evaluation as an integral part of the entire learning process, errors may be seen as opportunities rather than signs of failure.
They favor the reflective competence	Critical reflection or discussion among peers may help each of them inspect his/her own work from the outside and give an educational significance to the feedback and comments received by peers, in order to improve his/her own product and performance.
	Such methods transform the students into creative and "reflective" constructors of their own behaviors, choices and actions in the contexts of practice.
They foster interaction and communication	They encourage a sense of belonging among students by promoting a "learning community" education and acting positively on motivation.

assessment The peer evaluation supported by technology has undergone a series of changes in recent years (Fu et al., 2019): between 2007 and 2012 peer evaluation used the traditional computer and was carried out at the end of the lesson. In the following years 2012-2016 the studies (Fu et al., 2019) about the activities of peer assessments integrated into the school curriculum and are carried out during school hours. In addition to this, we accepted the idea that evaluation could be considered a teaching and learning strategy and can reinforce the effectiveness of the lesson. However, emerges the idea that, inter alia, evaluation scores among peers are usually built by teachers, almost never by the students themselves.

Therefore, in order to design an e-learning project in which peer assessment was a key element, specific reference was made to the seven basic steps illustrated in Table 2. Peer and self-assessment are learning tools with utmost validity in the training of teachers, as they are capable of supporting them in the acquisition of essential skills for their professional careers (Sluijsmans & Prins, 2006). Obviously, in order for PSA to represent an effective educational device, it must be adopt certain conditions. Van den Berg, Admiraal, and Pilot (2006) discovered, for example, that time management and the division of work into small groups are fundamental premises for the extraction of benefits from peer assessment feedback. Hence, in the development of the course specific attention was given to the organizational aspects of the on-line training sessions. Anyway, even though planning is important, the adoption of rigid protocols were avoided, since in the literature there aren't structured models to be simply reproduced. In fact, a recent study conducted by van Zundert, Sluijsmans, and van Merrienboer (2010) found a sort of systematic heterogeneity of this approach, because:

- Most of the diverse studies and experiences reported in the scientific literature, on the effects and benefits of peer assessment, are positive.
- There are various forms of peer assessment that may be referenced.
- As a result of the employment of such assessment technique, regardless of the specific procedures, numerous objectives regarding the quality of learning and the level of interaction among peers may be achieved.

The heterogeneity of experiences on PSA outlines the possibility of customizing participatory assessment "methods" according to specific needs of the target group or of the educational content proposed. Awareness of such is essential, given that peer assessment tends to be presented in a holistic manner, that is, without specifying all of its variables in terms of conditions, methods and results (van Zundert et al., 2010). Hence, more than a proper "method" it could be described as an "approach" for actively engaging adult students as active learners, enhancing reflexive thinking about their work and the aims of the course they are attending.

PEER LEARNING IN THE FIELD OF TEACHER EDUCATION

Peer learning is an approach based mainly on cooperation, communication and the giving and receiving of feedback to and from peers. It facilitates and promotes the sharing of knowledge and ideas among students in an atmosphere of reciprocal collaboration. Such approach encourages meaningful learning through the involvement of students who teach and learn to from one another; therefore, peer learning consists of the sharing of ideas, knowledge, understandings, meanings and experiences, fostering interdependent as opposed to autonomous learning (Boud, 2001)

The actual success of peer learning often depends on the applied assessment strategy, precisely because it is the very assessment that enhances the efficacy of the approach and consequently perfects and promotes its employment. Assessment strongly influences learning in formal courses, and if designed inadequately such may compromise the peculiarities and ad- vantages of an innovative teaching and learning strategy, like peer learning (Boud, 2000). This teaching method is particularly recommended for the training of teachers, as it favors several aspects of the permanent learning capacity that are not easily pursuable through other means (Slavin, 1990). More specifically, peer learning:

- Encourages adult students to work together and develop collaboration skills, by allowing them to be trained in educational design and teamwork and by including them in a learning community in which they assume important roles.
- Promotes the involvement of the group of adult students and incites them to assume the collective responsibility of identifying their learner needs and planning the achievement of such. Learning to learn is a vital skill, as well as one of the eight key competencies for permanent learning, which are stated in the Recommendation 2006/962/CE of the European Parliament and of the Council. More specifically, the recommendation states: "learning to learn is connected to understanding, to the ability to persevere in understanding and to organize understanding both individually and in a group, in accordance with personal necessities and in awareness of methods and opportunities."

Table 2. A synthesis of the 7 steps of peer assessment proposed by the University of Plymouth (cfr. http://www.educationaldevelopment.net)

N.	Step	Description
1	Train the students	Induction and training session informing participants of how to use PSA methods. This will stimulate their commitment to the course, considering assessment as a deliberate and forceful effect of a dynamic educational process. The role of the educator is fundamental in transmitting the right amount of competence and enthusiasm toward the correct employment of such methods.
2	Manage their privacy	Students often feel uncomfortable being judged by peers (Cassidy, 2006), and evaluating the work of others. For this reason, it is advisable to manage their privacy using a system that guarantees the anonymity of assessment (Ballantyne et al, 2002).
3	Confront reliability	Good design are usually associated with more valid peer assessments (Falchikov and Goldfinch, 2000). Students appear consistent in their markings but at times tend to overrate their work as opposed to the teachers (Ross 2006). Other studies (Lew et al 2010) reveal that issues related to the precision of peer and self-assessment may be handled if the students are appropriately trained to employ such methods and if they are directly involved in the development and negotiation of the assessment criteria. Issues linked to reliability are ascribable also to gender biases (Langan et al, 2008; Wheater et al, 2005; Pallier, 2003) that view males as having higher self-esteem than females. Such implies a higher assessment of performance on the part of males, thus affecting the group of peers.
4	Consider how to distribute work for peer assessment	It is advisable to consider a series of questions regarding the distribution of work. Making a plan and a check list would be advisable. The kind of issues to consider may be: should all of the work be assigned randomly and anonymously? Should the students work in pairs or it is better to proceed in groups of three or four students?
5	Promote the generation of good quality feedback	Peer feedback may be strengthened by providing the students with specific advice regarding its formulation (Miller, 2003).
6	Choose between formative and summative assessment	The literature on peer and self-assessment denotes conflict regarding the use of such methods in a macro program of formative or summative assessment. Among various conducted studies there seems to be a predominate tendency toward formative assessment; nonetheless, the possibility of including such methods in a summative assessment program should absolutely not be excluded.
7	Reflect upon its use as an occasional technique or as an integral part of the curriculum	Strongly opposing views on the conditions of use of such methods are found in literature. Some authors (such as Cassidy, 2006), believe that such methods should represent an integral part of the learning environment and program, not an occasional experience. Others (such as Ballantyne et al., 2002), recommend a limited use of peer assessment in order to prevent an abuse from invalidating the very benefits of the method.

- Aids adult students in developing the ability to *learn to cooperate with others* in order to accomplish mutual goals. Such ability represents an indispensable duty in our complex society and one of the fundamental requirements of group work.

As proposed by Boud and Falchikov (2007) peer learning is "natural educational process" that is part of the developmental kit of each individual, formal institutional learning has instead the tendency of transforming a collaborative practice in an individual one.

In order to improve engagement and collaboration in adult professional learning communities in the following experience the assessment processes was considered the starting point of an educational design process, aimed to empower teachers in training with new competencies and shifting the agency in the management of the course. There are a series of other assessment approaches that could have been implemented in the collaborative learning context that was designed, among them: group assessment, peer feedback and self-assessment, assessment of process, negotiated assessment and the use of cumulative rather than weighted assessment. In this experience, it was developed a peer assessment approach because it was specifically adapted to foster engagement in a teachers training on-line community, this approach develops in fact a peculiar cooperation processes, together with reflexivity on the assessment and learning procedures, and the development of new professional abilities in the field of assessment design (Taras, 2010).

Furthermore, peer evaluation is proposed as a training activity. Peer assessment, according to an experiment conducted by Teixeira de Sampayo et al. (2014) has allowed bringing out both the critical thinking of students in the activity of evaluation of colleagues, and the lack of disciplinary mastery of some students in the formulation of judgments. This last element is of fundamental importance for teachers and tutors. Among the positive learning outcomes, it is important to stress that this is a social process and some (Panadero & Alquassab, 2019) argue that the use of anonymity could also have benefits, especially for students' perceptions of learning value. It provides more critical peer feedback, greater self-perceived social effects, and a slight tendency to higher performance, especially in higher education. Peer evaluation is also a social process that must be based on solid social relationships; relationships of trust between peers have to succeed and not to fail. Interdependence can be a factor influencing the evaluation of learning outcomes, too. For this reason the directionality of the evaluation can be reciprocal (one evaluates in pairs or all evaluates all) or unidirectional (between evaluator in evaluated). Finally, even the online or presence mode has different effects on the evaluation process.

Self and peer-assessment allow adult students to be assessors and assesses at the same time, to evaluate the work of their peers as well as their own. Unlike the techniques of self-assessment, which are generally confined to basic cognitive levels (Bloom, 1956; Anderson & Krathwohl, 2001), peer assessment enables the development of learning at higher cognitive levels. The adult students are involved in the revision, evaluation and feedback process of an online piece of work (Bouzidi & Jaillet, 2009). There are some critiques on this approach; Doiron (2003) explains that some authors criticize the use of peer assessment in online education for at least two reasons:

- They consider it less rigorous than traditional assessment methods.
- It results often unreliable and ineffective, by demanding exaggerated efforts on the part of the students

In line with the studies of Falchikov (2001), it would be finally productive to differentiate the concepts of peer assessment and peer feedback and specify their contribution in the design of the course developed by ERID Lab:

- Peer feedback is a communication process among peers in relation to performance and standards. The students provide detailed comments on the product to be assessed without dwelling on the assignment of a score. The emphasis is on the possibility that interaction among peers may lead to a deeper understanding.

- Peer assessment is an assessment process among peers that requires the assignment of a score to the achieved product according to the pertinent criteria, which are preemptively established and shared.

The combination of the two approaches resulted as strategic in fostering assessment-oriented learning (Liu & Carless, 2006) and was then adopted in the design of the course described in this article. By commenting on and evaluating their own the work and the work of peers, teachers question their sense of objectivity. They leave aside their institutional role and start to ask themselves more questions. This reflexive approach ends up being transferred in their professional practice. The peers provide rich information with which teacher in training may analyze their work and continuously better themselves.

Elizondo-Garcia et al. (2019, p. 1026) write: “Peer feedback is information communicated to the learners in order to modify their thinking or behaviour, or otherwise increase student knowledge and skills (Shute, 2008). A typical sequence of activities in peer feedback are task performance and submission, reading each other’s tasks, writing and submitting feedback, receiving feedback from others, and task revision”. According to this perspective, if it is true that peer evaluation represents the attribution of a score, it is equally true that peer feedback concerns interpersonal communication, through which both the product and the learning process can be improved. If students give and receive feedback, they become more aware of their learning and meta-goals to be achieved, and help to improve this dimension in other colleagues. Necessarily the cognitive skills involved are of a higher order, so the student must be able to reason and argue how much s/he values. If the peer assessment action continues - Elizondo-Garcia et al. (2019) - but it is poorly designed or the comments received are superficial, you will get the opposite effect. In this condition, the students appear frustrated and hardly engaged in reviewing the criticized activity.

A further key component of peer review is the synchronous mode; many studies (e.g., Liu et al., 2018) report that if carried out on a deferred basis, the review produces opposite effects. Indeed, some experiments refer to discussion groups on the common evaluation criteria to be included in the rubrics. To increase the effectiveness of action, researchers proposed to use criteria for random and anonymous assignment of the task to be evaluated. Even if anonymity does not guarantee the traceability of information on evaluating students. The results indicate that quality, especially in writing (Liu et al., 2018) improves if accompanied by peer review actions. Students, despite having a positive perception of evaluation and teamwork, are not yet widely applied in training contexts. Contemporary literature (Wanner, & Palmer, 2018) shows an appreciable formative evaluation of this practice, first applied for summative purposes only. Peer evaluation is not just a summation, i.e. of what has been learned (results), but also formative of the way of learning (process). Approaching the model of self direction in learning (Toto, & Limone, 2019), peer assessment allows students to plan their learning, to identify their strengths and weaknesses - focusing the areas that need a corrective action - and to develop metacognitive skills, as well as to help peers. Peer feedback is more available than teacher feedback. It was demonstrated that (Topping, 2009, p.27): ” A peer assessor with less skill at assessment but more time in which to do it, can produce an assessment of equal reliability and validity to that of a teacher”.

Figure 1. A screenshot of the home page of the platform on which the training course was implemented.

THE CASE STUDY

The study was performed on two hundred teachers enrolled in the SLD (Specific Learning Disabilities) initial training course. All teachers are required to possess basic expertise on the matter of understanding and recognizing the characteristics of DSAs, as well as daily organizing a form of teaching that is capable of responding to the needs of all of their pupils. To fulfill such challenge, it was therefore necessary to design a wide educational intervention by referring to a teaching model that foster a meaningful learning for educators in service. In particular, the regional plans for education on Specific Learning Disabilities aim to provide useful knowledge for the application of assessment and intervention tools, with reference to dyslexia, language or calculation disorders, difficulties in complex learning and studying, mild mental retardation, hyperactive attention disorders as well as other cognitive, emotional and relational disorders. The achieved training also had the task of educating teachers on the ability to respond to potential requests related to the organization of services or appropriate initiatives for the premature prevention of learning disabilities (Limone & Dipace, 2012). The training course (Figure 1) was organized according to a modular teaching unit approach that included the division of contents into five Didactic Units (UDs).

This study exclusively observes UD 5 concerned on "IT for autonomy in Specific Learning Disabilities," for a total of 50 hours of online training.

According to the studies of Kollar and Fischer (2010), an educational action was de- signed and broken down into the following steps:

- Training of participants on the principles and methods of peer assessment, peer feedback and peer learning.
- Co-design of assessment criteria and task assignment.
- Peer assessment and peer feedback in practice.

Training of Participants on the Principles and Methods of Peer Assessment, Peer Feedback, and Peer Learning

Initial training on peer assessment, a defining common base of knowledge, factors to the various applications of this technique in adult education. It is considered a strategic element since it could prevent potential adverse or anxious attitudes toward change and innovation (Elton, 1988; Boud, 1990; Peters, 1996). Six video lessons organized in SCORM packets (Shareable Content Object Reference Models) were therefore loaded to the plat- form: such lessons presented peer assessment with short lectures offered by two university professors who are experts in the design and assessment of learning. In addition to the video lessons, access to in-depth analyses, useful links, demonstrative videos, updated bibliographic material (articles, issues, text, books) and case study presentations, were available. The teachers that participated to in training were invited to make use of such materials and discuss them with peers and the tutor-facilitator in a dedicated forum. The discussions were lively and rich with prompts for reflection. One of the principal topics of discussion concerned the validity and efficacy of the presented methods, as well as their effectiveness on students affected with Specific Learning Disabilities.

Co-Design, Planning, and Sharing of Assessment Criteria and Task Assignment

Online educational meetings were developed in regard to the designation of a score in an assignment (Table 3). One of the goals of these meetings was also the mutual recognition of the advantages of such methods as opposed to traditional methods (Rodan, 2004). The involvement of the teachers attending the training in this preliminary phase pertained to the design, planning and sharing of both the assessment criteria (Mowl & Pin, 1995) and the adopted teaching methods (peer learning). The online meetings were made possible thanks to the division of teachers into 5 groups of 40 participants and to the use of multi-user videoconferencing. Each group was moderated by an e-tutor and monitored by a professor responsible of the Didactic Unit. To facilitate communication with the e-tutors, each group endorsed a supervisor.

Peer Assessment and Peer Feedback in Practice

In order to develop the ability to provide feed- backs, it was asked each teacher to initially assess the work of a colleague in the form of a comment, not a score. That is, the participants were asked to debate the assessment based on the criteria that were preliminarily shared and approved within the shared rubric.

Price et al. (2010) sustain that feedback is the most important part of the assessment process as it fosters learning by providing useful information for the improvement and perfecting of future performance. According to Nicol and Macfarlane-Dick (2006), feedback is a form of educational assessment, capable of enhancing and accelerating the process of learning. More specifically, such scholars describe feedback as "anything that might strengthen the students' capacity to self-regulate their own performances" (p. 206). Furthermore, a good feedback aids in the fulfillment of a series of functions, by:

- Clarifying the meaning of good performance (objectives, criteria, standards).
- Facilitating the development of self- assessment and reflection.
- Releasing high-quality information about student learning.
- Encouraging dialogue among peers and with the teacher regarding learning processes.
- Acting on motivation and self-esteem.
- Offering the opportunity to reduce the gap between the current and desired performance.
- Providing information that is also useful to teachers in education design.

It is important to observe that Sadler (1989) identified three conditions that are indispensable to students in order to draw benefits from the use of feedback in academic tasks. He believes that the student must know:

- The meaning of "good performance" (that is, the student must be well acquainted with the concept of "learning objectives" and "standards").
- How current performance is related to "good performance" (the student must have the ability to compare current performance with optimal performance).
- How to proceed in reducing the gap between current and good performance.

In online learning environments, feedback may represent a strategic learning tool that acts on the success and efficacy of the educational course (Lynch, 2002; Palloff & Pratt, 2001). In fact, the absence of feedback is often a cause for the estrangement of students from materials and from the learning environment, as opposed to in the case of traditional courses of study (Ko & Rossen, 2001), and is thus a cause for failure of e-learning.

As mentioned previously, it is advisable to manage privacy using a system that is capable of assuring the anonymity of assessment (Ballantyne et al., 2002).

In this case study, the distribution of tasks among peer teachers was performed anonymously by file management carried out by the e-tutor, who assigned a task to each participant using an automatic random distribution system. Each teacher evaluated his/her own task and produced educational feedback of the same in the appropriate space of the platform. Once all of the feedback was received, the tutors sent the assessment of the complete feedback to the students.

The last phase of the experience involved a general discussion among all the participants of the groups involved in the training, mediated by the tutors and the professor responsible for the Didactic Unit. Participation in the discussion was of high-level and intense.

Table 3. presents a summary of the procedures performed to define the assessment criteria.

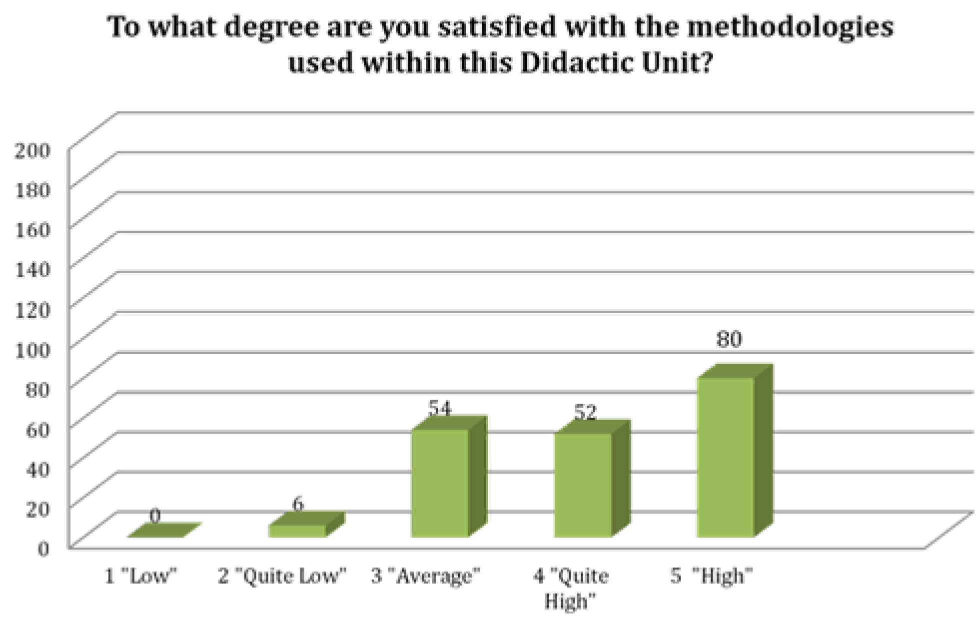
Days	Action	Description
Day 1	The loading to the platform of the task to be accomplished	Assignment of a task relative to UD 5. The title of the task to be accomplished was: "Make a educational activities to encourage reading and writing through using new technologies".
Days 2-5	The division into groups and the start-up of multi-user videoconferencing	The teachers, divided randomly into 5 groups of 40, were invited to participate in the videoconferences coordinated by the e-tutors and the professor responsible of UD 5. The main topics of the videoconferences were: - the co-construction of a proposal for assessment criteria; - the design of an assessment rubric that assigns both a score and a comment in the form of educational feedback to pieces of work. In constructing the rubrics, inspiration was drawn from the essay of H.G. Andrade (1997), in which explicit examples may be found.
Days 6 – 8	The analysis of surfaced data	Using the findings of the videoconferencing sessions, the e-tutor compiled a summary document with four (one for each group) rubrics containing the assessment criteria proposals.
Days 9 - 12	The opening of a forum discussion regarding assessment criteria proposals	The forum was monitored and animated by the e-tutor and professor responsible of the UD5. The participants were invited to discuss the four proposals and to propose the definition of a unique document. The supervisor of each of the 5 groups loaded the group proposal to the platform facilitating exchanges, communication and sharing among peers.
Days 13 - 15	The closing of the forum discussion	Using the analysis of the interactions and shared documents, the e-tutors constructed a unique proposal in the form of a rubric and then he shared it with the community.
Day 16	The sharing of the rubric and the request for approval on the part of the community	The participants took note of the document, discuss it, revised it and finally approved its definitive version of the rubric.
Days 17-21	Task assignment and performance	All 200 participants were required to perform the assigned task and to load its result to the appropriate area of the platform. The task had to be completed within 5 days.

THE STUDENT'S PERCEIVED SATISFACTION AND EFFECTIVENESS OF E-LEARNING

The perceived quality of the educational course was detected through the use of a short survey distributed at the completion of the course. Such a questionnaire was intended to identify the strong and weak points of the proposed approach, and moreover to understand whether or not the initial goals were met, at least according to the participants' opinions.

The majority of the questions requiring a quantitative assessment were administered with a Likert scale from 1 to 5, "1 = low," and "5 = high" satisfaction; as for its representativeness, the validity of results may be confirmed by the percentage of 90%, as the questionnaire responses were self-administered anonymously during a face to face event at the end of the course and almost all the present teachers answered the questions. The following is a brief report of the results aggregated according to each objective of the study:

Figure 2. The degree of satisfaction with the methodologies used within UD5



Objective A: To Foster Interaction and Communication Within an Online Learning Community.

In order to assess the perceived achievement of this objective, 3 questions were asked. Graph A illustrates the recorded results of these questions.

Objective B: To Train Educators to use an Innovative Didactic Model and an Alternative Assessment Method that may be Applied in their Professional Practices.

The perceived realization of this second objective of the study was investigated trough a set of questions regarding the effects of the course on each one's teaching career, as well as to what extent the teaching model used in the course could be transferred in one's school context, and if peer assessment could be employed in schools. These questions provided increased evidence of the perceived benefits of the proposed learning experience. Almost 70% of teachers expressed satisfaction with the teaching and assessment approach employed and valued positive a possible transfer of the techniques in their professional settings, 20% expressed an average satisfaction and just 5% a low satisfaction. Teachers were actively involved in the training, and since the inception phase, it was clear that the team of instructors would have worked collaboratively with the teachers to develop a meaningful experience that could have been transferred to their own professional context. In the co-design of the assignments and the assessment procedures teachers had an immersive hands on experience with this collaborative pedagogic approach, easily transferrable in a school context.

Objective C: To Confirm that Through Innovative Teaching Strategies Centered Around the User and Based on Collaboration, Such as Peer Learning and Peer Assessment, Meaningful Learning is Promoted. (Jonassen et al., 2008)

This last objective of the research refers to a definition of meaningful learning proposed by Jonassen et al. (2008) founded on several attributes: active, constructive, intentional, authentic, and cooperative. Learning is defined as "active" if the students are dynamically involved in the construction of knowledge in significant contexts, through:

- The manipulation of objects.
- The observation.
- The interpretation of intervention results.

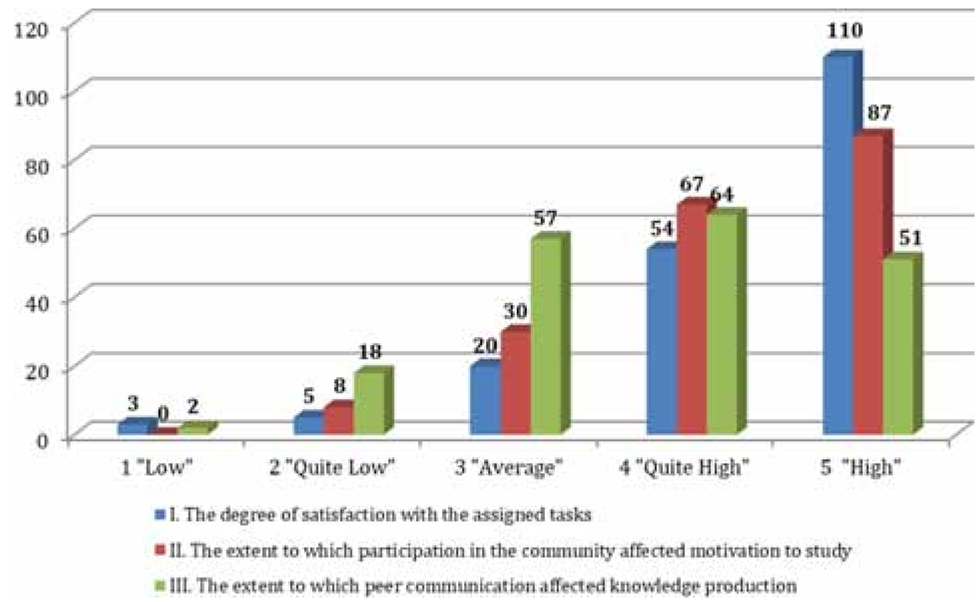
The action translates to learning through a productive method consisting of:

- The comprehension of tasks, deliveries and procedures.
- The cognitive and meta-cognitive reflection upon the experiences in progress.
- The understanding of the "why" and "how" of individual actions.

Learning also occurs in a meaningful manner when it implies events that are intentionally directed toward the achievement of a goal and are emotionally loaded. The use of scaffolding applied to peer assessment can reduce students' cognitive effort in complex learning tasks. The Seifert & Feliks study (2019) showed that this combination has a positive effect, reducing the time on the task and the perceived mental effort. However, if this teaching practice is performed before the content is mastered, it can have disturbing effects on student learning. Another element to improve is the scoring without a feedback or a comment explaining the reasons. At an international level, teaching practices of teamwork and mutual evaluation are often used in initial teacher education. In the subsequent vocational training, teachers work with colleagues through tutoring or mentoring and they share learning experiences. The perception of peer assessment teachers is an important element for educational success. The first important factor is the attribution of importance to the peer assessment if considered an educational activity within the curriculum. In this regard, Panadero, & Brown (2017) underline that the teachers who use the peer assessment detect the following strengths (p.135): "(a) bringing out the best in students, (b) improving the quality of reports, (c) adding variety and pace to teaching, (d) exposing students to different people's judgment, (e) improving writing and grades, (f) helping students gain respect for others' opinions, (g) helping students learn how to give feedback, and (h) helping students gain confidence in their ability to judge another's writing". Compared to the latter feature, studies often show that peer assessment is related to improving writing skills and self-monitoring of their own performance. One of the major concerns that teachers express regarding the use of this practice is the validity relationship between the teacher's judgment and peer assessment. Peers' judgment, indeed, is not always sufficiently competent for evaluation purposes, even if it is a reliable source of information on performance.

When the teachers enrolled in this training intended to accomplish a cognitive goal, they were instructed to learn more and share their questions and their findings. As the objective of learning was not imposed but was collaboratively designated it was evident an increase of active involvement, documented by an intensified communication in the platform among peers and among teachers and the staff. Awareness of the pursued purpose fosters the ability to make choices and decisions, and consequently strengthens one's conviction of possessing the skills, tools, and action patterns necessary to reach his/her intended destinations. The con- text was here represented by the communities of learning and of knowledge construction in which teachers could learn cooperatively, by understanding how to critically assess various

Figure 3. Peer learning and peer assessment promote meaningful learning



perspectives in order to confront and resolve problems. The communication processes among participants, although seldom spontaneous, were commonly promoted by the intervention of a tutor, it was activated, for example, by a set of problems, questions or just some posts in the forums.

For the purposes of assessing teachers' perceptions in regard to this last objective (C) of the study, they were asked to indicate: the degree of satisfaction with the assigned tasks, the extent to which their participation in the community affected their motivation to study and the extent to which peer communication affected knowledge production.

THE ANALYSIS OF FORUMS TO ASSESS PARTICIPATION IN THE COMMUNITY

In the studies on digital technologies aimed toward education, the LMS assume noteworthy importance, enabling the automatic tracking and processing of an enormous quantity of information and making the researcher's task of collecting data considerably easier (Calvani et al., 2005; Mazzoni et al., 2005). The tracking data and material analysis are fundamental to the assessment of network activities conducted by individual students and the assessment of the instructional design itself.

In order to evaluate the achievement of the objectives of the present study – which, primarily, introduce peer assessment techniques in an on-line teacher training course in order to improve collaboration an engagement- an analysis was conducted on the interactions occurring within various active forums in all of the UDs. More specifically, the intention was to see whether the levels of participation, interaction and communication were greeted in UD 5 than in the previous four other UDs.

The principal interactive spaces active in all of the UDs of the training course made reference to the categorization proposed by Ferrari and Piccardi (2010, p. 186), may be any of the following four:

- "Forums controlled by *disciplinary experts*, whose function is to enable discussion on topics that are specific subjects of education; for each UD of the course, a forum named "Let's ask the Prof." was activated.
- "Forums in support of planned synchronous activities; spaces for meta-reflection on the activities of chats and for the settling, enrichment and comparison of the prompts provided by lessons in videoconferences or chats"; for each UD of the course, a forum named "Thoughts and words" was activated.
- "Forums for the exchange of information and for work dedicated to specific groups"; for each UD of the course, five forums named "Group work" were activated.
- "Forums in support of communities with technical experts serving as socializing spaces extended to all the actors of education"; for each UD of the course, a forum named "Digital chatting" was activated.

Unlike the constructivist collaborative design of UD5, in the previous four UDs a traditional linear e-learning model was employed that included the uploading of a series of video lessons, in-depth analysis of integrative content and multiple choices self-assessment tests.

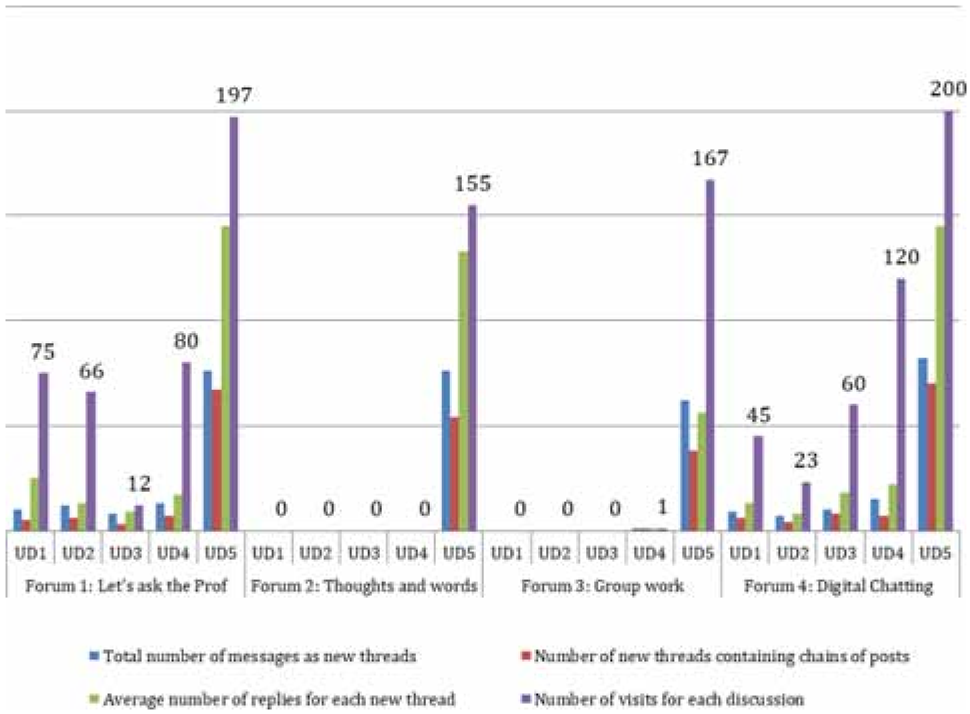
Following the example of Ferrari and Garavaglia (2006, 2010) study, the following quality indices were used to analyze forum participation:

- Discussion span: To calculate the index of depth the number of messages introduced in response to a discussion is considered.
- Forum span: The authors (Ferrari & Garavaglia, 2010, p. 189) define it as "the average of the discussion span (breadth)" contained in the forum. Such indicator "restores general balance in forum participation. The higher its value, the greater the success obtained by the discussions inserted within the forum (actually there are... very few dead threads and quite a few deep threads)" (Ferrari & Garavaglia, 2010, p. 189).
- Density: Such is calculated as the ratio between the total sum of messages introduced as replies and the total sum of discussions that is, messages introduced as initial posts. This indicator differs from the previous one as it is less affected by dead discussions, which authors do not take into consideration due to their reliance on brief periods during which participants are yet to be familiarized with the use of forums.
- Success: It is related to the previous indicators as it enables the "comparison of densities of multiple forms with diverse spans."
- Lurking: This refers to the level of passivity of a forum, or rather, the ratio between the active operations (writing) and passive operations (the reading of posts without participation).

In order to respond to the macro objectives of this study, a quantitative approach was ad- opted by analyzing the interaction in the forums, interpreting the occurrences as indicative of the presence of a communication flow and a collaborative phenomenon, the data collected were focused on the following variables:

- The total number of messages inserted as "new discussions."
- The number of "new discussions" that contain "chains" or "networks" of messages.

Figure 4. The macro analysis of the 4 forums for all of the course's UDs.



- The number of replies, that is, messages that form the communicative chains "triggered" by the opening questions for discussion.
- The number of visits (reads) for each discussion.

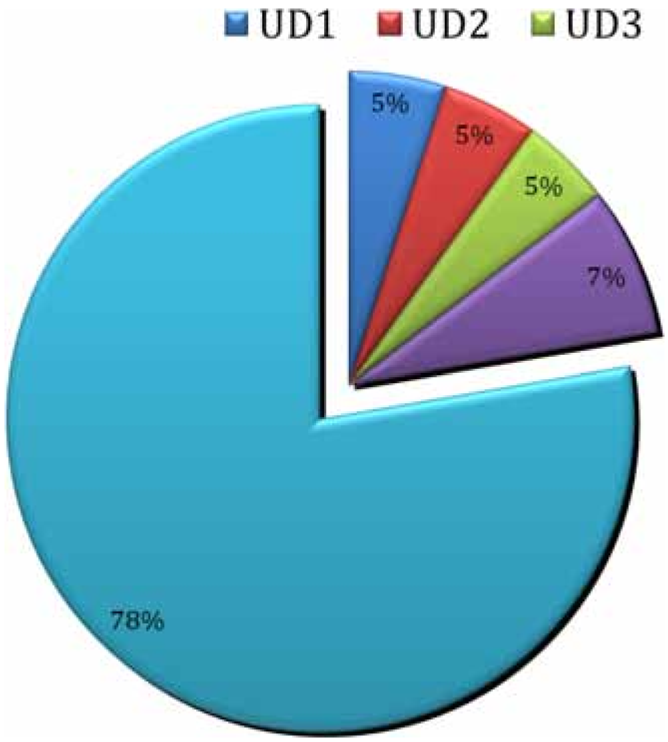
The reading of such data enabled the ex- traction of information regarding the previously mentioned indices of the forum. Such data fully demonstrated that the recognition of the forums present in UD 5 was by far superior to that of the previous 4 UDs.

Using the analysis of the discussions developed in the forums, the tracking analysis, and the previously indicated macro analysis criteria, Graph B are generated, according to the individual forums present in each UD:

- Forum 1: Let's ask the Prof.
- Forum 2: Thoughts and words.
- Forum 3: Group work.
- Forum 4: Digital Chatting.

Graph C illustrates, using absolute values, the data related to forum participation with respect to the indices through the entire duration of each UD (50 hours online). It must be specified that for each UD there are about 40 days dedicated to intense teaching activity. Even though the users were always able to access and benefit from the contents and resources present in the UDs, including the concluded ones,

Figure 5. Level of participation among the course's five active UDs.



only the lapse of time in which each UD held didactic activities was considered in the data analysis of the present study.

In the units that were not involved in the peer learning experience, less than a 30% of teachers indicated an involvement in on-line forums. Most of them used just to read the message and a limited group, less than 10%, posted new thread or even replied to a post. In a UD 5, the one that was designed with a collaborative approach, it could be observed an eruption of active participation, reaching in one case (the informal forum named "Forum 4: Digital Chatting") 100% of users that read at least one message in the forum.

Also UD 4 shows also considerable activity although restricted to just two forums, namely "Forum 1: Let's ask the prof" and "Forum 4: Digital Chatting," the explanation relies to the teaching methods adopted in that unit. Since the staff apparently were posting information about the course in those two forums, fostering the participants to read them from time to time.

The "Forum 1: Let's Ask the prof" was generally the most active, in all units, at least an average 43% of the teachers in all units visited the forum and read a single message, but very few decided to reply. It is a typical forum con- trolled by the disciplinary expert, which offers integrative materials and additional information elicited by questions from the participants.

Graph D clearly highlights the difference between the participation in the first four UDs of the course and that in UD 5. 78% of the interaction in the platform was recorded just in UD 5, the other units employed much less interactive communication, from 5% to 7% of the total interactions.

According to the data, it appears that discussions, interactions and communicative activities played a key role in the online learning environment that was developed for this study. Interactions and peer communication represented a key means to establish collaborative learning practices.

Teachers during this research intervention have exchanged ideas, provided clarifications, shared multiple perspectives and participated in other types of discussions.

The experience developed in Foggia has confirmed that peer learning and peer assessment is strictly correlated with the increase of involvement and direct engagement in the on- line platform, which could be a precursor for the development of a community of learners.

Peer learning processes facilitated a proliferation of interaction and communication dynamics and offered a privileged tool for professional growth, eventually inducing the diffusion of new knowledge and specialized practices.

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CONCLUSION AND FUTURE RESEARCH

The ability to interpret and evaluate the work of peers is a fundamental requirement for the improvement of one's learning performance (Verloop-Wubbels, 2000). Moreover, the training of peer assessment may produce significant effects in each individual's professional sphere. Mastering the correct employment of peer assessment could be one of the key competencies of a good teacher. According to Sluijsmans and Prins (2006), peer assessment implies an extremely powerful pedagogy that is especially valid in the education of teachers, for at least 2 reasons:

- The teachers may work together, learn from one another and feel like members of an organization for learning (Verloop & Wub- bels, 2000). Furthermore, the importance of communication among teachers in schools was recognized by many studies (Cohen, 1994; Johnson, Johnson, & Johnson-Holubec, 1992; Sharan & Sharan, 1994; Slavin, 1995). Peer learning and peer assessment
- Approach, as previously shown, increases significantly communication abilities; hence, this technique could be particularly valuable in teacher training.
- Reflections on the work is much debated in discussion in the field of teacher training. Such is demonstrated by the numerous studies conducted and ongoing in this field (Korthagen, 1985, 2001; Newman, 1996; Reilly-Freese, 1999; Richert, 1999). By encouraging teachers to mutually evaluate one another's products through a communicative exchange, an educational discussion resulting from peer assessment further pro- motes their capacities for critical reflection and analysis

(Birenbaum, 1996; Sambell & McDowell, 1998). Such capacities are necessary for the reliable judgment of the work of peers and of the co-assessment of the work of pupils.

In summary, the use of teaching and learning methodologies based on peer learning and feedback within this experience, in addition to fostering interaction and communication among the participants, seems to have successfully affected their motivation to study, with perceived positive consequences in each of their professional careers.

It would be interesting to conduct further studies analyzing the content of the forums in all the UDs of the course, comparing UD5 with the initial 4 units in which a prevalently behaviorist approach was adopted. It could also be valuable that this group of teachers had reiterated direct experience in the processing of critical and meditated judgments and in the evaluation of their own performance (self-assessment) and that of their peers (peer assessment).

An analysis could verify whether or not the experience of UD5 has continued to produce effects, even after the end of the course; that is, whether the experience has affected the com- munity's activity over time.

Moreover, a follow up micro analysis of the forums may be developed in order to understand the quality of the interactions and the role of the moderator and teacher in the experience.

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ENDNOTES

1. The platform can be reached at: http://elearning.dsapuglia.it
2. The course was offered during the project "Commun-I-Care" founded by the Region Apulia, Italy. Erid Lab had the responsibility to manage the e-learning activities for the health care professionals in the provinces of Bari, BAT, Taranto, and Foggia.
3. Recommendation 2006/962/CE of the European Parliament and of the Council, dated 18 December 2006, concerning the key competencies for permanent learning (Official Gazette of the Italian Republic L 394 dated 30.12.2006, p. 10).

Chapter 2
The Educational Research Flipped Inclusion Between Social Metamorphosis and Technocratic Hybridizations

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ABSTRACT

In the post-modern glocal society, with an economy of continuous training generated by a trans-human technological expansion, we are witnessing an informative consumerism and a capitalism of knowledge that produces a socio-economic co-evolution. The complex idiomatic locution flipped inclusion, introduced in the descriptive-transformative experimental research at the University of Salerno from 2014, crosses, declines, and transposes the concept of inclusion as a social construct in an ecological-systemic perspective and the logic of flipped learning in a systemic learning perspective – learning organization, learning of society, lifelong learning.

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INTRODUCTION AND BACKGROUND CONTEXT AND EDUCATIONAL PROBLEM IN THE UBIQUITUS COMPUTING SOCIETY

In the glocal postmodern (Appadurai, 2001) society (Robertson, 1992) with an economy of continuous learning (Isfol, 2004), generated by a transhuman technological expansion (Kurzweil, 1999), we are witnessing an informative consumerism (Castells, 1996), a cultural capitalism (Fiske, 1992) and a knowledge capitalism (Castells, 1998).

A pervasive expansion of cybernauts and digitalization produces socio-economic convergence and co-evolution (De Haas, 2004), which transforms human and social capital (Lukacs, 1983). All this determines the transition to the era of capitalism of permanent formation (ISFOL, 2004). The ubiquitous computing with the global interconnections generated by the invasive use of technologies infiltrates every segment of life. They produce new educational needs of multiple and flexible competence, to face the underlying risks of a narcotizing human technocratization (McLuhan, 1998) or a tendency to biologize machines (Pinto Minerva, 2011).

All processes are accelerated, which become dichotomous and permanently transformative, characterized by inversions of liquid identities (Bauman, 2003), individual and collective, devoid of personal and social awareness (Honneth, 2012). We are in the presence of technocratic processes of human hybridization (Pinto Minerva, 2011) with reproductive metamorphoses, computational and mechanistic, which produce new social needs. The weak relativistic boundaries (Ruiz García, 2012) and the induced forms of existential precariousness, which characterize the complex (Beck, 1986), liquid (Bauman, 2003) and post-modern technocratic (Augè, 1991) are expressed in interacting complex systems (Von Bertalanffy, 1968). These systems are dichotomic-hologram-dialogic, because they promote interactive dynamics, even with differentiated perspectives (Cambi, 1991). They are both autopoietic, because they self-determine their own development, starting from multiple access paths (Morin, 1985). This is based on ubiquitous, democratic and participatory citizenship for the management and enhancement of emotional and value potentials. The supra-structural educational aim is to cope with hybrid velocisations, automations of human behaviors and to manage the risks of a social bio-technologization, forming ethical, to a perspective and awareness co-responsible and ecological-systemic.

The identification of problematic aspects with shared horizons of meaning, are some of the strategic tools for re-enabling situational solutions, that derive from the post-human atomistic social structuring. The latter promoted and rooted in the web, while activating comparisons and symbolic productions, generates precarious, fluctuating and involuntary processes of identity and collective re-designation, which pertain to neo-needs for recognition.

The new cross-media democratic citizenship must invest in intersubjective human capital, through existential design education (Dewey, 1984), to take root in the value of awareness of a strengthening of the system, which is born of individual efficiency and social recognition.

To trace a post-modern epistemology of complexity (Morin, 1993) in the cross-media era of web 4.0, it is possible to affirm that: transnational delocalization (Vertovec, 2009), induced by the media network, destroys contexts and categories of space - time. All of this generates states of permanent metamorphosis (Appadurai, 2001), polytheism of values (Maffessoli, 1990), loss of certainties and production of liquid identities (Bauman, 2003), as an expression of embodied representations of postmodern personalities (Winnicott, 2005).

We are in the presence of new forms of cross-media sociality, often unaware and poorly managed (Maffessoli, 2004) and of a social need for emotional control and guidance (Gordon, 2014) with which the educator must confront.

Free access to the web and the ease of use of digital tools facilitate network interaction, break down hierarchies, roles and favor the democrat (Dewey, 1961), the comparison to peer.

The widespread participatory and creative culture, while facilitating the regeneration of the community, motivated by the purpose, also risks promoting convergent cultural forms (Jenkins, 2007) for interest.

"*There is talk of widespread modernity (Appdurai, 2001), with a secure and limited border, which announces the advent of an unstable global society, to be considered" in its various spheres of influence, in various knowledge and in various areas of society* " (De Giuseppe, 2018c, p.29).

The unidirectional web 1.0, representative of mass communication and rooting in national identities, is replaced by the new cross-media vision of web 4.0, which is characterized by the production of glocal and deterritorialized communities (Germano, 1999), with an identity liquid. The processes of cultural and value deterritorialization, generated by a cross-media ecosystem, hide the risks of an existential precariousness and a rarefaction of ties and a sense of belonging. The consequent "involuntary progressive closure of relations (Bauman, 2006), which have become fragile and random" (De Giuseppe, 2018c, p.32) promotes the fluid coexistence of interests and purpose

Intersubjective creolization (Merleau Ponty, 1942) socio-cultural (Beck, 2000) produces experiential contaminations in the movement (Colombo, 2005) and dynamic belonging (Appadurai, 2001) that are self-generated in the ubiquitous exchanges on the web (Tomlison, 2001) . We are in the presenceof transnational and glocal processes (Robertson, 1992), (Breidenbach, Zukrigl, 2000), as a result of a zeroing of space-time categories, favored by synchronous and timeless cross-media communications.

The network, in promoting incessant reorganisations of the contexts of interaction, which cancel the space-time distances, but also the relational ones, in the presence of poorly managed communication dynamics (Putnam, 2004), risks involuntarily promoting processes of decline of the social capital, with forms of homologation of differences, responsible annihilation, self-reference. A similar hyper-consumption cosmopolitanism (Beck, 2000) is the result of an accessibility (Corona, 2018) communicative-democratic, which guarantees "direct access and participation in knowledge (Dewey, 1961) in the continuous co-construction" (De Giuseppe, 2018, p. 32). We are in the presence of a new technologically dependent society, in the continuous search for the satisfaction of the desires of liquid hypervelocity (Fusilli, 2016).

These desires generate an experience of momentary happiness (Csikszentmihalyi, 1990) that, replacing the desire to pursue a condition of happiness, produces a permanent state of unhappiness (Bauman, 2017).

"*We are in a condition of double bond (Appadurai, 2001), characterized by an emotional and decision inconsistency, which generates individual and collective profiles from oscillations and precarious emotional and decisional processes"* (De Giuseppe, 2018c, p 33).

Free sharing, with unconscious and poorly managed flows of interchange (Winnicott, 2005), the polytheism of values (Maffesoli, 1990) and virtual identities, often representative only of a hypothetical or potential self, risk to be depersonalised (Baudrillard, 1976) individual and collective profiles making them liquid (Bauman, 2003), emotionally fragile, with flexible and complex values (Morin, 1993).

Therefore, the training needs are highlighted, the training need of a transmedia media education, with a qualitative and quantitative evaluation and the monitoring of cross-media actions / interactions / collaborations, followed by a methodological direction from the bottom up and from the top towards the low, on ecological-inclusive prospects.

A transition should be organized from the informative transmedia story to a cooperative narrative, with critical, proactive and co-responsible reflections, to support intrinsic motivation and to act consciously, through a management of digital democratic decentralization and the decoding of standardized convergent cultures.

The resolutive management (Beck, 2000) and aware of impulses, emotions, conflicts and problems (Gordon, 2014) situated by context, represents the priority educational objective to face the cross-media *complexity of reality* (Visalberghi, 1978, p. 24) formal, non-formal and informal. "Overcoming the culturalist paradigms, it is necessary to invest in heterogeneous research areas, to be declined pedagogically and situated educationally." (De Giuseppe, 2018c, p.91).

It is necessary to overcome the lines of research from the hyper-specialized and disciplinary vision, invest in multidimensional educational perspectives, for an aware management of the liquid complexities of the post-humanist technocratic society and stem the relative risks of hybridization (Marchesini, 2002). Through a new understanding of plural differences (Gordon, 2014) and the forms of new participatory citizenship (Altin, 2010) crossmediale (Eco, 1964), rooted in a democratic confrontation (Dewey, 1961), it is possible to guarantee social inclusion and respond to new individual and social needs (Habermas, 1998).

The formal, informal and non-formal educational spaces must be redefined, for an experiential investment in co-mediation (Dimitriadis, 2008), criticism (Frabboni and Pinto Minerva, 2001), dynamic and systemic, even symbolic (Mead, 1934), with a school, life process (Dewey, 1961). To educate a flexible lifestyle, capable of seeking a continuous ongoing balance, through coexistence (Dewey, 1961) in action, interaction, collaboration and systemic cooperation, represents the multidimensional and multi-perspective educational challenge, aimed at forming identity (Besozzi, 2006), plural, dynamic and responsible, aware of the value of a proactive and prosocial glocal belonging. The new educational challenge must be anchored to the strategic and conscious research of happiness (Bauman, 1999), through forms of selectivity 1) communicative, 2) perceptive, 3) representative and 4) empathic, to manage the emotional over-stimulations induced by an unconscious use of crossmedia.

It is a matter of re-educating the management of media accessibility, through the formation of fluid and decisive skills, to increase the levels of problems (Berthoz, 2011).

With the ubiquitous web, the shared dissemination of codified symbolizations goes beyond the boundaries of contexts. We are in the presence of a transnational, that if not rationally aware, re-produces the presuppositions of a social action (homologated in behaviors, thoughts and structures of relationality).

In this perspective, society is the result of a phenomenon of communication of coded symbols. The crossing from domains produces effects both on the representation of sense / meaning and on the transformation of identities.Media literacy (UNESCO-EFA, 2005) produced by easy digital accessibility to information and knowledge (Street, Lefstein, 2007), gives priority to the re-production of new learning contexts, formal, non-formal and informal to educational interventions for the re-interpretation of multidimensional phenomenologies. The latter involve the different spheres of existence, from personal to socio-political-cultural (Gee, 1990), to be framed historically and by context in an inclusive perspective (UNESCO, 2009).

It is an educational investment in the transmitting management of relationships, which requires the acquisition of resolutive and inclusive procedural approaches, such as: "shared mentality" (Rivoltella, 2006, p.74) and the domain of emotions (Rivoltella, 2006, p 64) in complex problems. This implies an education to accessibility, understood also as participation (Dewey, 1984) co-responsible and democratic for the interactional media processes for an inclusive formation of the personality (Caprara and Cervone, 2003), with an impact on the sense of belonging and on the identity.

In fact, through the multidimensional use (Albarea, 2012) of cross-media codes and languages it is possible to start experimental educational implementation paths, focusing on forms of transmedia narration. The simulation of online actions, in the personal search for a plural redefinition, the transmedia narrative, even with simulated roles, favors identity experiences.

This allows us to experiment with forms of protagonism, as an actor with interpersonal cooperation (Lévy, 2002), shared and co-responsible, community and prosocial, which traces Deweyan's sense of a process of scholastic life (Dewey, 1961).

In summary, the forms of existential disorientation, implicitly connected to post-human technocratic complexities, represent, therefore, crucial elements of the post-modern epistemological debate in a perspective of education to long life, with forms of existential design (Dewey, 1984).

MAIN FOCUS OF THE CHAPTER: THE FLIPPED INCLUSION RESEARCH AND THE ANALYSIS OF COMPLEX TECHNO-POIETIC HYBRIDIZATION PROCESSES AS AN EDUCATIONAL PROBLEM

The analysis of the propagation models of the new forms of abstract symbolizations and of the modalities of decoding the action, as founding structures of the new-construction processes of post-modern phenomenologies, represents elements of interest of educational research. It is an educational investment in the generative dialectic of self, individual community (Mead, 1934) and in the processes underlying the attributions of meaning and meaning of the cross-media knowledge society (De Giuseppe & Corona, 2018).

The research carried out at the University of Salerno, in the years 2014/2017, derives from such an analysis of the degenerative risks (De Giuseppe, 2018) socio-psycho-anthropic-cultural, connected to the complex perturbed processes (Dewey, 1981) (Mori 1985) of techno-poietic hybridization (Marchesini, 2002), which characterizes the knowledge society (Castell, 1997), with a continuous life long learning economy (ISFOL, 2004).

Step 1. Ask a Question.

In the field of research, an initial phase of exploratory study was launched concerning 1) the use of personal computers, 2) the use of the Internet, with a distinction relating to daily use and age, in the period 2014 (beginning of the exploratory study year).

It emerged that compared to 2013 (Istat, 2014):

- The percentage of personal computer users remains stable at around 54%
- 33.5% make it a daily use
- The percentage of users using the Internet has gone from 54.8% (2013) to 57.5% (2014), of which:
- 36.9% with daily use
- The percentage of people who use the Internet daily increases significantly, from 33.5% (2013) to 36.9% (2014)

  § frequency of use by age group:

- between 15-24 years, over 70%
- b) strong increase in the daily use of the Internet between
- 25-34 years (+7 percentage points)
- 15-17 years (+9.2 percentage points)
- 60-64 years 41.6% (2014) versus 36.4% (2013), higher growth in Internet use

This last datum is emblematic, as it underlines the importance of an educational investment in learning the system, in view of lifelong learning, lifelong learning, lifelong learning.

Another emblematic fact that was found in the Istat survey (2018) concerns Internet users in Europe, which represent an average of 70%, which in Italy falls below the European average to 48.9% of the population: only the 26.4% connect daily.

The research also launched a first exploratory study on the impact of the videogame phenomenon as a habit of young people aged between 3 and 38, the incidence of video games on lifestyle. Account was taken of data from 2014, the World Health Organization (WHO, 2015) and surveys relating to health implications, excessive use of the Internet and cross-media tools.

The exploratory-descriptive-transformative research has set itself as a pilot study and pedagogical avant-garde, rooted in the computational logic of the 4.0 era, to form identities able to stem and manage the complex hybrids of the technocratic era of knowledge and stem addictive drifts (as reported in the 11th edition of the International Classification of Diseases-ICD-11, 2018- in the chapter on mental pathologies and before that in DSM-5, 2013).

Step 2: Do Background Research.

The macro-analysis of the postmodern cultural socio-anthropic context places the problem tackled in the flipped inclusion research carried out at the University of Salerno, in the phenomenological framework concerning the new challenges of inclusive education. The latter represent strategic tools from the bottom up, proactive reflection and prosocial interventions, for a digital democratic citizenship, in a perspective of lifelong learning, lifewide learning, lifedeep learning, as an inclusive policy of organizational and strategic socio-psycho-educational management. Analyzing the technological pervasiveness of media on informational, communicative (Strate, 1999) and socio-psycho-cultural processes, the existential design model of inverted inclusion represents an interdisciplinary educational challenge (Lum, 2006) and it is metadisciplinary (Nystrom, 1973).

We are in the presence of an investment in forms of learning the system (Alberici, 2002), structured by increasing levels of complexity (Sibilio, 2014), ranging from learning organization, to the learning society and to lifelong learning, without losing sight of macro-forms of learning, such as global learning and lifelong learning.

Lifelong learning, which concerns the duration of learning, is understood as lifelong learning, a continuous and recursive dynamic process that involves the whole existence.

Lifelong learning, as a widespread learning process, which considers life itself as a laboratory macro-context of life and takes place in every context (formal, non-formal and informal; micro, meso, eso and macro); therefore, it concerns the spatial dimension of learning places;

Lifedeep Learning, as a form of deep learning, focused on the emergence and improvement of qualitative values, which guide human life, through an education that traces the origin of the Latin term, a former ducere, leader, for a full development of staff

The recursive dynamic model of inverted-IFM inclusion (De Giuseppe, Corona, 2016) traces the logics of trans-spatiality and trans-value, which characterizes the complex organizational-structural configurations, produced and reproduced in the network.

Starting from an analysis of socio-contextual risks due to the excessive and uninformed use of the network, in the field of experimental (Dewey, 1961a) exploratory-descriptive-trans-formative research (Cox et al., 2011) at the University of Salerno the simple idiomatic expression launched inclusion was introduced. The study combines, declines and transposes (Chevallard, 1985): 1) the concept of inclusion, as a social construct (ICF, 2001) in an ecological-systemic perspective (Bronfenbrenner, 2002) and 2) the logic of inverted learning (Bergmann et al, 2012) of which the system of reversal of roles, spaces and times is followed, remodulated from a perspective of trans-educational learning of the socio-psycho-anthropic-educational system (Alberici, 2002). We are in the presence of an existential design model (Dewey, 1961b) which is based on the value of the re-education circular (Dewey, 1961a) (Merleau-Ponty, 1942) and crosses the computational logic of the web 4.0 transversally.

The complex idiomatic locution, which summarizes the logic of the model, is the basis of the socio-psycho-educational value of change management skills. From here we highlight the need to learn to foresee and solve the competencies of complex emerging and localized problems (De Giuseppe, Corona, 2017), through a strategic investment in structured learning systems of a simple, permanent, jointly responsible and self-managed learning system in a network (organization of learning), with prosocial vision and inclusive wellness mission.

Flipped inclusion is part of a methodological macro-orientation of New Literacy Studies, like a new cross-media literacy. It is intended as: "... something more than reading and writing; it concerns our way of communicating within society. It concerns practices and social relations, knowledge, language and culture" (UNESCO, 2005, p.1). It is characterized by educational investments regarding the use of technological means, such as formal, non-formal and informal, communicative-cultural environments and on the "[...] way in which they influence communication on human culture (Scolari, 2015), perception, knowledge, emotions and human values "(Postman, 1970, p.161).

It invests in the didactic promotion of forms of multimodal communication (Gee, 2008), which through phases of re-understanding (Gee, 2005), relativized to meanings by semiotic domain, favors a learning of the system (Alberici, 2002), which uses society of learning (Stiglitz, Greenwald, 2014) through a learning organization, in view of lifelong learning (De Giuseppe, 2016c).

The neo-inclusive model of ecological-systemic media empowerment (Postman, 1968) is structured on modular and recursive paths, organized according to increasing levels of complexity (Berthoz, 2011). Within it intersect dichotomic design logic applied didactically, both from top to bottom, with the analysis of frames (Goffman, 2001), which are grafted onto structural systems from the bottom upwards, with cooperative micro-intergroups, meso, eso and macro paths, in an inclusive perspective (Buckingham, Willet, 2009) ecological systemic (Bronfenbrenner, 2002). It is a structural modality that attempts to retrace the complexities of the network, accumulated by an inter-agency observation between context factors, from micro to macro-structural. The goal is to educate on a management of the inputs and dynamics that occur in the technological habitat, for an awareness of the socio-psycho-cultural changes that are self-generated.

The inverted inclusion design architecture is based on the interconnection of opposing top down and bottom up logics.

Retracing the epistemological perspectives of complexity that are supported by the technologies used as instrumental teaching, we intend to propose an inversion of the Aristotelian approach and an adoption of the poietic philosophy (Dewey, 1984) socio-intersubjective (Hickman, 2000), of a partner - constructivist and connectionist.

Step 3: Construct a Hypothesis

The Research Between Objectives and Intervention

The research project took into account the review of the literature, which addressed the exploratory investigation, concerning the role of cross-media technologies and the incidents on the socio-political-economic macro-structure and educational psycho-anthropic

Inclusive (ICF,2011) and simplexity approaches (Sibilio,2014) have been applied to flipped lerning (Bergman et al.,2011).

The research hypotheses verified were:

- the teaching-transformative-design model of flipped inclusion promotes pro-social skills;
- transforms contexts into an inclusive, ecological-systemic perspective.

The general research questions were (De Giuseppe, 2018):

Research Question 1: Does the overturned inclusion model facilitate your study method and influence learning, cognitive and attribution styles (communicative, relational, cooperative)?

Research Question 2: The flipped inclusion has promoted the formation of inclusive and plural individual and collective profiles (De Giuseppe, F. Corona (2017c), able to manage complex problematic situations, through *simplex didactic* practices (Sibilio 2014)?

Research Question 3: Does the upside-down teaching of inclusion influence the promotion of inclusive contexts?

From the exploratory analysis (1. Exploring) initiated in the first phase of the research, which highlighted the problems of the post-modern technocratic society, the idea (2. Idea) and the design (3. Design) of the flipped inclusive design model were derived. Inclusion, tested in the subsequent phase (4. Experimentation) of the research, with field courses aimed at university students, trainee teachers and compulsory school students.

With the experimental research-action pathways, therefore, the incidences of the flipped inclusion model were investigated, with cross media applied in the classroom and beyond the classroom on:

- cognitive and metacognitive, social and prosocial processes;
- inclusive learning styles (knowledge and skills), cognitive style and attribution style (communicative and socio-relational) and
- promotion of inclusive, ecological-systemic prosocial contexts.

The descriptive, interpretative, hermeneutic and critical approach was conjugated with the intent to observe the deconstructive training processes of the sub-personnel, started with an action of research-action and an extension of the computational logics to a system learning according to the inverted learning approach from an inclusive perspective.

Step 4: Field Courses and Activity Structure

The experimented research-action activities related to the flipped inclusion model are structured taking into account the four dimensions of well-being and quality of life (Lawton et al, 1968), such as:

- Behavioral competence
- Objective environment
- Quality of life perceived
- Psychological well-being

The existential democratic approach (Dewey, 1984) was followed in an inclusive-systemic perspective (Jenkins, 2010), as a tension and circular learning movement (Merleau-Ponty, 1942), to experience citizenship (Altin, 2010) also digital.

Flipped inclusion, therefore, is rooted in the principles of strategic accessibility of Universal Design (Mace, 1998), as universal values and rights (Ainscow, 1991) in terms of inclusive opportunity: for free cross-media access and for facilitation of trans-formative re-organization processes (Ferlino, 2009), it is necessary to invest in education for socio-psycho-relational and empathic-affective re-recognition (Corona, De Giuseppe, 2016a).

For research activities, we have used complex systems of mixed learning with formal, non-formal and informal settings (Corona et al., 2016), real and virtual, in the classroom and outside the classroom.

The Flipped Inclusion invests in the construction of stimulus environments: in favoring generalization processes (Baer, & Deguchi, 1985), benefits are produced for the individual and for the group context, through paths of co-responsible prosocial mediation. Therefore, the research on flipped inclusion has explored, investigated and described the activation of dynamically critical intersubjective trans-formative processes (Eco, 1964) (Frabboni & Pinto Minerva, 2001). Complex blended learning tools and platforms have been used to foster skills of 1) investigation, 2) discovery and 3) resolutive-design mastery and 4) experiential.

The cross-media tools, therefore, are strategically used in the Flipped Inclusion as a support to the design and systemic inclusiveness. Retracing and transposing the structural logics of computational thought and in particular of knowledge management (Nonaka, Takeuchi, 1995) with the DIKW (Date, Information, Knowledge, Wisdom) pyramid hierarchy, the phases of Flipped inclusion are organized in:

- Date, with an exploratory collection of informative data - EXPLORE phase.
- Information, which involves a process of aggregation and contextualization of data, transformed into information in the phase of the Idea).
- Knowledge, as a transformation of information into organized knowledge - Design Phase.
- Wisdom, is the phase of metacognitive wisdom, based on personal re-elaboration, which is connected to the experience, phase of Experimentation.

With the situated contextualized designs included in the flipped inclusion research, experiments have been started (Dewey, 1961) aimed at managing formal, non-formal and informal technological interposition. The intent was to reunite experience through formal, non-formal and informal places and times in which knowledge, knowledge and relationships are co-built. In this way, the central value of the person who, in free and accessible autonomy, explores, selects, creatively reorganizes and proposes new stimuli is reaffirmed, but needs a new pedagogical awareness about the strategic value of the interdependent cor-responsibility between systemic levels, micro, exo, meso and macro of formal, non-formal and informal social contexts, to acquire proactive modus operandi (Covey, 1989) and prosocial modus vivendi.

The activities of flipped inclusion, therefore, retrace the logic of modularity and computational recursion, with the aim of inductively promoting inclusive processes.

They are based on phases of:

- perception of the self (Bandura, 2000), as an understanding of emotions and motivations;
- self-esteem (Coopersmith, 1967);
- self-knowledge (Ricoeur, 2005), in compare;
- self-esteem, as an individual self, as a community - as a society (Mead, 1934).

We invest in a systematic organization of thought, as an understanding (Understanding), characterized by a systemic vision of the learning context. We use behavioral reinforcement, an attribution of significance (Gee, 2005) and a breakdown of problems into subproblems according to the simple didactic logic (Sibilio, 2014).

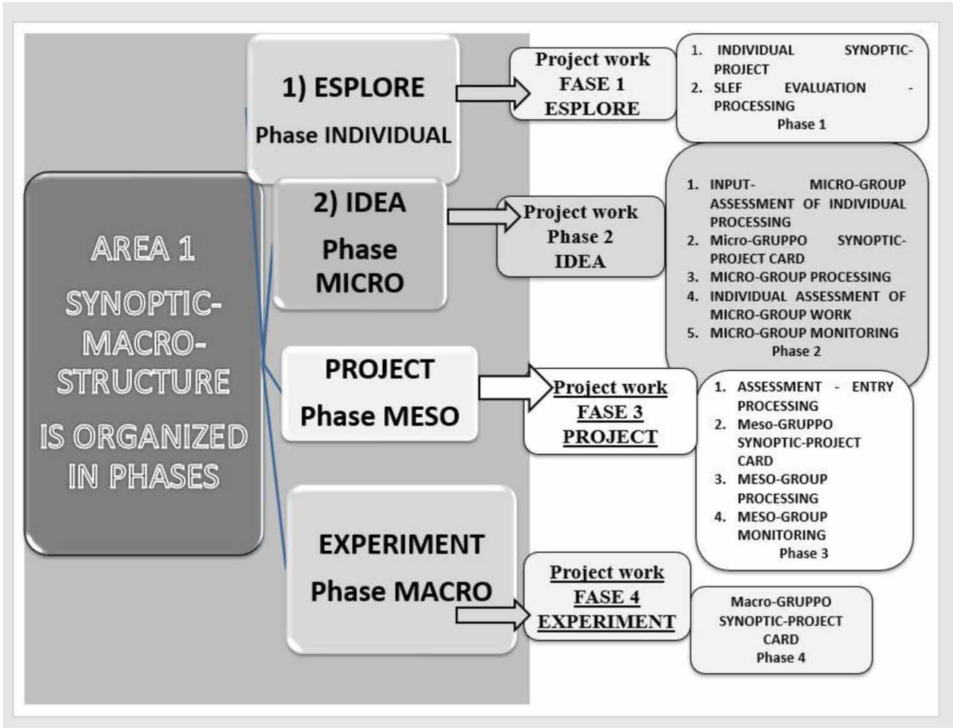
In the Flipped inclusion, through the preparation of contexts based on sharing, interaction, collaboration and cooperation, training courses have been launched of integrated management, off line and online, between two levels of community:

- community of practice (for research solutions to common problems in a mutual exchange of experiences and information;
- learning community (for the acquisition of knowledge, skills and competences).

For this reason the activities experimented in the research have followed work phases 1) individual, to exercise the action with a sense of responsibility; 2) of a micro-group, to proactively experiment with forms of interaction 3) of a mesogroup, to practice social, co-responsible and proactive collaboration; 4) of macro-group, to experiment with forms of co-responsible, proactive and prosocial cooperation. Cooperative interrelations for and between levels of increasing complexity are organized in a cooperative manner according to structured rules specific to cooperative learning, in particular learning together (Johnson and Johnso, 1985) and complex education (Cohen, 2003).

So we are in the presence of an algorithmic structure, which is structured according to increasing levels of complexity, according to the logic of simplicity (Berthoz, 2011), linking EDDE (Explore-Design, Designing, Experiment) modules in a recursive and modular way, in phases didactics of work with Frame Analysis (Goffman, 2001) and for levels of micro complexity, meso eso and systemic macro (Bronfenbrenner, 2002) in a global perspective.

Figure 1. Project work- Flipped Inclusion (De Giuseppe, 2018, p. 205)



- *Individual Inclusive Contextual Projects* concern individual per-courses (products and processes): these are micro-systemic paths, based on the perception of the self (1. Exploration phase).
- *Inclusive Contextual Micro- Projects* are bottom-up, micro-group design paths that derive from the sharing of individualized contextualised designs (individual frameworks).
- *Inclusive Contextualized Meso-Projects* derive from metacognitive re-elaborations of the contextualized inclusive Micro-Designs (microgroup framework).
- *Inclusive Contextualized Macro-Projects* have from the metacognitive reworkings of inclusive contextual meso-designs (meso-group framework).

The phases of the modeling process follow (Bandura, 1969) and the incremental stimulations, with which a careful and selective facilitation is promoted, focused on motivational reinforcement. Therefore, the activities follow progressive actions: 1) of choice with a circumscription of stimuli of interest (key), 2) conceptualization of an observation framework (framework), 3) focus on the problem (classification), 4) identification of identified resolutions and conjectural (framework) (De Giuseppe, 2018). In this way we try to intervene on a perceptive, cognitive and metacognitive level, but also on a skill level, which can be translated into social and prosocial behaviors.

In flipped inclusion, through cross-media tools and free platforms, Blendspace and Spiral, flipped learning activities are facilitated (Bergman & Sams, 2012). Also the interventions on platforms follow the methodological structuring foreseen by the Flipped Inclusion, which follows the macro-logic of problem solving (Duncker, 1945) divided into meso-phases of: 1) learning(Kuhn, 2000), 2) discovery learning (Bruner, 1961); 3) learning of mastery (Bloom, 1971), through 4) experiential learning (Kolb, 1984).

Figure 2. Flipped Inclusion- phase 1° Explore

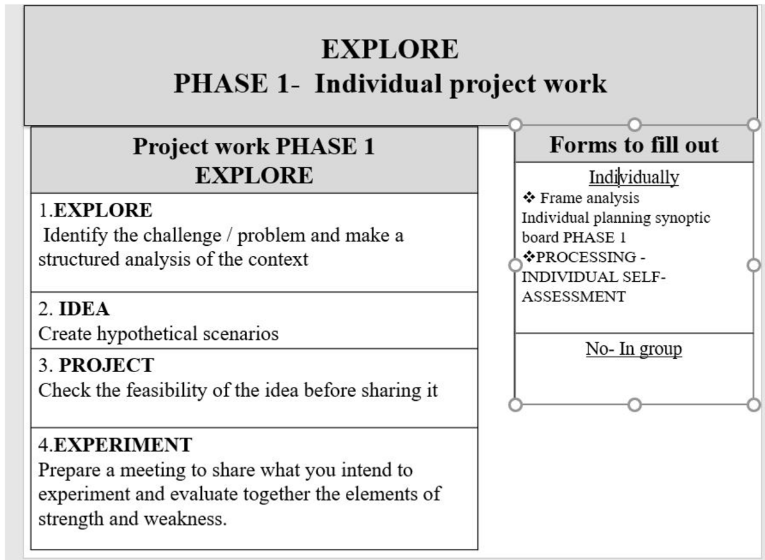


Figure 3. Flipped inclusion Phase 2° - Idea

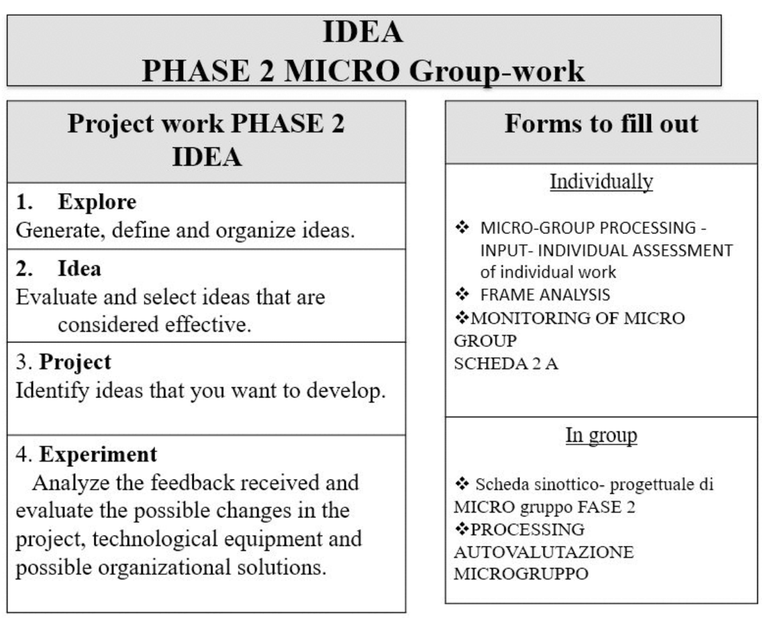


Figure 4. Flipped Inclusion Phase 3°- Project

PROJECT
PHASE 3 MESO group work

Project work- PHASE 3 PROJECT	Forms to fill out
1. **Esplore** Define: recipients, resources, tools and convenient means for the realization of the idea.	In gruop **Project** ❖FRAME ANALYSIS ❖ Synoptic-design card - MESO group -PHASE 3 **Assessment** ❖ MICRO-GROUP PROCESSING - INPUT- INDIVIDUAL ASSESSMENT of MICROWORK ❖ PROCESSING MESOGRUPPO SELF-ASSESSMENT ❖MONITORING SELF ASSESSMENT
2. **Idea** Improve the idea and identify improvement actions.	
3. **Project** Develop the idea.	
4. **Experiment** Identify the tools, the real and virtual spaces, the materials and the different work phases, distinguishing the activities to be performed at home and at school.	

Figure 5. Flipped Inclusion Phase 4 Experiment

PROJECT
PHASE 3 MESO group work

Project work- PHASE 3 PROJECT	Forms to fill out
1. **Esplore** Define: recipients, resources, tools and convenient means for the realization of the idea.	In gruop **Project** ❖FRAME ANALYSIS ❖ Synoptic-design card - MESO group -PHASE 3 **Assessment** ❖ MICRO-GROUP PROCESSING - INPUT- INDIVIDUAL ASSESSMENT of MICROWORK ❖ PROCESSING MESOGRUPPO SELF-ASSESSMENT ❖MONITORING SELF ASSESSMENT
2. **Idea** Improve the idea and identify improvement actions.	
3. **Project** Develop the idea.	
4. **Experiment** Identify the tools, the real and virtual spaces, the materials and the different work phases, distinguishing the activities to be performed at home and at school.	

The purpose of promoting peer media education, even with a way to re-read the phenomenon of cultural video media, is related to technological progress.

Considering the role of the privilege of the visual sphere in cross-media society, with the vision and the production of images, it was considered useful to invest in social learning, with video-modeling activities, to identify and counter antisocial behavior and promote target behavior modeling (Bellini and Akullian, 2007), prosocial (Buggey, 2005) and existential skills. Therefore, the upside-down inclusion activities focus on motivation and perseverance with actions by levels (Gee, 2008) that follow the principles of Gee learning (2005). It is about educating to an ethnographic look with a decentralized and contextual approach (Gee, 2008), able to reconstruct liquid phenomenologies of meaning and meanings (Bauman, 2003).

In this proactive-productive and interpretative phase the meta-reflexive processes of (Corona, De Giuseppe, 2019) are promoted with videomodeling activities:

- representation of self and sociological observation with video stimulus (Exploring);
- cross-media re-education with text processing and interactive production of multimedia hypertexts (Design);
- conscious reproduction of information, knowledge and knowledge, with subjective and cooperative production of images and videos (Designing);
- shared experiential actions and simulation processes (Falloon, 2011) for levels of increasing complexity (Sibilio, 2014) with a collective vision of the video product (Experimenting).

Through the production and textual-audio-video decoding, subjective and intersubjective, based on evidence-based practice criteria, a phenomenological reading of the communicative, social and behavioral domain, which derives from visual sociology, has been made possible.

For flipped inclusion testing activities we also used the flippedinclusion.it site, which, through a reserved area, allows access to 4 types of formal learning environments (Koster, 2004):

- Planning: publish and define deadlines, appointments, goals over time;
- Conferences, on which topics of discussion are defined and the folders of materials and messages managed;
- Sharing documents and sharing links: sharing documents online and individual and group links.
- Personal messages to send and receive individual messages, of micro, meso and macro-groups (Corona, De Giuseppe, 2019).
- It is also possible:
- loading of products and video texts made in the context of experimentation;
- monitoring, self-assessment and evaluation, both initial and final, in phases and levels (Wagner & Srivastava, 1989).

Moreover on the site it is possible to consult research and scientific publications on the inclusion upside down; methodology data and experimental data.

Figure 6. Sampling and Students Involved Research-2014/2017 (De Giuseppe, 2018, p. 205)

RESEARCH CONTEXTS:
FORMAL SPACES (academic courses - Department of human and philosophical sciences and training, Department of Medicine and Surgery, Comprehensive Institute of Montoro-Avellino);
INFORMAL SPACES (Facebook, campus of Salerno's University)
NON-FORMAL SPACES(Blendspace, Spiral)

RESEARCH SUBJECTS- RESEARCH SAMPLES- RESEARCH YEARS 2014/2017			Age of users involved in the experimentation
Anno di ricerca	**TOTAL STUDENTS involved in the experimentation**	**SAMPLE NUMBER (simple random sampling)**	between 12 and 55 years old
2014/15	318	159	
2015/16	802	401	
2016/17	652	326	
University	1772	886	
Secondary school	50	25	
TOTAL	**1822**	**911**	

Step 5: Context and Methodology of Research

The longitudinal pilot study proposed the flipped inclusion model (Corona & De Giuseppe, 2017c) on an interinstitutional sampling, in the school and extra-curricular fields, in the context of life-long bio-psycho-social learning (Bronfenbrenner, 2002).

The research was carried out in the formal spaces (academic, school) and informal courses (campus of the University of Salerno - Department of Human and Philosophical Sciences and Education, Department of Medicine and Surgery). Spatial and institutional contiguities have been used to obtain a convenience from the point of view of information gathering.

In the three years of research, 2014/17, 1772 students, on a sample of 886 (academic students) and 50 students on a sample of 25 compulsory school, involving a total of 1822 students, took part in the experimentation, with simple random sampling of 911 people. The experimentation was carried out involving students in training, average age 25 years, but also on teachers in training with an average age of 45 years.

Interpretative-descriptive-transformative research (Cox, Geisen, Green, 2011) has been elaborated as an integration of two traditionally antithetical heuristic models, action research and experimental research.

The experimentation of activities in flipped inclusion, which made use of research-action in the field, made it possible to combine the quantity of data and the quality of the interpretations relating to the individual and contextual modifications produced. This also allowed to produce theoretical elaborations to face educational needs.

We focused on the collection of data that can help us examine, discriminate, highlight conclusions based on evidence and on scientificity as a process quality of life (Dewey, 1981) and answer questions regarding aspects of society, to understand it (Bailey, 1982). A multi-method research has been launched, due to the complexity of the object of investigation and of the pedagogical-training processes, which brings out the need to synergistically integrate quantitative and qualitative research models (Creswell, 2003) cross-checks have been initiated and different data collection procedures, about the examination of the same issues, to guarantee such a quantity of empirical data to produce a critical meta-reflection on the meaning of the results. Qualitative investigation techniques were used (Zammuner, 1998), such as focus groups, participant observation, descriptive assessments.

The focus groups (Bloor et al. 2002) were used in the questioning route mode, according to a didactic transposition of the frame analysis, supplied to the group discussions. However, the topic guide mode is also adopted, with the initial input of the prompting and fading phase, in the works of micro, meso and macro-group, to foster cooperation, starting from the framework of the previous phases. Audiovideo productions also represented moments of evaluative and self-evaluative reflection, through methodological investigation techniques (Boncori, 1993), deriving from visual sociology and sociology of images (Faccioli, Lo Sacco, 2010).

The quantitative data was collected through the administration of incoming and outgoing questionnaires, tabulation of data, collected through structured assessment sheets by levels (individual phase, in micro-group, mesogruppo, macro-group) and processing by role.

For each phase, structured forms were given, which refer to indicators and descriptors, subdivided by Rubric or observation areas, relating to knowledge and skills (Rubric A), communication skills (Rubric B), cognitive / metacognitive skills (Rubric C), social skills (Rubric D).

“The investment of research on social cognition, as an ability to understand and respond in an adaptive way to emotions, which is connected to the development of empathic-emotional competences, promoting prosocial behavior, has seen the useful application of the Toronto Empaty Questionnaire (Spreng et al., 2009) a measure of psychometric empathy. It deals with validating a factorial-analytical solution to several empathic measures, to verify the evidence of the educational research hypothesis, according to which the FI model promotes prosocial behavior (Roche, 1995) mainly reflects an emotional process, or an accurate affective intuition in the emotional state of another. The questionnaire was administered in input and output to a sample of 20 students and produced a calculation of the average relative to the behaviors tested, also through a hypothesis test (Ttest) to verify the difference. “(De Giuseppe, 2018c, p.136)

The research took into account only the observable differences and the trend effects of the experimental teaching methodology.

It was a research related to the training action that starting from the Evidence based did not deny logical inferences, but supported with educational actions with empirical evidence, the training action that starting from Evidence based did not deny logical inferences, but supported with educational actions with empirical evidence.

For the evaluation, the participant observing variant was privileged in order to return data about the relational dynamics, taking into account the possible risks of unpredictability and flexibility that characterize the socio-educational phenomenologies and an immersive approach avoiding categorical descriptive schemes, which would limit the understanding of the complexities typical of interrelations.

For the evaluation, the participating observing variant was privileged, in order to return data about the relational dynamics. Possible risks of unpredictability and flexibility, which characterize socio-educational phenomena, have been taken into account. An immersive approach and categorical descriptive schemes were avoided, which would have limited the understanding of the complexities within the interrelationships.

The complex factors of formative evaluation (Lipari, 1995) were organized in relation to:

- social and prosocial skills (general level);
- communication skills, cognitive-metacognitive (specific level);
- disciplinary knowledge (didactic level).

"The aim of the research was to understand if and how the flipped inclusion model can promote individual and collective, inclusive-prosocial contexts and profiles, in an ecological (Kelly, 1966) systemic perspective (Bronfenbrenner, 2002), for managing socio-psycho-educational problems, connected to the complex postmodern globalization. "(De Giuseppe, 2018, p. 121)

A meta-evaluation triangulation of the researched data was performed with the analysis technique S.W.O.T. (Stregnths, Weakenesses, Opportunities, Threats) (Hill & Westbrook, 1997) to avoid the risks of logical contradictions or implicit meanings, through a constant adherence to the theoretical research framework.

The evaluation phase carried out a function of social certification of experiential results in the flipped inclusion research-action activity, with an educational investment in the reflexive-metacognitive processes, as tools of self-awareness.

The following were carried out:

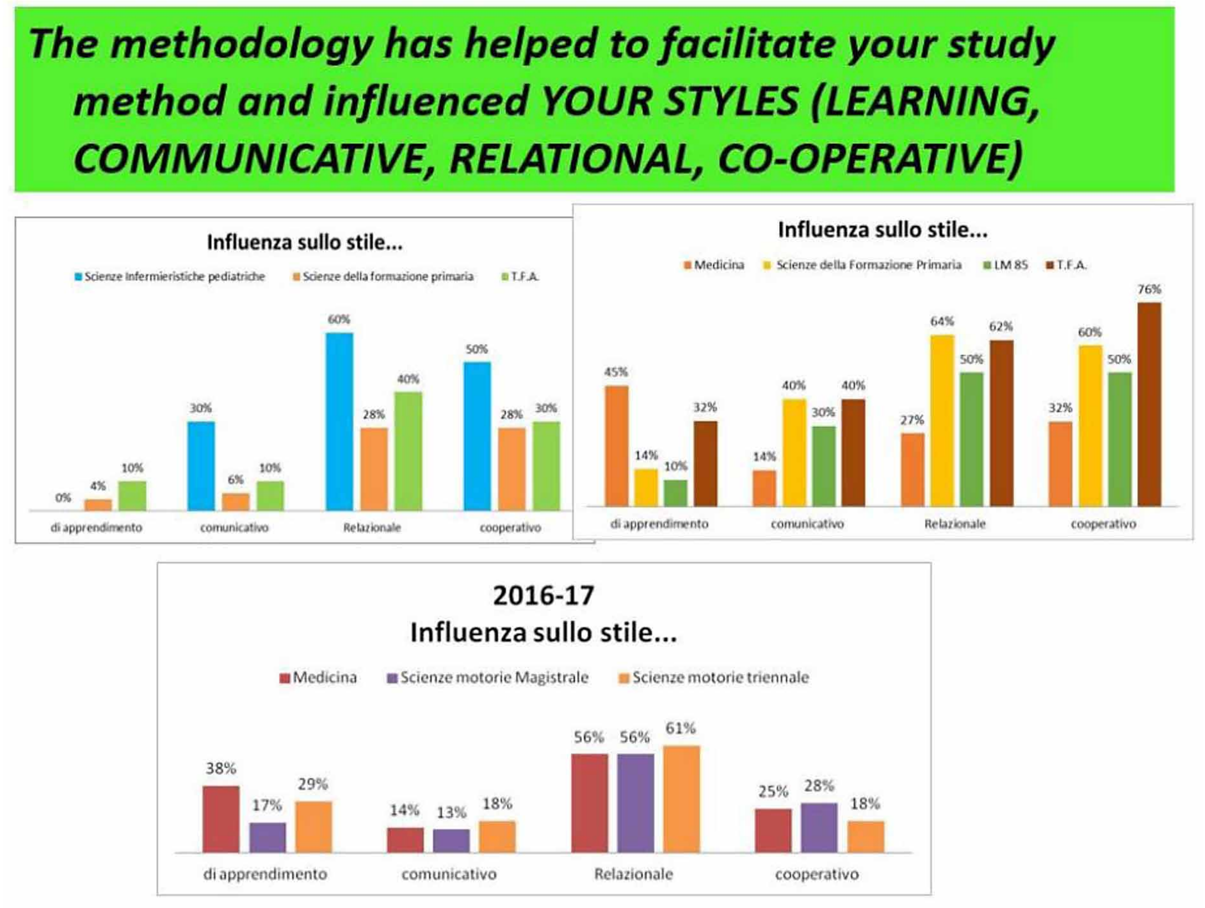
- personalized assessment that measures the individual goals achieved, with respect to the starting levels;
- alternative authentic evaluation (Wiggins, 1993) which requires proactive awareness to evaluate processes (Benzoni, 2004) with self-assessment modalities of learning self-efficacy (Bandura, 1991) and a pro-social co-evaluation;
- socialized evaluation, managed by groups;
- mixed external evaluation, functional to self-esteem, which focuses on individual and comparative progress.

The evaluation significance was based on the individualization of expected, observable and globally measurable behavioral performance levels. The range of variability was defined as the range of expected performance levels and the number of expected ratings, each of which was associated with a numerical value, to then arrive at an overall value of the results achieved.

In the evaluation of social skills we did not prescind from principles (Bandura, 1975), such as (De Giuseppe, 2018, p. 196):

- the discussion, to examine and define the skills to be learned and the recognition of new behaviors;
- objectivity, observational about prosocial behaviors, to induce imitation;
- reinforcement, understood as any event that increases the probability of issuing behavior;
- reflection on the experience made.

Figure 7. Data relating to the influence of flipped inclusion on learning, cognitive and attribution styles (De Giuseppe, 2018, p. 208)



EVALUATION AND RESULTS

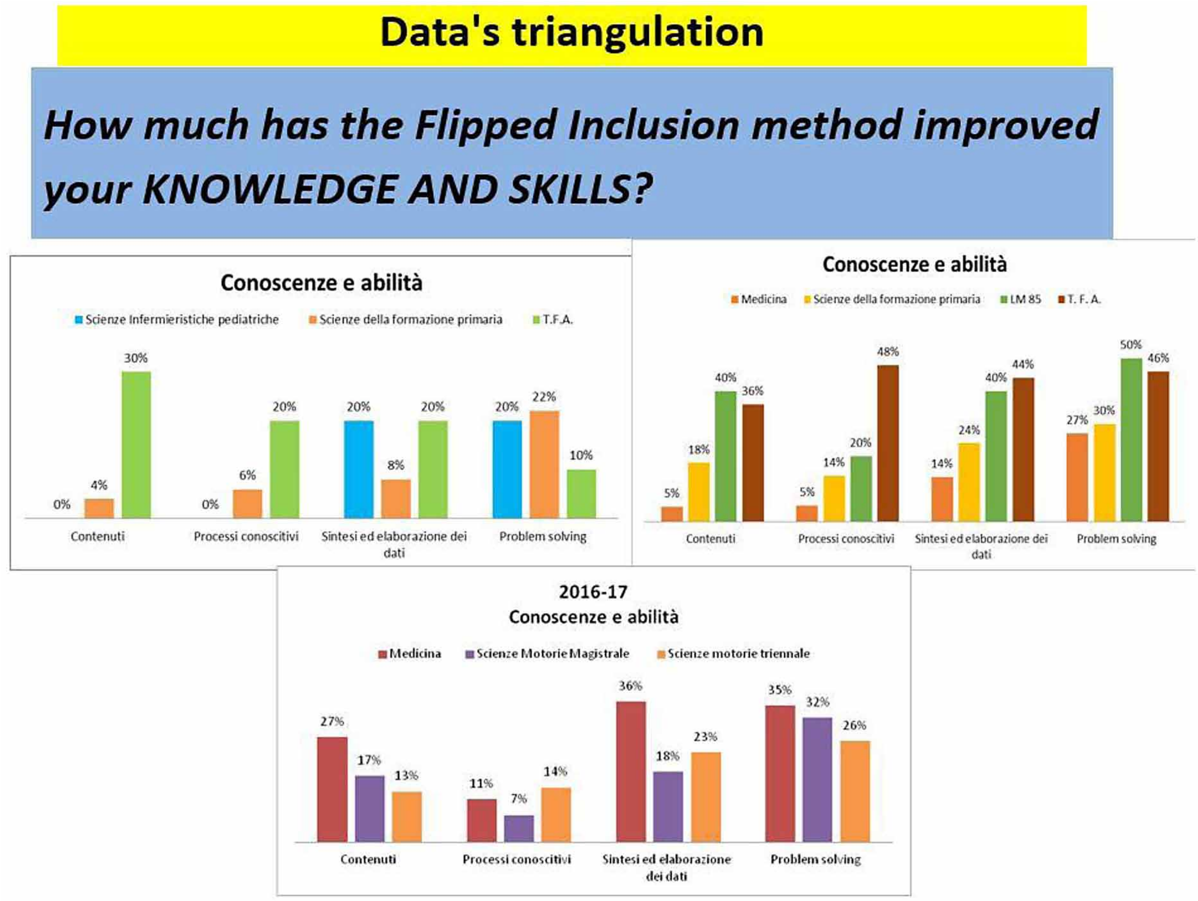
From a triangulation of qualitative and quantitative data relating to a three-year research period, in light of the results of the post-test, carried out one year after the trial, it is possible to answer the guiding questions related to the application of the flipped inclusion model.

In reference to the *first question of the research*: has the methodology helped to facilitate your study method and has it influenced your styles (learning, cognitive and attribution-communicative, relational, cooperative)?

The students / interns obtained a high score (4 out of 4) when asked if the methodology had helped to facilitate their method of study (42%) while only 6% considered that the methodology did not influence their method of study.

For the same students the method of Flipped Inclusion has influenced in a very positive way the cooperative (58%) and relational (59%) style (De Giuseppe, 2018c, p.207).

Figure 8. Triangulation of the final data of the three-year experimentation relating to Knowledge and skills (De Giuseppe, 2018c, p. 209)



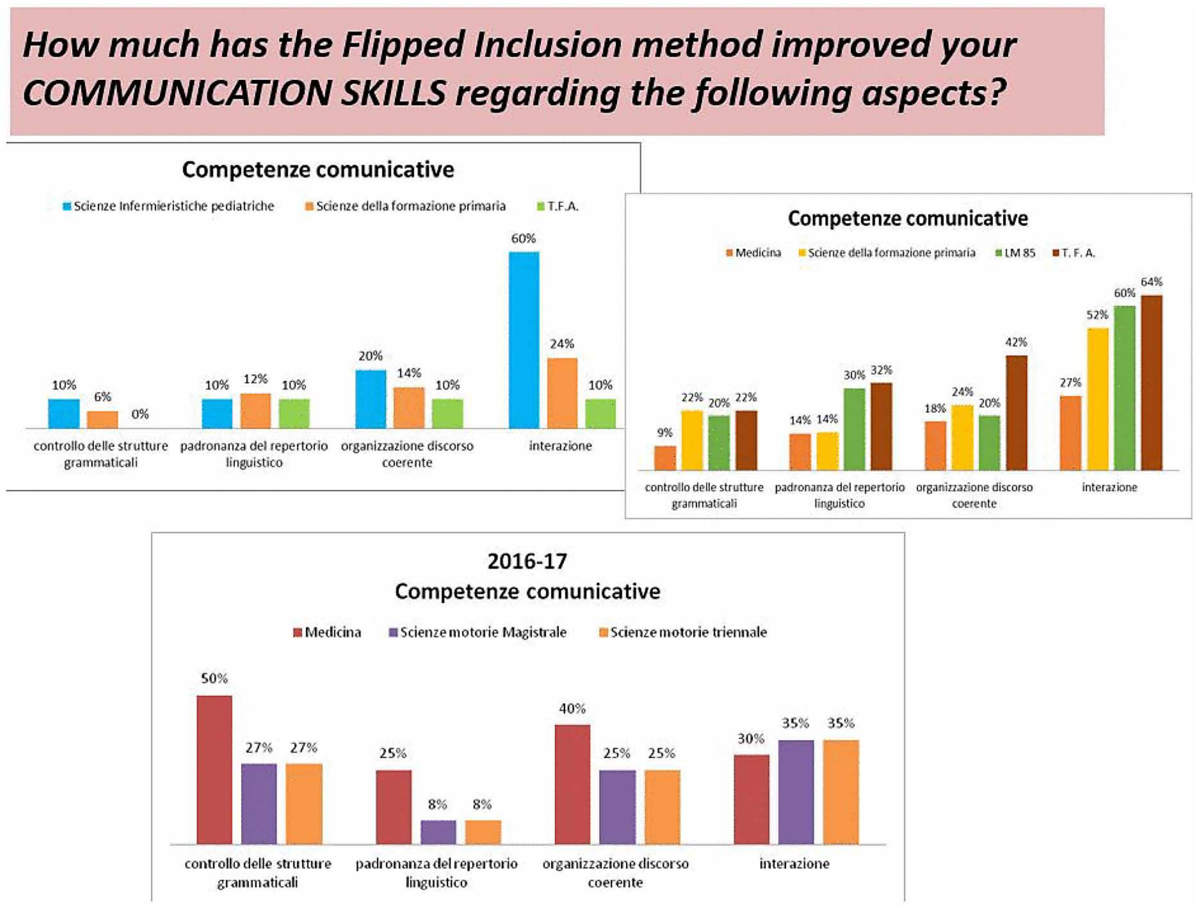
Students highlight that the experimentation of the Flipped Inclusion has had a noticeably positive influence on the learning, communicative, relational and cooperative style, also within the micro-group, the mesogroup and the macro-group, attributing to each item the highest score (4 on 4).

"…44% of respondents said they continued to work in micro-groups ". (De Giuseppe, 2018c, p.207). From this it is possible to assert that a flipped incluion as a model using formal, non-formal and informal cross-media logics has produced improvements that affect learning, cognitive and attribution styles.

To Answer the Second Research Question:

*2): Did Flipped Inclusion Teaching Foster the Formation of Inclusive and Prosocial Individual and Collective Profiles (De Giuseppe, F. Corona (2017c), Able to Manage Complex Problematic Situations, Through Simple Didactic Practices (*Sibilio 2014)?

Figure 9. Triangulation of the final data of the three-year experimentation relating to communication skills (De Giuseppe, 2018c, p. 209)

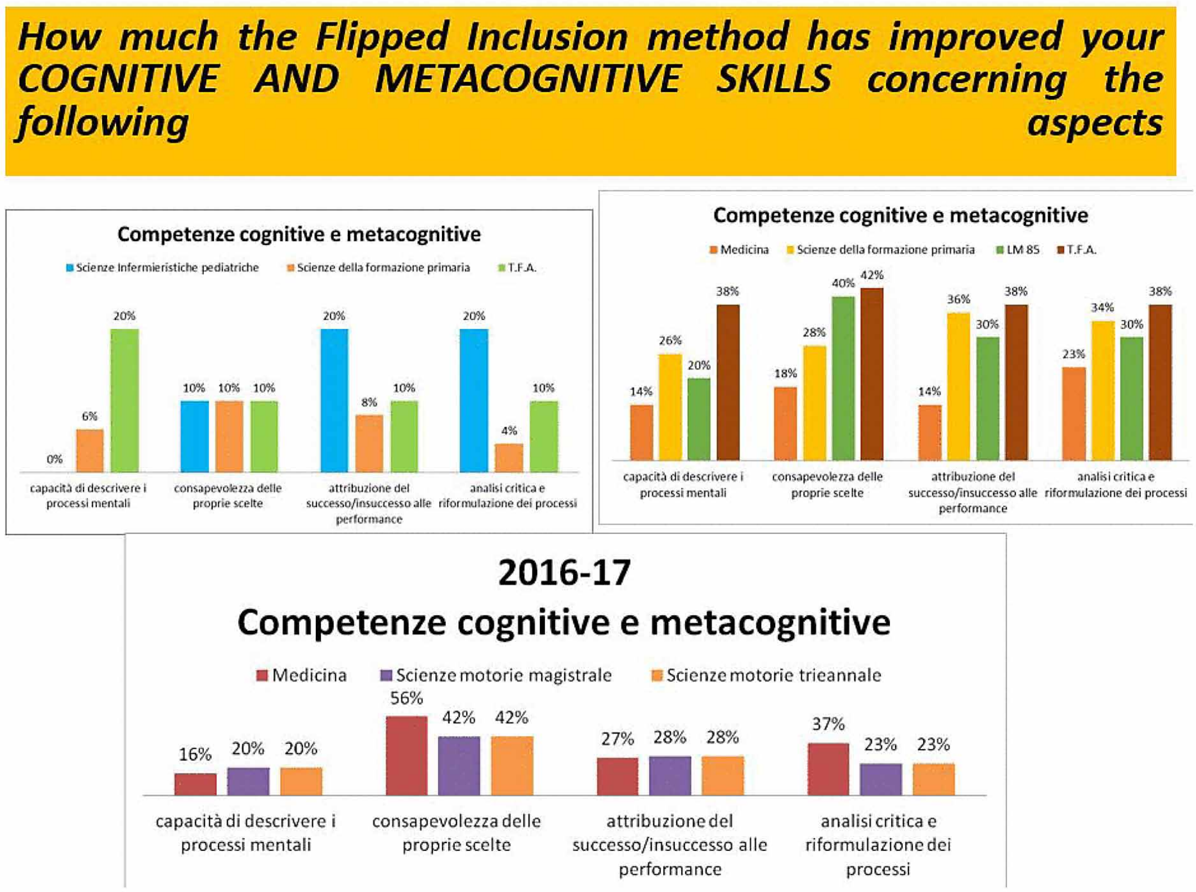


The parameters observed and evaluated through the check list and evaluation columns organized by increasing levels of complexity concerned:

- knowledge and skills (Rubric a) on
  a) content; b) cognitive processes; c) data synthesis and processing; d) problem solving;
- communication skills: control of grammatical structures; mastery of the linguistic repertoire; consistency in the organization of the speech; interaction;
- cognitive and metacognitive skills: ability to describe mental processes; awareness of their choices; attribution of success / failure to performance; critical analysis and reformulation of processes;
- social and prosocial skills: listening to the other; understanding the needs of others; acceptance of rules and regulations; problem solving;

The data also shows an improvement in *communication skills*, whose detection is structured in: control of grammatical structures; mastery of the linguistic repertoire; consistency in the organization of the speech; interaction.

Figure 10. triangulation of the final data of the three-year experimentation relating to metacognitive skills (De Giuseppe, 2018c, p. 210)



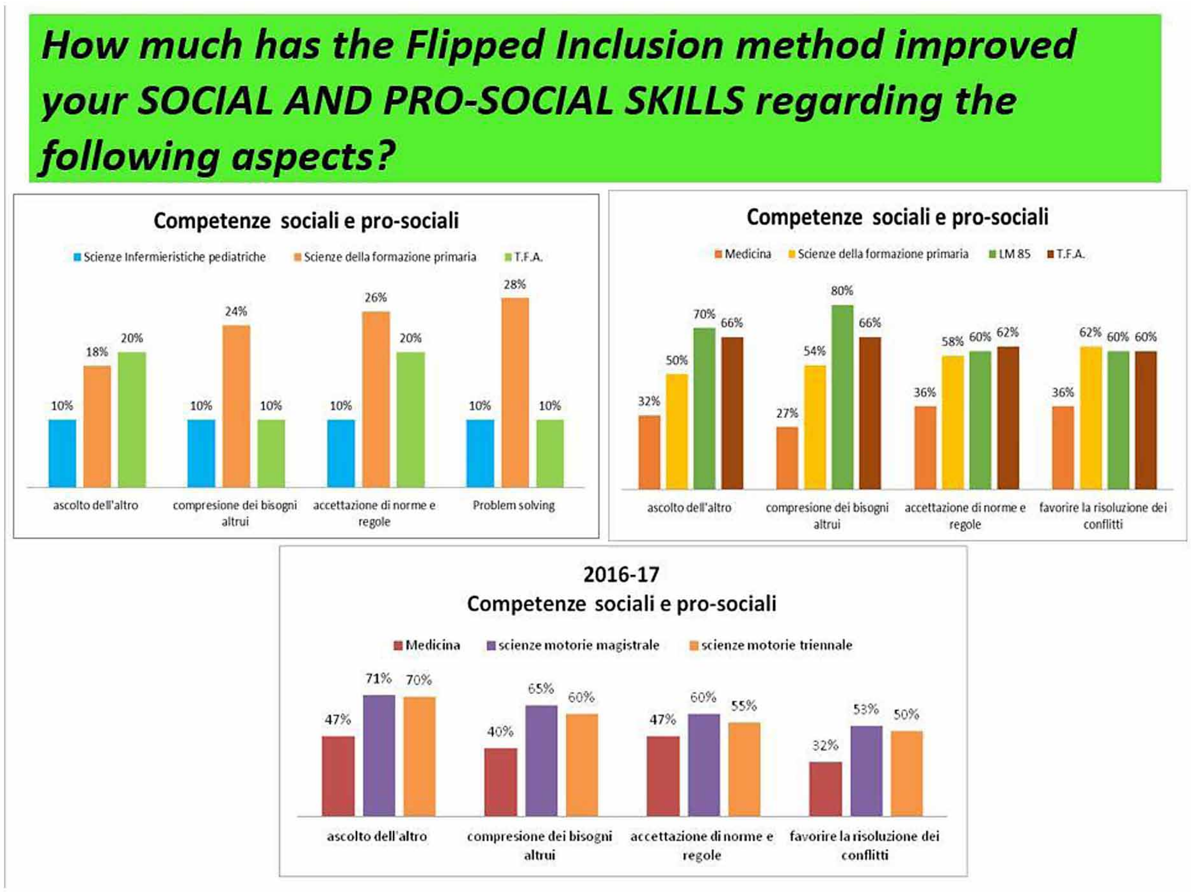
The lowest score appears to have been detected in relation to the mastery of the linguistic repertoire, with a percentage of 8%, while there is a noticeable improvement in the interaction with percentages that reach 65%.

With regard to social and pro-social competences, there were high scores (4 out of 4) with: listening to the other 54%, acceptance of norms and rules 54%, understanding the needs of others with 55%, favoring the resolution of conflicts.

The results collected in relation to the different areas observed show an improvement in:

- average high knowledge and skill in problem solving skills for 56% of the boss;
- communication skills high in interaction (52%);
- cognitive and metacognitive skills, with an awareness of their choices (42%) and capacity for critical analysis and reformulation of processes at 32%.

Figure 11. Triangulation of the final data of the three-year experimentation relating to the promotion of inclusive processes and contexts, with flipped inclusion (De Giuseppe, 2018c, p. 211).



With regard to social and pro-social competences, there were high scores (4 out of 4) with: listening to the other 54%, acceptance of norms and rules 54%, understanding the needs of others with 55%, favoring the resolution of conflicts.

To Answer the Third Research Question 3: Does Flipped Inclusion Teaching Affect the Promotion of Inclusive Profiles and Contexts?

It was intended to collect the subjective perception of students regarding the promotional action of flipped inclusion on inclusive processes and on the construction of inclusive contexts. With a positive response, the percentages are 55% and 61% relative to the sample of 886 people considered.

"The probabilistic value of the conclusions, which characterize experimental educational research, taking into account the impossibility of reaching the definition of causal inferences, with the exposition of the evaluation of the result to the risks of imprecision and indetermination, both due to the innumerable intervening variables and the impossibility of a rigorous control of unpredictable dynamic phenomenal events, only partially allowed to arrive at a first evaluation of the significance of the research results.

Therefore further studies are needed with strict control measures “(De Giuseppe 2018c, p.230), hence the interest / need to continue the research with studies on samplings and new fields of investigation **and communicate you results.**

META- ANALISYS, CONCLUSIONS AND NEW RESEARCH PERSPECTIVES

The importance of a change of perspective in the role of the teacher emerged from the research, underlining the strategic value of the teaching profile, as a cross-media media educator, which analyzes and promotes prosocial processes (Margiotta, 2014) of inclusive media education based on self-regulation (Bernowitz et al., 1964) systemic ecological. It is a re-educating to an empirical-critical, intersubjective (Walster, 1978), co-responsible and qualitative vision (Lawton et al., 1968), through a resolutive self-regulatory management (De Giuseppe et al., 2017) of contextual conflicts. The educational investment in the media plurality, as a pedagogical device on which to focus forms of collaboration and cooperation, allows to manage with inclusive eco-logics, interfering osmotic processes.

The organizational governance, which characterizes the processes in flipped inclusion, is based on the complementarity between technologies (learning by interacting / complex blended learning) communities of practice and learning, for a management of the complex and conflicting differences that characterize human resources (learning organization / flipped classroom), online and offline. It is therefore necessary to invest pedagogically in the promotion of social cohesion, through a permanent formation of the Community of Knowledge (Castells, 1998) qualitatively inclusive (Lawton et.al, 1968), through a didactic action that intercepts and inclusive proactive attribution style, therefore, pro-social communicative, relational and cooperative.

Connectionist learning (Smolensky, 1988), an expression of situated and contextual interactive intelligence, places at the center of the pedagogical debate the socio-educational value of formal, non-formal and informal learning environments, such as negotiated interaction plans not always controllable (Jonassen, 1995).

In light of the results of the pilot study, a new longitudinal study is hypothesized with a view to lifelong learning, lifewide learning, lifedeep learning, with inter-institutional sampling, in the territorial, scholastic / academic and extra-curricular areas.

Starting from an analysis of the evolutionary process of the training systems of the Campania region (in Italy), connected to the introduction of digital media in schools (Ottaviano, 2001) we intend to analyze, in a non-formal and informal context and on territorial social areas, the implementation of flipped inclusion model, to evaluate the possibility of pedagogically influencing pro-social management, in an inclusive ecological-cross-media bio-psycho-social perspective (Bronfenbrenner, 2002).

The implementation of the pro-social flipped inclusion model of the new research involves individual professional training (Mezirow, 2003), as a social ecology of identity. Through community education, learning and practice, reflexive actions would be activated to decode and reinterpret the processes, contents and epistemic premises of the experience. It is always necessary to make use of real and virtual, formal, non-formal and informal training settings, to be used in a perspective of existential trans-educational, ecologically sustainable accessibility.

In this way it will be possible to reaffirm the concrete role of education based on ecological and qualitative tools, which affect the individual and collective existential, with design tools of systemic inclusiveness, such as flipped inclusion.This confirms the profile of the teacher who must use a phenomenological

(Husserl, 1917) experiential-perceptive method (Merleau-Ponty, 1945), rooted in intersubjectivity and in the value of otherness, which with a didactic action characterized by circular, relational movements activates processes of personal reconquest of the world of life (Merleau-Ponty, 1945).

In such a perspective the inclusive mediaeducator teacher with the flipped inclusion promotes modifications of the strategic paradigms of didactic intervention, through changes of perspectives no longer centered on the institution but on the organizational-structural management. In this way we invest in education not only on the culture of management, but on that of opportunity production, through principles of democratic assertiveness, not authoritarian. Thus, we opt for glocal, virtual and real holistic reticular training logics, in order to contrast linear mechanistic and localized visions. Such an organization by processes is based on the professionalizing orientation to results, inter-functional problem solving and inclusive-existential cooperative quality.

The ubiquituos Web technocratization of social and macro-structural processes underlines the educational urgency of investing in neo-productive, reticular-horizontal transnational structures, which require an investment in human capital (Bourdieu, 1979) and in a democratically re-productive management of decentralized, flexible and cooperative knowledge.

The *knowledge production* factor thus becomes the propulsive element capable of generating value 1) Embedded; 2) Embodied; 3) Enculturated; 4) Embrained. All this allows an increase in the marginal productivity of intangible capital / training and development, which requires an organizational management improvement of information, knowledge and knowledge (Abramovitz & David, 1996).

It is therefore necessary, through exploratory analyzes and protocols of operative information-educational intervention to ecological forms of cross-media communication, to invest in socio-economic-productive, contextualised educational-training policies, to promote experiments with models inclusive of lifelong learning of the system- inclusive educational community, such as flipped inclusion.

It is necessary to expand the fields of application of the flipped inclusion model in light of the liquid technocratic challenges. From this derives the need to start permanent experiments, to be rooted in a pedagogy of authentic time, as a conjunction of learning and social process. It involves investing in the value of the dialogic and interdisciplinary nature of complex adaptive systems (Cortoni, 2011), which characterize postmodern complexity, to decipher and mediate simple and complex dichotomies, through simple processes (Berthoz, 2011).

Since the presented teaching technique of the flipped inclusioni is new for practicionners, it is important to determine its' effectiveness. In order to evaluate the proposed projects, it would be necessary to check the improvements of students and the opinions of students and teachers. In the following, we present some research instruments that should be developed to test the suitability of the use of new technologies in the flipped inclusion as a teaching technique.

Thus, we propose to start a follow-up study among teachers and students regarding the approppriatness of the use of new technologies in the flipped inclusion teaching. This could be done using focus groups and/or group disussions about the topic. In this study researchers would get some important information about the advantages and disadvantages of using new technologies in the flipped inclusion classes. Participants would be asked to list all possible problems that emerged during this process. In this case, participants (students and teachers) should be already taking part of the flipped inclusion classes, in which the learning process is supported by new technologies.

It would be also of great interest to the target audience to benefit from comparative results with multiple countries. To achieve this goal, we propose a quantitative research model, using questionnaires. In this study the target population would be educators from various regions / countries. Participants would be asked about their acquitance with the flipped inclusion classes, the possibility of using new technologies in such classes. They would be also asked about their point of view about the use of new technologies in flipped inclusion classes. In doing so, we could gain the information about the interest of the presented teaching technique and get an insight into the actual situation.

In the following, we suggest an experimental study, of the use of new technologies in the flipped inclusion before and after the introduction of the teaching technique. This study would be conducted using participant observation and survey as a research technique. Researchers would select a partner (teaching institution) that does not use the flipped inclusion classes. Teachers in this institution would be instructed about this teaching technique. Before that, they would answer a questionnaire about their teaching technique practices, advantages and disadvantages. After the acquitance with the flipped inclusion they would be asked to start using this technique. They would be asked to evaluate their new technique of teaching. During all the period the researcher would do in-class observations. After a semester of teaching with the flipped inclusion they would be asked about their opinion.

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Chapter 3
Pedagogy and ICT:
The Principles of Differentiated Teaching and New Technologies

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ABSTRACT

While the principles of the personalisation of study plans are now affirmed at scientific level and in the school world and while, at the same time, a sturdy current of educationalists sees in new technologies a "tool" that must be used appropriately, reflections on the personalisation of ICT in relation to different learning styles still seem scarce, particularly with regard to its use in differentiated teaching strategies, as a means of support for students with disabilities or learning difficulties as well as in ordinary teaching. In this chapter, the authors develop a thread of reasoning conducive to exploring the use of ICT in the more general context of pedagogy and teaching to promote a development that is integrated and not exclusive or alternative to methodologies that have already been experimented by teachers in their professional roles, focussing on the concept of differentiated teaching and giving some operational proposals of integrated learning environments by way of example.

In his book *The Children's Machine: Rethinking School in the Age of the Computer* (Papert, 1993), Seymour Papert imagines the situations in which a surgeon and a teacher would find themselves, were they transported a hundred years on, from the 800s to the 900s, and had to work in their professional contexts after the changes that had taken place in that time lapse. Without a doubt the surgeon would find himself confronted by an operating theatre that was totally different from past times, with technological innovations that would prevent his professional work. Vice versa, the teacher would find a context that had hardly changed, except for a few slight modifications in the furnishings: the same classrooms, the same blackboards, tables and desks; and he could carry out his professional work without difficulty.

This comparison was taken up by a number of commentators (in Italy even by the Ministry of Education) to underline the scarce propensity for innovation in schools and call attention to the need for renewal, with much emphasis being placedon the changes that new technologies can bring about in the

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spheres of education and training. It initiated a season of important investments to equip schools with the necessary materials, from IWBs to computers and tablets in every classroom. The goal has been reached in part but continues to be pursued, together with the need to provide teachers with adequate training in the appropriate use of ICT.

In the debate between techno-optimists and techno-sceptics, the more traditional current underlines that new technologies are simply a "tool" for good teaching, perhaps to calm the anxieties of the many non native digital teachers who have trouble acquiring familiarity with sophisticated technologies in which students often prove to be more competent than their instructors.

Some scholars (Varisco, 2002) stress the importance of constructing technology-rich innovative learning environments (OECD, 2103; Groff, 2013), the value of which lies not in the presence or absence of particular types of tools, but in the quality of the educative project supporting them. So it is the teacher, through the instructional planning, who confers value and significance to the technologies.

Then there are those who say it is not right to think of ICT in mechanistic terms for the transmission of knowledge, or to introduce ICT into the school system as a mediator of learning on the basis of its innovative potential (Cesareni & Cacciamani, 2014), conceptually rejecting its merely "instrumental" use.

According to some authors (Varani, 2002), new technologies should be considered resources that are active, "situated" (Lave & Wenger, 1991) and "problematizing" (Calvani, 2000) in the construction of knowledge, to be "set up" expertly and attentively for the creation of significant learning environments.

Pier Cesare Rivoltella intervenes in this debate with elements of clarification. He asserts that digital technologies, precisely because of the highly important role they play in the processess through which we today construct and manage our relationships, organize our time, define our identity and promote social acceptance, constitute the infrastructure and languages of our society (Rivoltella, 2015) and their role is not limited to being cognitive or didactic mediators (Damiano, 2014). Continuing with the distinctions between *Education Technology* and *Media Education*, he maintains that, far from being a factor of discontinuity, digital should be considered a *re-mediation* of reality, that is, a reconfiguration in another key of the elements of daily reality. Digital does not replace anything, rather it enriches our possibilities of intervention in real life situations (Rivoltella & Ferrari, 2016). Observing the European context in general and the Italian situation in particular, where the theoretical approach often prevails over pratical aspects, it is apparent that the level of conceptualizations is still fluid, fluctuating between definitions of "tool" or "cognitive/didactic mediator", "active resource", "infrastructure" or "language", even though everyone acknowledges an active role in the re-mediation of reality both of the teacher, as the person behind the training programmes, and of the student, who uses the new technologies, considered "problematizing resources", in an informed manner,

Despite the depth of this debate, most reflection seems to concentrate on learning *environments* and *dynamics* rather than on educational relationships and the relevance of the teaching itself.

Taking a cue from these considerations and mindful of the need to elaborate orientations for educational policies, we began to reflect on the use of new technologies, which we have monitored for more than 12 years, starting from the use of ICT for inclusion, in order to provide indications for ordinary class management – classes which, since the abolition of special classes in Italy in 1977 to initiate the process of inclusion, have been very heterogeneous.

An important investigative element in the acquisition of scientific data was the 2010 Report of the Istituto Nazionale di Valutazione – National Institute of Evaluation (INVALSI), in collaboration with the Istituto per le Tecnologie Didattiche – Institute of Teaching Technologies – of the CNR in Genova (ITD-CNR)[(1)]. Now, nine years later, we have begun a further investigation on new technologies for inclusion in all the provincial core schools (which I will discuss shortly), from which we have come by a number of considerations. Additional reflections have been derived from the participation in some European projects, carried out in conjunction with the *European Agency for Special Needs and Inclusive Education*(2).

From the examination of the scientific literature and from the data collected, as well as from visits to hundreds of schools, it emerges that:

- There is a growing tendency - in the school world but not in academic circles - to see the use of new technologies as an alternative to traditional teaching. The risk is the creation of a fracture between “innovative” teaching based on ICT and “ordinary” or traditional teaching methods and as a consequence, the prospect that each new didactic technology cancels studies, research and experiences related to previous methodologies. This hypothesis is sustained by the observation, for example, that many teachers use new technologies with the methods of the frontal lesson. In this case, the means change but not the method.
- Side by side with instances of excellent practices, in many cases an improper use of new technologies can be discerned, especially in pre-primary and primary education, where skills that are learnt through manual exercises and through the body cannot be acquired through ICT.
- While in the field of special teaching the use of ICT is in a phase of development, with positive synergy between academia and teaching activities, in ordinary teaching good practices are more rare and there are more requests for appropriate and effective methodological indications.
- In particular, whereas there is intense study and research activity related to the sociological, communicative and strictly technical factors of the impact of ICT, and to learning psychology, there is little reflection on the personalisation of study plans and on differentiated teaching through new technologies. The whole corpus of psycho-pedagogical studies on the need to “tailor a suit for each student” seems to fade into the background of the debate, the terms of which appear to be an ousting match between ICT yes ICT no.

A clear reference framework is therefore required, both at theoretical level and with regard to pratical teaching activities, so as to orientate education policies on the basis of an effective identification of educational needs, with the indication of precise objectives to be reached.

The intention of the present article, starting with the study of the most active research areas and recognizing the need to investigate some issues that are fundamental to daily teaching experience, is to provide a contribution:

- by describing examples of some experiences of integrated learning environments in which the principles of differentiated teaching are applied;
- by integrating the diagram of Carol Ann Tomlinson (Tomlinson, 2014), which we have adopted as our theoretical reference scheme to frame the concept of differentiated teaching, with arguments that we shall put forward, so it can be used more effectively in teaching with ICT.

Research Focus (1): Learning Environments: From IWB to Decomposed Class

Most of the reflection on ICT is concentrated on "physical" or "functional" aspects, that is, on the changes in the learning environment determined by the presence of a device and consequently on the different organization of spaces. Hence the concepts of a "liquid class" (3) or a "decomposed class".

«The new "decomposed class" is a classroom where there are no longer fixed seats (or roles), but desks that are moved (or removed) in accordance with teaching needs, multimedial stations with internet access, multimedial projectors to see videos taken perhaps from Youtube, (…). A liquid class changes shape continually…» (Bardi, 2014).

It is clear that the introduction of an IWB in class, the substitution of books with tablets and of exercise books with laptops, the renewal of the old-style school furniture with modular desks - unavoidable transformations, respect to which it is futile to propose nineteenth century models - constitute a revolution that is producing learning environments in line with the evolution of the times, in a process that can no longer be arrested, but it should be accompanied by intuitions linking the knowledge of medical science, psychology, architecture (and Universal design) with the demands of education, in order to ensure the well-being of students and teachers at school.

We mean by this that the concept of "learning environment" should not be interpreted in a merely *functional* sense, but must maintain a pedagogical connotation. So the most appropriate way to intend the concept would seem to be that of a "context", as developed in the ICF perspective and experimented in 92 schools in a national project carried out from 2010 to 2015(4). Take for example a paraplegic child who goes to a school without specific accessibility criteria and whose classroom is on the first floor of the building and is furnished in the usual manner; then imagine the same child in a different school, with a classroom that is easily accessible on the ground floor, with specifically designed furniture, a "smart desk" (Zappaterra, 2013), adapted mouse and teachers trained for disability. In this second case, the learning context/environment plays an important facilitating role and takes differentiated teaching into account.

Research Focus (2): Learning Dynamics

The anthropological sphere is another crucial area of reflection, from the works of Helmuth Plessner and Arnold Gehlen onwards, with the latter's concept of "deficient being" (Gehlen, 1990), a sphere which continues and overlaps with that of communication science, stretching to reflections on the hybridisation between mind and computer (Benasayang, 2016).

But closest to teachers' experience are unquestionably the studies on learning psychology.

In this connection, the research by Giuseppe Riva on learning levels related to the use of ICT is interesting. Combining the visions of Vygotskij and Piaget, the researcher identifies a first level, closely associated with the child's cognitive development, which is the result of direct interaction with the environment. Interacting with the surrounding world, the child creates mental schemes through processes of assimilation and adaptation. Technology can guide these processes through the dimensions of games (e.g. Serious Games). The second level regards the "zone of proximal development" and consists of what the student can learn with the help of a teacher or expert. This type of learning is guided by a process of *scaffolding*: the teacher supports the student in the same way that scaffolding supports a house under construction. The phases conclude with the "fading", that is, with a diminishing degree of support by the teacher which corresponds to a greater independence of the student. At this level, the use of technology consists in the possibility of utilizing new media to find and share contents put together by experts, conceivably through distance training and the use of MOOC. Lastly, there is the third level connected with the shared activity of a group. In this case, we are in the “Collaborative Virtual Environments (CVEs)” in which collective reasoning, that is, a kind of “communal thought”, is developed, enabling the emergence of creative processes and shared knowledge. The teacher’s function at this level is to moderate the group and foster the reflective process. Virtual collaborative environments «are diffuse digital places where subjects can meet and interact with the aim of reaching a formative objective, and range from asynchronic environments like web-forums, blogs and wikis to synchronic environments like virtual worlds and social media» (Riva, 2014).

This overview of learning processes and new technologies shows how in reality research is concentrated on aspects which, although important within the bounds of the study of general processes of knowledge acquisition, barely touch upon teaching, whether ordinary or special, remaining on the plane of considerations on the general dynamics of education and the organizational aspects of classwork. They fail to respond adequately to the need of the subject teacher to further the competence of his students, starting from subject matters and processes, developing skills and products. Above all, the issue of differentiated teaching, the individualisation and personalisation of study plans, is completely evaded, leaving a background of a still “massive” and impersonal use of new technologies.

Differentiation and ICT

Luigi D’Alonzo defines differentiated teaching as «a basic methodological perspective that promotes meaningful learning processes for all the students present in a class, aimed at proposing distinct educational activities designed to satisfy the needs of the single students in an educational climate in which it is normal to approach school work in different ways» (D’Alonzo, 2016, p.47).

The initial intuition as regards differentiation belongs to Carol Ann Tomlinson, who in 1999, in her book *The Differentiated classroom: Responding to the needs of all learners*, brought to the attention of the scholastic and scientific world the necessity to bear in mind, in the course of ordinary teaching, the specific learning needs of each student. In reality there were earlier studies on the individualisation of study paths. In 1993, Convery and Coyle had already focussed on «the process by which teachers provide opportunities for pupils to achieve their potential, working at their own pace through a variety of relevant learning activities» (Convery& Coyle, 1993, p.13). Twenty years later, Gershon takes up and simplifies the concept: «differentiation is “planning and teaching in a way that takes account of all learners in a class”» (Gershon, 2013).

In Italy, with the introduction of the concept of Special Educational Needs (5), personalisation – already provided for by Law no.53/2003, accompanied by a policy document (“Recommendations for the implementation of national indications for personalised curriculum”) - becomes an ineludible necessity in a context of classes lacking homogeneity and possibly including five foreign pupils, two disabled students, one student who is dyslexic and others with a background of social disadvantage.

In Great Britain, Section Five of the National Curriculum’s *Teachers’ Standards* (DfE, 2012) is devoted to the issue of “differentiation”. Teachers are expected to «adapt (their) teaching to respond to the strengths and needs of all pupils (DfE, 2012, §5)».

Differentiated teaching is therefore no longer just another facet of educational research, but a requirement of the national educational authorities. And yet, with a few rare exceptions (*Cf*. Benjamin, 2005), the parallel tracks of methodological research on the one hand and the development of new technologies on the other, continue to prevail.

Tomlinson herself, in the second edition of her book fifteen years later, underlines the modification in the school scenario in these words: «Whereas in 1999, there was precious little classroom technology available for teachers and students, now technology routinely opens classrooms to the world and to a world of ways to think about teaching and learning» (Tomlinson, 2014). Just the same, notwithstanding this observation and the awareness of the changed situation, we don't find in the new text the hoped-for synthesis between teaching with ICT and ordinary teaching in the spirit of differentiation.

Her model nevertheless remains very effective (Fig.1). At the end of this article, we shall propose an integration that will assign a place to ICT as an active resource and an essential tool of the learning environment.

Adaptability, Individualisation, Personalisation

Learning is always personal, whether it occurs in a group or alone. The learning environment, the people, the tools can play a fundamental role, but the acquisition of knowledge and skills and the transformation of the latter into competences is a sort of "alchemical process" in which it is the learner who takes action according to her/his unique and unrepeatable traits and potentialities.

Therefore, what must be "personalised" is teaching; teachers should be enabled "to provide opportunities for pupils to achieve their potential, working at their own pace through a variety of relevant learning activities".

To such an extent for the purposes of a correct conceptual framing of our proposal, it might be useful to focus more precisely on the meaning of the terms "individualisation" and "personalisation", also examining some of their nuances and variations, including the term "adaptation". In fact "individualisation" and "personalisation" are not synonyms and the scientific debate on this issue is fairly broad [(6)].

«An "individualised" intervention is that which is individually adjusted, rather than on the whole class or on the small group. The "personalised" intervention is that which is tailored to a particular learner's needs.

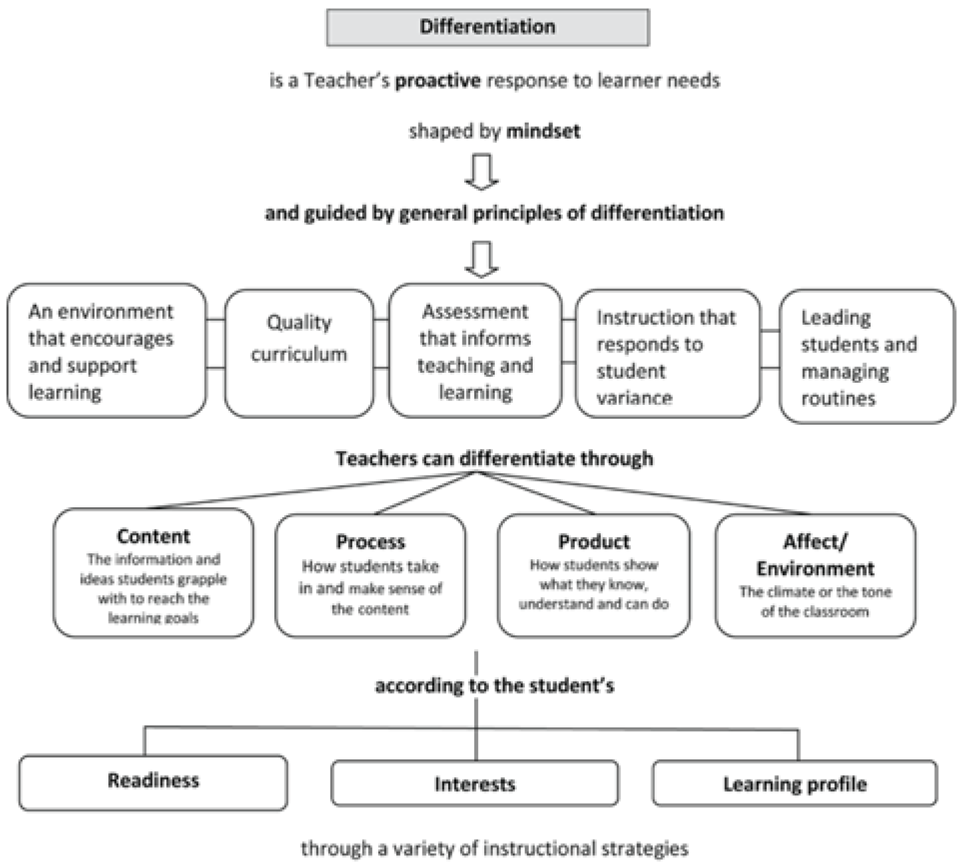
More generally, the individualised intervention sets common goals for all the members of the class group [...] with the aim of ensuring that every pupil acquires the core curricular competences [...].

The personalised intervention has the aim of giving each pupil the opportunity to develop her/his potential in the best possible way and, therefore, setting different goals for each learner, being tailored to that specific and unique pupil to whom it's addressed» [(7)].

Let us remember that the term "individualisation" stems from the Latin term *individuum*, which is not further divisible.The *one*. In this sense, "individual" is opposed to "collective", focusing on the dimension of the individual, rather than to the group dimension. Therefore, the individual task is paced on the individual rather than on the group, but it is not yet on the *personal* level, it is only a *numerically singular* application of the proposed activity.

It is worth remembering the schemes of Porphyry, the 3rd century CE Greek neoplatonist philosopher, who describes in his *Isagoge* the logical process from the universal level to the particular level.

Figure 1. Revised version of Tomlinson's Map of Differentiation of Instruction published in Tomlinson, C.A. (2014). The Differentiated classroom:Responding to the needs of all learners (2nd Edition), Alexandria, VA:ASCD



Because species are embedded in *genera*, the hierarchy *Animate*®Sensitive®*Mortal*®*Rational* comes to the last species, *Man,* that being indivisible, is the terminal point of the philosophical investigation (*terminus ad quem*).

If, in fact, you look at some Scholastic diagrams it is impossible to inquire about "*Peter*" and "*Paul*", since they are not Universals, but personal experiences, and therefore they can't be philosophical objects.

However, "*Peter*" and "*Paul*" can be the object of Pedagogy, which precisely considers and values every personal difference, for the development of a human being's full potential during the developmental age.

Therefore, it is not correct to state that ICT allows personalised teaching for the simple fact that it is possible to transform a font or to listen an mp3 rather than reading (e.g. "Easy reader"). That is not personalisation, but "customisation" of the tool, in the same way that a shoe is purchased in the size corresponding to the foot of the person who will wear it.

Personalisation is a much more complex operation as successfully Carol Ann Tomlinson outlined in her diagram (except for the some clarifications and integrations proposed in the present contribution).

Thus considering the two sides of the educational relationship - the teacher and the learner – the same tool can be used in a flexible way, by the learner in terms of "customisation", and by the teacher for the purpose of personalisation.

"Customisation" means the possibility of making changes, "adjusting", the tool to the individual characteristics and needs. By following brief operating instructions, this can be done directly by the user, i.e. the pupil. It is crucial, however, that the pupil receives adequate guidance on how to use it.

One of the inherent risks of ICT - smartphones, tablets, laptops – lies in their ease of use, that allows to capture only a very superficial part of the technical ability of the device.

A much greater risk, which can undermine the learning quality, is located within the "volatility" of the contents, that are "swiped up" without being grasped.

Learning is a process that becomes steady to the extent that involves the whole person. Being deeply engaged in research activities, guided by self-awareness and reflection, on the edge of intuition, draws paths within our awareness that leave a trail on a conscious level.

In this way, metacognitive processes become explicit. Even after some time, it is possible to retrace the intellectual connections that led us to a certain conclusion (for example we are able to understand what's written in our notes full of seemingly incomprehensible signs, symbols and references).

So processes covering activities such as comparing texts, rewriting or underlining, listening to a speech or to music - involving mind, perception and motor experiences, are transcribed as deep mnestic traces. Memory permanence is even more lasting, if a feeling, an aspiration is linked to the intuition combined in ideality.

Web search, on the other hand, leads to the elimination of most of these processes, taking place at the mere visual and intellectual level. Very often it works through "copy and paste", while the simple act of handwriting, implying the transition of the intellectual understanding through the body, mediated by internal processes, facilitates the acquisition of knowledge.

The risk, in short, is gaining on a surface level but losing on a deeper one.

This is why it is crucial a conscious use of ICT in learning, under the watchful eye and the guidance of educators.

And, with this in mind, it's up to the teacher to ensure that personalisation is achieved, as it requires a specific pro-active commitment from the teacher.

The Improper use of new Technologies

The following two examples narrate school experiences in which ICT is used inappropriately. The first describes the outcome of research carried out in this regard. The accent is on the need for pedagogical competence in the use of new technologies and in adopting tools suited to the developmental age.

To investigate the potentialities and effects of the *2.0 school* on children aged 6-10, Benedetto Vertecchi, full professor of experimental pedagogy at the Roma Tre University and president of the European Centre of Education (CEDE), conducted an experimental project (Vertecchi, 2016) involving nearly four hundred children in two Roman schools. «We asked teachers to make all pupils write brief texts and thoughts of four or five lines for fifteen minutes every day, using only cursive handwriting. It is now indisputable that the decline in writing skills coincides with a diminished coordination between thought and action, but also with a worsening in discourse organization and an impoverishment of language and memory. The results of this singular laboratory, called in Latin *Nulla dies sine linea*, a quotation from Pliny the Elder, were surprising. As the children got used to using a pen - seeing that keyboards are now becoming common even in many primary schools - we noticed gradual improvements in the accuracy and richness of the language, in the phrase structure, in the spelling as well. A sign, in other words, that in cursive handwriting thought flows freely from head to hand, unlike what happens with printing, which produces syncopated, chopped phrasing instead» (De Luca & Scalise, 2014).

Commenting on the work promoted by his Laboratory for Experimental Pedagogy (*Laboratorio di Psicologia Sperimentale*- LPS), Vertecchi affirms in another article that: «Youngsters and boys and girls are showing increasing difficulty in writing by hand. Many have lost the ability to use the cursive form and use printed letters as a substitute, one next to the other. There is a clear relationship between this decline in manual writing and the spread of digital devices. One wonders, however, if it is only a question of technical change in the production of signs or if the different way of writing corresponds to changes in mental activity which, particularly in the case of young children and boys and girls, could lead to negative consequences. Scholars of neurosciences are observing that the spread of digital devices coincides with a decrease in memory and in the capacity for spatial orientation and a less precise perception of temporal relations.(8) (9) From the educational point of view, the reduced capacity for writing by hand often appears to be associated with a more limited capacity for perceptual-motor coordination. It is like saying there is a sort of tangible breakdown in the relationship between thought and action. The purpose of the *Nulla dies sine linea* experiment is to verify whether this relationship can be recuperated, at least at primary school level, through simple didactic solutions. The results are an encouragement to continue in the same direction: the teachers who participated in the experiment are convinced of this» (Vertecchi, 2014).

The experience reported by a number of our trainee teachers in their *Training Period Diaries* provided the opportunity to explore a further distorted use of new technologies at pre-primary level. In many cases, the use of coloured pencils and brushes to create watercolours and pencil drawing was substituted by the use of the "Paint" programme on the IWB. The small pupils were invited by the teacher to come up to the board and use the programme, which has very reduced graphic functions, as is well known (the curved line produced by this software is really a set of little segments, so the resulting graphic sign is very approximate). To complete the educational offer of these classes, pre-printed cards (photocopies) were distributed to be coloured in along the margins with felt-tip pens.

Clearly the graphic and visual-perceptive skills, as well as the fine motor coordination and spatial orientation capacities are hindered in their natural development, if not completely inhibited, by practices of this kind, creating significant difficulties and deficits in the child's maturation process.

The massive introduction of technological instruments in schools without sufficient consideration from the pyscho-pedagogical point of view can produce the effects described above. Vice versa, a mindful use of tools, methods and teaching strategies can lead to very positive results in the acquisition of competence.

In the following example, drawn from a study trip to Beijing in China in November 2015, with a delegation composed of representatives of the Ministry of Education, the University of Siena and various Italian schools, the approach was diametrically different, perhaps excessive in the opposite sense.

Before visiting the schools, we were sure we would find classrooms full of technological tools, the desks covered with tablets and PCs. On the contrary, in the primary schools there was – and is – nothing of all this. In fact, new technologies are used only in the higher grades of instruction. In the primary school, there is a prevalence of artistic activities (drawing and painting, choral and instrumental music, dance) and motor, linguistic and mathematical activities.

We were invited to participate directly in the impressive writing exercise (Figure. 2 and 3).

Figure 2. Beijing Haidian Cuiwei Primary School

Figure 3. Cuiweischool – A writing exercise

Figure 4. Cuiweischool – A writing exercise

With the help of an overhead projector, the teacher illustrated a graphic sign that the pupils were asked to reproduce with brushes on a coloured sheet of paper.

It was a sign composed of 16 segments, of different shapes and thicknesses, often tapering off at the edge or ending with 'drop' swellings (Figure 4).

The experience highlighted the difficulty of the execution of the task, which the reader can verify personally by trying to reproduce the graphic sign in Fig.4. The simple act of placing the brush on the sheet to begin the reproduction of the figure entails the mental assumption of the whole form in conformity with the original, the spatial possession of the mental image mediated by the hands and in short the imagination of the whole figure as it will appear on the sheet from the beginning, perfectly centred.

To do this requires visual-perceptive skills, mastery of the spatial dimension (real and as a mental image), mastery of the graphic-motor act, in other words a formidable development of fine motor abilities, as well as skill in the use of graphic and painting techniques. At present no *device* is able to promote the development of these skills and faculties. Plainly, awareness of this concept is the reason for the delayed introduction of the use of new technologies in Beijing schools, concentrating attention rather on honing skills and competences that can be refined only through laboratory activities and the development of perception and manual prowess.

The scenario in the field of new technologies for inclusion is very different, since the principles of personalisation were adopted from the very first applications.

New Technologies for Inclusion

Italy has seen significant progress in the development of ICT for inclusion thanks to some fruitful interventions in education policy implemented by the Ministry of Education (MIUR). In 2006, the CTS – 'Centri Territoriali di Supporto' or Territorial Support Centres – were created to boost technological innovation: 96 CTSs with 2 or 3 professionals in each centre trained in an initial four-month course at Montecatini, who subsequently encouraged and disseminated the use of new technologies for disability through an extended and well-structured network of core schools for inclusion that covers the entire national territory. Today there are 107 CTSs in Italy situated at provincial level. Two teachers specialised in ICT for inclusion are employed in each centre, a total of approximately 200 professionals. The Centres are located in a "core school", local schools with a long experience of integration and inclusion. The main aim of CTSs is to develop a permanent network of schools at local level able to retrieve and disseminate the best practices of ICT for inclusion (i.e. knowledge acquisition and training courses, other resources, hardware and software) in order to foster the process of inclusion through new technologies (10). The CTSs also lend appliances for disability (braille keyboards, speech syntheses, etc) gratuitously.

The mission of the Centres is to concretely support schools, helping them understand what to buy and how to use these technologies effectively. In creating CTSs, the Ministry of Education triggered a process of development: these centres have managed to expand their relations and commitment to schools in a beneficial way throughout the country and build up an invaluable network, providing a platform for the exchange and comparison of experiences among teachers and other professionals. Besides promoting experimentation and research in the field of special education needs and in ICT development, many of the latter have also elaborated educational software, made freely available. Synergies have been established with the Institute for Educational Technology of the National Research Centre (CNR) in Genoa, Regional Assistive Technology Centres and other research centres have been set up. The importance of the CTSs' role lies not only in giving support to schools and teachers, but also in representing an interface between the central administration, the regional offices and the schools themselves. This organizational arrangement and the peer learning approach carried out by teachers has spawned widespread competence in the use of new technologies for inclusion and the educational spin-off is held in high regard.

From the early 90s, application programmes have been developed in Italy to devise study paths for students with severe or multiple impairment. The large, squared exercise books, in which cut outs from magazines or books could be stuck and to which the teacher added words or taped music or a CD, were transformed into the first "Hypermedial Exercise Books"(11), multimedial pages where a central image is associated with audio recordings and various links (explanations by the teacher, music recordings, pages dedicated to the viewing of videos). Written language is not contemplated because the pages are mainly meant for people unable to read or write (many children have Rett's Syndrome). Starting with Hypercard (in Mac) or Toolbook (Windows) platforms, they go on to Run Time Revolution and finally to Livecode, which, besides exploiting numerous additional functions, takes greater advantage of internet and all the new mobile devices (IOS and ANDROID). The designers of this software subsequently adapted the functionality of the various programmes and user platforms to the development of technological supports, bearing in mind the educational goal: in this case new technology is truly an instrument in the teacher's hands, amplifying teaching possibilities and reducing barriers for the students using it.

Successive developments in the field of ICT for inclusion, from the early programmes of speech synthesis to the haptic interface of the Parloma project (12), maintain this close interrelation between technology, assistive functions and education. The principles of the personalisation of study activities with ICT, for example with dyslexic students, have been fully implemented. There is, in fact, the opposite risk, namely the adoption of the technological tool only by the person with SLD and not by the whole class.

Two Operational Proposals

A highly intelligent use of new technologies was instituted by ITIS Majorana in Brindisi, under the guide of the principal, Salvatore Giuliano (13). Inventor of the project *Book in progress,* for the purpose of replacing paper books with digital ones, Giuliano's intuition consisted in finding a common denominator in ICT, enabling all students to follow the lessons and carry out their own activities with hardware and software conceived as study facilitators. It is rare to find a dyslexic student in the Brindisi school because the use of compensatory tools is inbuilt in the tablets, laptops and IWBs available to every class and every student. This situation is the result of very careful preparatory work by the teachers and equally attentive psycho-pedagogical and didactic lines of orientation. For example, every textbook is published in accessible fonts and styles and every student possesses a programme of speech synthesis with wireless headphones which enables him or her to read without any revelation of learning difficulties. In the same way, Mind Maps are used by all students, so that there is no sense of their being compensatory, as happens in other classes. Since the teachers themselves construct the digital textbooks, every lesson has already been devised to be presented and adopted by the student on a particular digital support. In this case, technology becomes a true helping hand in the educational process.

One of the fundamental precepts of the ICF is enacted in this manner, as *barriers* are eliminated and *facilitators* are boosted to the utmost. And this is one of the most extraordinary potentialities inherent in ICT.

Experimentations in three Italian provinces (Biella, Milan, Verbania), in collaboration with the Universities of Milano Cattolica, are about to be undertaken, following the example of ITIS Majorana. The common denominator is represented by technological tools (tablets, laptops, IWB) while *contents* and *processes* are differentiated [in keeping with the terminology used by Tomlinson], the teachers themselves preparing the texts used in the lessons, as is done in the Brindisi school. Each lesson therefore takes the individuality of the single students into account and is constructed to respond to their different learning styles.

A second proposal regards software that we elaborated in collaboration with the Centro Leonardo Education in Genoa, at the moment still in the experimental stage. So far the Alpha version of the project has been completed and can be downloaded at http://www.go-cicero.com/. The programme concentrates on the "educational product" created by students and exploits the ample flexibility and potentiality of new technologies, inspired by the fact that smartphones and tablets are widely used for recording, including the students' own voices. This happens in normal life contexts but not in study places, where however these tools and modalities could be extremely useful to develop awareness and refine skills and competences. The use of images and audio and video recordings is common among young people, their thinking being structured more by images than words. We could define it as "imaginative" thinking, since the use of images is more congenial to the expressive capacities of the young. This possibility of transmitting the images and sounds of ICT is absolutely extraordinary and close to the way young people feel, behave and express themselves, and should be made use of in this sense. In classrooms we can observe that oral expression and the exposition of concepts that may be well understood at cognitive level is often poor: young people express themselves with phrases that are too short, contain frequent repetitions, or are interspersed with recurrent words or catch phrases, in other words, in a syncopated manner. They are unaware of this and attempt not to dwell consciously on the matter, confining the negative experience of a bad 'interrogation' at school to a memory they would like to erase. On the contrary, it is a situation that should be faced and recognized, not an easy thing to do in class because of the psychological mechanisms that are set in motion when speaking in public. These considerations led to the *"Cicero"* project, software which provides teachers with the means to innovate the traditional forms of learning assessment and gives students the opportunity to demonstrate the competence they have acquired through a plurality of languages. To put it briefly, the teacher sends a test (in the form of a video, audio, text or presentation) to the whole class to verify the acquisition of the topics dealt with in his subject. The student can answer in various ways: with a video in which he films himself while responding in a discursive manner (the classical 'interrogation'); with a presentation, recording an exposition in his own speaking voice; with a written or narrative text; with other creative forms mediated by artistic expression (a brief theatrical text, a short film, a poem, a song…). The most interesting aspect from the pedagogical point of view is that the student has the time he needs to prepare his product and can observe his performance with greater objectivity. If, for example, he chooses to reply in the form of a video, recording his response, he will be able to see himself and correct himself, recognizing the defects in his oral expression. He will try to improve because he will have evidence of what needs to be improved, unlike in the emotional situation he experiences in class in front of the teacher and his classmates. From the perspective of differentiated instruction, the project allows for the exploitation of individual learning styles and the exercise of "multiple intelligences" (Gardner, 2006; Gardner & Davis, 2013.*Cf*. in particular the chapter on imagination).

This project, too, will be included in the experimental activities that were commenced last year and will be implemented scientifically in the provinces of Biella, Milan and Verbania.

CONCLUSION

Going back to the points raised at the beginning of this article, we can say that:

- the use of new technologies as an alternative to traditional teaching and the consequent fracture between "innovative" teaching through ICT and "ordinary" teaching methods is an issue that in many ways suggests the need for greater commitment by the scientific world, the various sectors of which at times follow separate tracks with different approaches and objectives, thus maintaining a separation between studies and research related to the two areas. While making due distinctions, technological innovation must inspire and fecundate the psycho-pedagogical sphere and vice versa. Like Rivoltella (2016), we believe that tradition and innovation are not antithetical concepts. On the contrary, the only way schools can safeguard tradition is by innovating. In this sense, technologies do not substitute but integrate.
- As far as the improper use of new technologies is concerned, particularly in pre-primary education and primary schools, the applications available are useful only in a pedagogical framework. Without such a framework, they risk being counter-productive rather than facilitating the learning process. It is obvious that competence must be acquired at the appropriate time in the child's development (Berteletti, Lucangeli, Piazza, Dehaene, & Zorzi, 2010) and the ICT employed must be suitable for the child's age, bearing constantly in mind the objective of the activity proposed. Vertecchi's laboratory shows that there is a relationship between the decline in manual writing skills and the spread of digital means, and more worrying still, that the improper use of digital means corresponds to a deficit in the development of memory skills and spatial and temporal orientation.

Table 1. To Summarize

	Elements of differentiation	Output
Didactic Unit	Content/process	Through ICT, the teacher can bring different contents to each student/group of students or differentiate the content of the single didactic unit, according to the various backgrounds, learning styles and learning needs of the students presents in the class.
	Product	Through ICT, students/student groups develop different products in response to the teacher's request (to show what they know about the subject).
	Educational tools (Technological devices/ Teaching and learning tools)	Different tools are used in the learning process and/or in the development of products.

There is an aspect of craftsmanship in teaching, especially in the earliest classes, that cannot be ignored or neglected, in the sense that all instruments – including "objects that support knowledge", such as text books, notes and handouts distributed in class – have a correct use that must be recognized by the person proposing them and by the person using them. A bricklayer faced with the task of creating a groove in a wall doesn't use a goldsmith's burin but a metal chisel of a precise size and shape that enables him to break into the particular material of which the wall is made. He knows how to hold it, how to strike the wall, which hammer to use to achieve his aim. Similarly, a teacher must know the characteristics and use of a brush, just as he knows those of a *device.* A brush is appropriate for developing the fine-motor skills of a five or six-year-old beginning to write. A fundamental aspect of writing, from the physical and functional point of view, is constituted by the dynamics of the pressure and traction of the hand so that the brush, with its flexible tip, executes the graphic-motor act in the best possible way. Likewise the tablet, in its use and functions, possesses characteristics that make it an instrument suited to certain educational purposes, not only to have rapid access to information or for the ergonomics of the use of the touch-screen (which simplifies and speeds up its use), but, for example, its distinctive reference to images, an essential component of the thought-patterns of children and teenagers, as we tried to argue above (*Cf*. Ciambrone, 2012 and 2015).

Thus if smartphones, laptops and IWBs are "tools", they must be understood in relation to the person using them, in their educational function.

ICT can be used in this way, on the basis of the *content* and the specific learning *process* we intend to develop, as in the example of the Brindisi school, or of the educational *product* to be elaborated, as in the example of the *Cicero* software.

A third hypothesis is to personalize the study path and the use of various tools according to the interests, potentialities and learning styles of each student, so that in the same class we could have a group of students using ICT and others who use different instruments.

In any case, the peculiarity of the technological tool is that it can be used as a differentiating element in itself (that is, as a mere tool to be used individually or, in a wider sense, as an essential part of the learning environment), but given its characteristics, which we have tried to outline, compared to other differentiating elements its transversal value is such that it has a modifying effect on contents, processes and products.

- As for the development of ICT, which is inspired by principles of personalisation in special teaching, the same practices must be disseminated and "imported" into the field of ordinary teaching. Pedagogical history teaches us that a century ago, Maria Montessori formulated principles and orientations that were effective in ordinary teaching, founded on the study of disorders and learning difficulties. Methodological research must be developed in this sense, to provide teachers with operational indications, each of which they can verify and translate into daily teaching practice. The CTS core schools already proceed in this way. It is necessary to reinforce the liaison between school and university, in a virtuous circle where the theoretical principle is tested in teaching practice, and subsequently, enriched by direct experience, returns to the examination of Academia so its implementation can be validated and it can be updated with new scientific acquisitions. We are working in this direction, after the experience of 70 university courses on SLD which trained 7,000 teachers, with laboratory activities carried out in schools and the creation of a positive synergy between research centres (ITD-CNR), universities and CTSs.
- Lastly, educational research must be focussed on differentiated teaching through new technologies.
- The theme of "differentiated teaching" seems to be the *missing* link or the *real* link between ICT and ordinary as well as special teaching. It entails teachers' possession of a whole range of competences, from the knowledgable use of technological and traditional tools to the identification of learning styles.

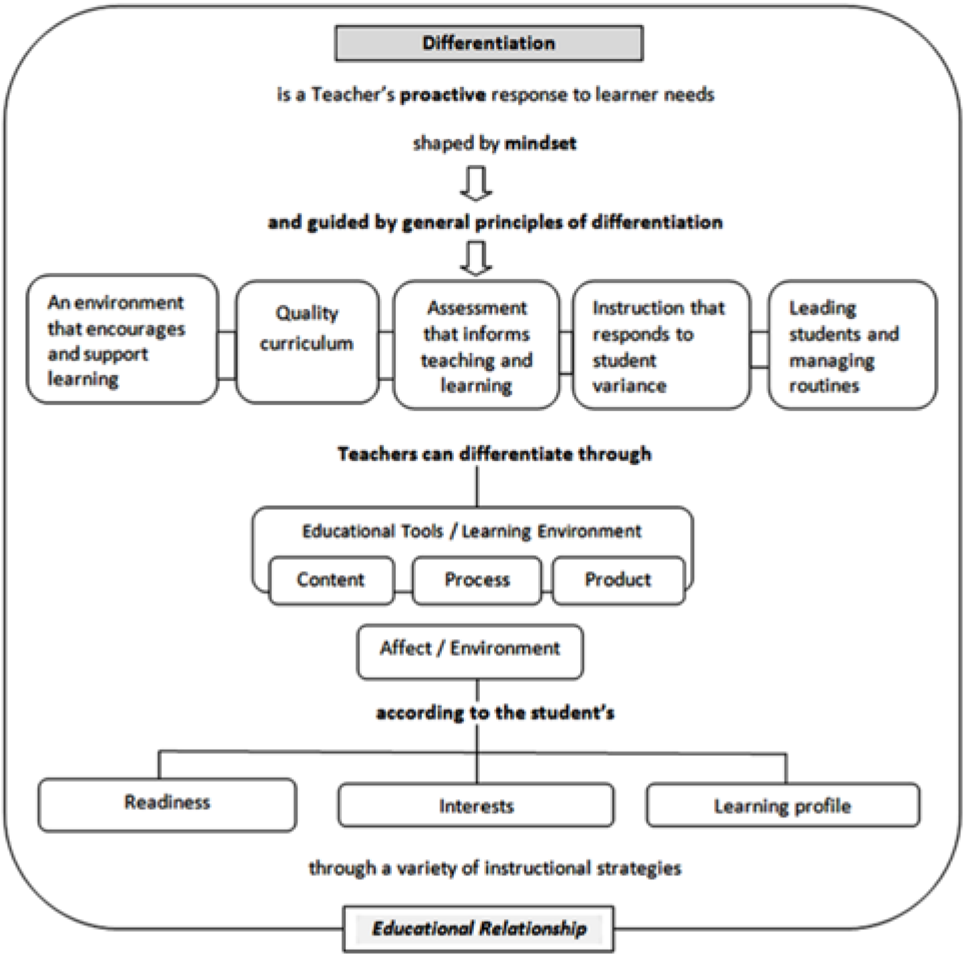
In any case, the fundamental value of the *educational relationship* (Laporta, 2000; Baldacci, 2012) should never be forgotten, since it is the fulcrum of the training experience, confers sense to every use of instruments and at the same time embraces and includes all the elements mentioned. It is the special bond between teacher and student that is created spontaneously and inevitably in the various learning contexts, through which the process of cultural transmission of knowledge with the development of competences and socialization take place. It is the educative relationship that dictates the behaviour of both subjects, who become master and student of each other only within that specific sphere, with roles that are different but of equal importance (Laporta, 2000). It is a mutual relationship in an asymmetric dimension, a place of exchange, cooperation and collaboration between teacher and student.

Let us try to imagine a classroom without any infrastructure, instruments or physical constructions surrounding a group of students, without even a building to house them – as perhaps is still possible in some corners of the globe – and the teacher-student rapport will be condensed to the essential elements that reveal the value of the educative relationship. To be clear, this is the essence of the relationship between Aristotle and his disciples as they walked under the porticoes, in the absence of any physical structures, premeditated arguments, didactic instruments…nevertheless transforming *informative* dialogue into a *formative* relationship. It is what every good teacher recognizes today as the crucial element that transforms a "normal" lesson into a lesson that is "extraordinary". An essence that is imponderable but concrete.

Here then is the integration to Tomlinson's scheme, with the addition of a fifth element of differentiation, "Educational tools /Learning environment", encompassing new technologies, but above all placing the whole scheme in the wider circle of the "educational relationship".

With these integrations, we feel that the scheme is easier to transmit to the school world, is more complete with regard to technological innovation and in fact contributes, should it be adopted as a working method, to the fusion of ordinary teaching and the use of ICT.

Figure 5. Map of the concept of differentiated teachingto include "Educational Tools/Learning Environment" and "Educational Relationship"/Redisegned and adapted from Tomlinson (2014).



The extension of a technological culture in schools is therefore fundamental. New technologies find fertile conditions for integration where there is a shared reflection on teaching methods, guided by insight into the human being, in a climate that is totally open to change. This however requires a rather lengthy process, accompanied by recurrent training, methodological reflection, ongoing assistance, the stabilization and gradual sharing of experiences, regular assessment, on line support groups (Bonaiuti, Calvani, Menichetti, 2017).

The prospect is the construction of integrated learning environments. The prerequisite is psycho-pedagogical competence in the approach to new technologies.

Asserting that "native digitals" already possess digital competence means ignoring that theirs is only technological confidence, which must be transformed into technological awareness. (Rivoltella & Ferrari, 2016). To win this challenge, it is necessary to know others and oneself. In such a scenario, new technologies may represent an opportunity to rethink and renew teaching activities for the benefit of everyone, an opportunity for change throughout the school world.

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ENDNOTES

1 *Cf.* The European Agency for Special Needs and Inclusive Education (EASIE) web site https://www.european-agency.org. See, among the projects developed by the EASIE: "ICT for Information Accessibility in Learning (ICT4IAL)" (2015); "Country Policy Review and Analysis" (CPRA):in which Italy participated at the piloting work together with France, Lithuania, Malta, Norway, Portugal, United Kingdom (England) and United Kingdom (Scotland) (*ongoing*); "Raising the Achievement of All Learners in Inclusive Education"together with Italy, Poland and Scotland (EASIE, 2017).

2 *Cf.* http://www.invalsi.it/invalsi/rn/doc_monval/5.Report4%20e5.pdf [last accessed on 16th Aug. 2019].

3 *Cf.* See, among the various School 3.0 projects, the one developed by ITS Luca Pacioli, Crema. See also TEAL (Technology Enabled Active Learning) http://www.pacioli.net/pvw/app/CRII0009/pvw_sito.php?sede_codice=CRII0009&from=2&page=1898865[last accessed on 16th Aug. 2019].

4 *Progetto ICF. Dal modello ICF dell'OMS alla progettazione per l'inclusione* (MIUR, 2010-2015). 563 schools took part in the first phase of the project. 93 schools have implemented the two-year experimental phase. *Cf.* http://www.emis-studios.eu/bes/ [last accessed on 16th Aug. 2019].

5 MIUR Ministerial Directive (2012). *Strumenti d'intervento per alunni con Bisogni Educativi Speciali ed organizzazione territoriale per l'inclusione scolastica*. Roma: MIUR, 27 dicembre 2012. Available also on http://www.marche.istruzione.it/dsa/allegati/dir271212.pdf [last accessed on 16th Aug. 2019].

6 U.S. Department of Education, *Transforming American Education Learning Powered by Technology*. *National Education Technology Plan 2010*. Available also on https://files.eric.ed.gov/fulltext/ED512681.pdf [Last accessed on 16th Aug. 2019]. *Cf.* Also *Personalization vs Differentiation vs Individualization* by Barbara Bray and Kathleen McClaskey on https://education.alberta.ca/media/3069745/personalizationvsdifferentiationvsindividualization.pdf [Last accessed on 16th Aug. 2019]

7 MIUR Guidelines for the right to education of pupils with specific learning disorders, annexed to the ministerial decree 12 July 2011.

8 See, on this point, Maria Luisa Eboli and Pier Filippo Polidori, *Apprendimento e nuove tecnologie: il contributo delle neuroscienze*, in Vertecchi, B. (2016).

9 Until a few decades ago the role of the environment was totally underestimated, whether recent scientific research in Epigenetics shows that environmental influences can actually affect whether and how genes are expressed. According to these researchers, "All environmental information does not act directly on DNA, on the genome, but on the epigenome that, like the software in a computer's operating system, determines which functions the genetic "hardware" (DNA) does and does not perform [*Cf.* Ernesto Burgio 2018]. Thus, crucial epigenetic changes are involved in learning and memory processes. A correctly stimulated brain develops a network of rich and, above all, harmonic dendritic connections (synaptogenesis). Research on Epigenetics identifies electromagnetic radiation as a high risk for the health of the child but also the excessive use of smartphones and tablet PCs can affect the brain development.

10 In the first two years of their activity, the CTSs have developed 260 training courses, involving more than 13.650 teachers and professionals. This data come from the INVALSI – the National Institute for the Evaluation of the Education System – which conducted a survey on the NTD project.

11 *Cf*. *Quaderni del Centro Nuove Tecnologie per l'Integrazione HANNA*, Ovada (Alessandria) – ISBN 978-88-903343-8-2. Available also on http://www.vedrai.it/jmla/index.php?option=com_content&view=category& layout=blog&id=45&Itemid=78 [last accessed on 16th Aug. 2019].

12 Researchers of the Politecnico di Torino and Milano have developed PARLOMA, a system to enable remote communication between deaf-blind persons, a Real-Time Single Camera Hand Gesture Recognition System for Remote Deaf-Blind Communication. It is composed of a low-cost depth sensor as the only input device, paired with a robotic hand as the output device. Essentially, any user can perform hand-shapes in front of the depth sensor. The system is able to recognize a set of hand-shapes that are sent over the web and reproduced by an anthropomorphic robotic hand. It can work as a "telephone" for deaf-blind people. *Cf*. Russo et al. (2015).

13 *Cf*. www.bookinprogress.org. On Salvatore Giuliano and the ITIS Majorana School in Brindisi *cf*. the survey by INDIRE-Istituto Nazionale di Ricerca Educativa on the «Avanguardie educative»: a Cultural Movement for the Educational and Organizational Transformation of the Italian School.

Chapter 4
An Ecological Approach to Technology Appropriation:
A Sustainable Digital Learning Material Development Ecosystem

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ABSTRACT

The study aims to construct an innovation-based digital learning material (DLM) development ecosystem that penetrates and sustains within the school culture in order to diffuse and maintain DLM development. Sixty-two teachers from 21 different branches participated in this nested mixed design study. Data were collected through scales and interviews, and the study was based on the steps adopted by Rogers on the diffusion of innovation. Quantitative data were analysed with cluster analysis, logistic and multi-linear regression. Qualitative data were analysed with structural, in vivo, and axial coding in order to construct the ecosystem. The findings demonstrate that the main variables, which were determined to influence the adoption and sustenance of DLM development by teachers, were the support of administrators and colleagues, the willingness and need to develop DLM, computer knowledge, and DLM development self-efficacy.

INTRODUCTION

Digital Learning Material (DLM) can be defined as any kind of material developed for instructional purposes using digital media such as computers and mobile devices. DLM encompasses a wide spectrum of applications from examinations to games, and from animations to presentations (BECTA, 2008; Stepherd, 2012). DLM is among the learning opportunities from which students experience real-life conditions in the classroom (BECTA, 2010; Beetham & Sharpe, 2013; Chen, Lambert, & Guidry, 2010;

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Figure 1. Tools That Allow Development of Various DLM

Wright, 2015). Planned integration of DLM in educational and instructional environments can improve teacher-student communications (Chen et al., 2010; Wright, 2015), increase academic success, facilitate the exploration of difficult and abstract meanings (BECTA, 2010), and support inter-student collaboration (European Commission/ICT Cluster, 2010).

DLM could be considered an important educational resource when the contribution of technologies and accessible, free software that facilitates DLM development are added to the aforementioned factors. Alternative media samples and classifications that enable teachers to develop DLM easily are presented in Figure 1.

As shown in Figure 1, there are many different platforms to develop DLM such as editing audio, establishing web site/blog, building poster or infographics, preparing a presentation, video, e-book, content/concept map, crossword, assessment instrument. Despite the simplicity of DLM development and the diversification of development media, classroom usage for DLM is still very low in several nations (see Table 1) (Fraillon, Ainley, Schulz, Friedman, & Gebhard, 2014).

Based on Table 1, teachers in several countries still prefer to use Microsoft Office software and websites as resources in their courses (IEA, 2013). The least preferred media include conceptual maps and e-Portfolios (Fraillan et al., 2014). One of the important reasons for this situation is inadequate e-content (Alabay, 2015; Keles, Öksüz, & Bahçekapılı, 2013; Önder, 2015; Yıldız, Sarıtepe, & Seferroğlu, 2013), which directly affects the teaching process (Dursun, Kuzu, Kurt, Güllüpınar, & Gültekin, 2013). Furthermore, a review of the literature found very few studies that proposed recommendations for the solution of the content problem (Başak & Ayvacı, 2017).

Technological instruments developed for educational purposes in the integration process, and technologies (software/hardware) that should be integrated into instructional environments are considered as innovative for teachers and administrators. The diffusion and usage of technology-based innovations are not the product of individual efforts, but require better understanding of collaboration and innovation within organisations; in other words, within schools. Rogers (2003) emphasised the importance of innovation for the pace of diffusion by stating five characteristics of innovation in the theory of innovation

Table 1 . Percentage of Digital Content Use by Teachers in Several Countries

Countries	Tutorial Software	Digital Learning Games	Presentation and Word Processor Software	Multimedia Production Tools	Concept Map Software	Data Storage and Monitoring Software	Simulation Modelling Software	Social Media	Communication Software	Interactive Teaching Materials	E-Portfolios
Australia	7	6	41	10	2	5	4	1	15	15	2
Czech Republic	12	2	23	1	0	2	0	1	4	16	0
Korea	28	7	47	17	3	5	6	5	12	11	6
Lithuanian	19	4	29	9	1	12	2	2	16	13	10
Poland	9	2	13	6	1	2	1	1	6	9	1
Russia	19	7	44	9	6	13	5	4	10	20	7
Slovenia	22	5	31	9	1	2	2	1	7	12	1
Thailand	10	6	26	12	9	8	5	18	17	16	9
Turkey	15	9	23	10	8	8	5	3	8	15	4
Denmark	7	3	31	4	1	1	1	2	10	21	2
Germany	1	0	10	2	0	2	1	1	1	3	0
Hong Kong	22	3	52	11	3	3	3	3	13	13	2
Norway	3	2	19	1	0	1	0	1	3	6	2
Canada	13	10	41	17	5	9	6	7	20	18	5

diffusion. These were the relative benefit, complexity, suitability, trialability, and observability of innovation. The literature shows that diffusion of innovation theory is commonly used in technology-based appropriation studies (see Buc & Divjak, 2015; Isleem, 2003; Soffer, Nachmias, & Ram, 2010; Thayer, 2013), and that these five characteristics of innovation directly affect sustainability (Zehetmeier, 2010).

Masca (2009) is defined the sustainability as planning by balancing the needs of future generations and nature without disturbing the natural balance. There are three generally accepted dimensions of achieving sustainability; economic, environmental, and social (Holmberg & Sandbrook, 1992). In the economic dimension, it is expected to lower costs and provide financial incentives for individuals, organisations, and nations; while in the social dimension, requirements such as equality, opportunity, freedom and security should be fulfilled; and in the environmental dimension, the outputs obtained with consumed resources should be recycled with minimal wastage (Holmberg & Sandbrook, 1992). The significance of technological sustainability in education is increasing daily (Djordjevic & Cotton, 2011; Yuan & Zuo, 2013), and the focus of several projects including largescale projects such as The Technology Innovation Challenge Grant (TICG) and Preparing Tomorrow's Teachers to Use Technology (PT3) were discussions on the methods to sustain technology-based innovation initiatives (Sherry & Gibson, 2002).

Considering that DLM development would be affected by technological advancement, sustainable change is inevitable for continuity. Teachers would play the most important role in this change, because, in order to develop quality material, it is a requirement to assess and analyse several criteria such as student traits, course objectives, class structure, available technological infrastructure, teachers' skills, and to combine analysis results with the technology. Furthermore, this cycle should continue throughout for educators and learners. However, it is also necessary to prepare teachers for technological innovation within sustainable professional development models, which maintains teachers' knowledge current on technological advances (Albion, Tondeur, Forkosh-Baruch, & Peeraer, 2015; Blau & Shamir-Inbal, 2016).

Overall, there is a need to establish a sustainable innovation-based ecosystem that spans the school culture in order to promote and sustain DLM development in schools. Thus, the current study aims to construct a DLM development ecosystem for teachers in order to propose solutions to the aforementioned problems. Based on this general aim, the following sub-objectives were determined.

- 1. Are the contributions of gender, age, willingness to develop DLM, support of administrators for innovations, support of colleagues for innovations, the need to develop DLM variables to the appropriation of the development of DLM model significant*?*
- 2. Are the contributions of the DLM development self-efficacy scores of teachers and basic computer skills self-assessment scores to the appropriation of the development of DLM model significant?
- 3. What should be the contributions and duties of administrators in ensuring the sustainability of the development of digital instructional material?
- 4. What are the contributions of the experts that would be available at schools to the development of digital instructional material by teachers?
- 5. How could coordination be provided to improve the contribution of colleagues to sustainability?
- 6. What kind of opportunity should be provided for teachers to improve their willingness and need to develop digital instructional material?
- 7. What is the contribution of the technological infrastructure to the process of the development of digital instructional material by teachers?
- 8. What are the effects of storage space on the continuation of the development of digital instructional material by teachers?
- 9. What should be done to improve teachers' self-efficacy in digital instructional material development and their basic computer skills?
- 10. Based on the overall study data, how should the DLM development ecosystem be constructed for teachers?

METHODS

Research Model

In the study, the nested mixed design, one of the typologies proposed by Clark, Creswell, Green and Shope was used. This design can be used when both quantitative and qualitative data are needed when searching for answers for the research problems in a qualitative or quantitative-oriented study (Clark, Creswell, Green and Shope, 2008). In the study, quantitative and qualitative data are nested, sometimes in sequence to support each other, and sometimes in integration. All collected data were combined and interpreted to construct an ecosystem.

Target Population

The diffusion and sustainability of an innovation in a social system is accelerated and provided by the use of the innovation by all stakeholders within the system. Teachers play the most important role in strengthening and supporting technology-based innovation environments at schools (Learnovation Consortium, 2008) and it is critical for the teachers to receive training on technology integration (Eurydice, 2011). In the present study, teachers employed in different fields were included in the study group and the selection was made with maximum diversity sampling based on the teaching fields. The target population included sixty-two teachers employed in elementary, junior high and high school sections in a private

Table 2. Distribution of Participating Teachers Based on Field

Department	*n*	%	Department	*n*	%
Classroom	11	17.7	Drama	1	1.6
Turkish	8	12.9	History	1	1.6
Math	8	12.9	Music	1	1.6
English	7	11.3	Philosophy	1	1.6
Literature	4	6.5	Spanish	1	1.6
Science & Technology	4	6.5	German	1	1.6
Chemistry	2	3.2	Religious Culture & Ethics	1	1.6
Biology	2	3.2	Computer & Instructional Technology	1	1.6
Physics	2	3.2	Guidance & Psychological Counselling	1	1.6
Kindergarten	2	3.2	Assessment & Evaluation Specialist	1	1.6
Technology & Design	1	1.6	Geography	1	1.6
Total	**62**	**100%**			

school during the 2014-2015 academic year. In which country? Region? City? The distribution of the fields of participating teachers are presented in Table 2.

As can be seen in Table 2, a total of 62 teachers from 22 different fields participated in the study. 83.9% of the participating teachers were female and 16.1% were male. Furthermore, 54.8% of the participants were primary and secondary school teachers, and 45.2% were high school teachers. The majority of the teachers participating in the study are between the ages of 35-39 (27.4%). This group is followed by the 30-34 age group (25.8%). 12-9% of the other teachers were between the ages of 40-45, 12.9% were 55 and after, 11.3% were 20-24, 6.5% were 45-49, 3.2% were 50-54.

Data Collection Instruments

In the determination of the data collection instruments and the study variables, the focus was initially on the concepts of sustainability, innovation diffusion, digital instructional material, school culture and technology use and other variables that were determined to affect the above-mentioned concepts and were identified with a literature review. Furthermore, in order to reveal the latent themes that affected the model of sustainable digital instructional material development, an interview form was developed to determine all variables that might affect the process in detail. Brief information on measurement instruments is provided below.

Appropriation of DLM Development Scale (ADLM). The scale was developed by Karademir (2018) in order to measure the levels of teachers' appropriation of DLM development based on innovation diffusion theory. The scale includes 27 items grouped in five sub-dimensions: Complexity, Observability, Suitability, Relative Benefit, and Trialability. Together, the sub-dimensions explain 73.32% of the total variance and the correlation between the scale sub-dimensions is significant. The Cronbach Alpha Internal Consistency Coefficient was found to be .791.

DLM Development Self-Efficacy Perception Scale. The scale was developed by Karademir (2018)) in order to measure teachers' self-efficacy perceptions about DLM development. The scale includes seven items in a single dimension. The single dimension explains 58.72% of the total variance. The Cronbach Alpha Internal Consistency Coefficient for the scale was found to be .894.

Basic Computer Skills Self-Assessment Scale. The scale was developed by Karademir (2018) in order to measure teachers' basic computer skills with self-assessment. The scale includes 41 items in six sub-dimensions; Word Processing, Number Processing, Visual Operations, File Operations, General Features, and Communication-Internet Skills. Together, the sub-dimensions explain 83.248% of the total variance. The Cronbach Alpha Reliability Coefficient was found to be .808.

Design of the Interview Forms. Interview questions were developed in the study to identify the latent variables that could affect the development of DLM. Variables such as innovation (i.e., digital instructional material development software), time (i.e., seminars, workloads), social system (i.e., agents of change, leaders, administrators, colleagues), communication channels (i.e., seminars, workshops), school culture and three dimensions of sustainability, which are considered to affect the appropriation and diffusion of digital instructional material were scrutinized in the design of interview questions. While in the economic dimension, especially digital instructional material development software and material motivators were emphasized; in the environmental dimension, technical infrastructure, storage areas, facilities, leaders and policies were dwelled on. In the social dimension, especially the questions that would reflect the school culture were included. The developed questionnaire included 40 items and sub-questions and was finalized after an expert review.

Pilot Scheme and Data Collection Process

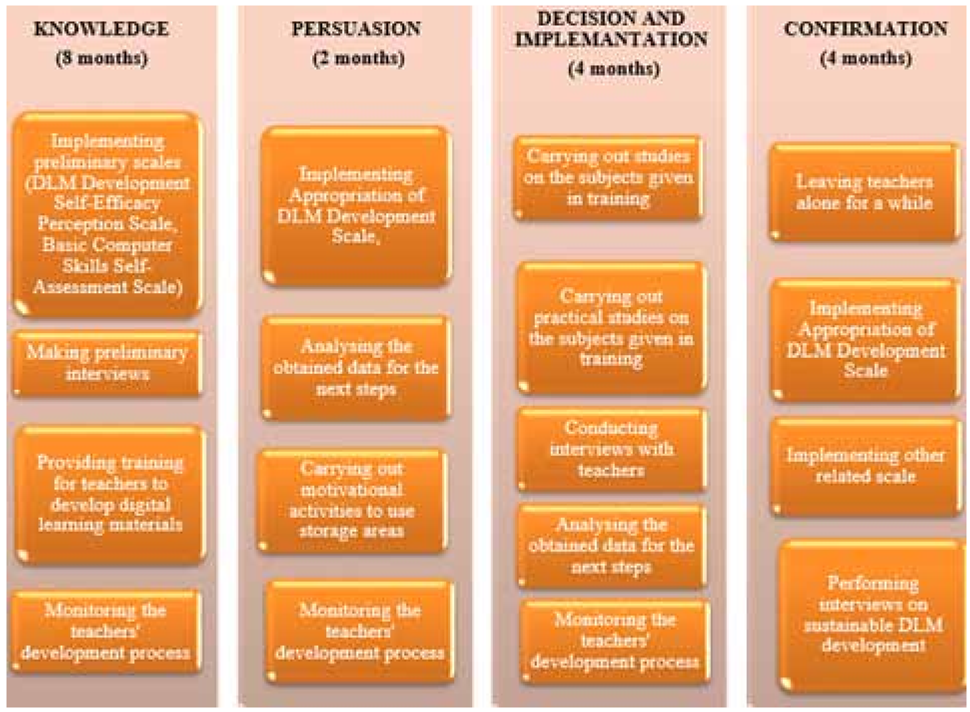
In the initial phase of the study, a pilot scheme was conducted with 22 teachers for 10 weeks to determine the adequacy of the education program, the availability of the storage areas, determination of the physical infrastructure and auxiliary equipment, the initial experiences and impressions of the teachers and possible problems before the implementation. After reviewing the problems encountered during the pilot scheme, the actual implementation that lasted for one and a half years and conducted with 62 teachers, was commenced. During the implementation phase, the steps for the appropriation of innovation that were determined by Rogers (2003) in the innovation diffusion theory were adopted (see Figure 2).

Data Analysis

Study data were collected using both quantitative and qualitative measurement instruments. Data obtained at the stage of persuasion, decision and implementation were analysed while the study was carrying out. Other data were analysed at the end of the study. A holistic approach was adopted in the interpretation of the obtained study data. The utilized data analysis methods in the present study are given below.

- Cluster analysis: In the study, teachers were grouped by non-hierarchical cluster analysis method based on their ADLM scale scores. The aim of cluster analysis is to separate the data according to specific behavioral characteristics and to determine the data sets in the separated clusters (Tryfos, 1998). The significant difference between clusters is particularly important in terms of giving cluster names. That's why, in this study, it was decided that clustering analysis is the most appro-

Figure 2. Research Steps



priate separation method for naming clusters. The clusters obtained in the analysis were used in both qualitative and quantitative data analyses.

- Logistic regression: Logistic regression was used to determine whether the categorical data obtained with the questionnaire modelled the appropriation of digital instructional material in two different categories in the study. While the dependent variable in the study is categorical, some of the independent variables are continuous and some are categorical. The characteristics of the data are given in Table 3.

Logistic regression analysis (Cook, 2008; Tabachnick and Fidell, 1996, cited by Çokluk, 2010) is the analysis that can make the best modelling in such studies involving different data types. Therefore, it has been decided that logistic regression analysis is the most suitable analysis for data modelling in this study. The hypotheses were tested before the analysis and standard errors, tolerance, VIF values, multiple correlations and the paired correlations between variables were analysed and it was found that the data was suitable for logistic regression analysis.

- 3. Multilinear regression analysis: Multilinear regression was used to determine the presence and the degree of the impact between the digital instructional material development self-efficacy perception scores and basic computer skills scores and sub-factors that were considered to have an impact on their appropriation of digital instructional material development behaviour in the study. Normal distribution, Cook distance and outliers were examined to determine whether the as-

Table 3. Characteristics and Categories of Independent Variables

Independent Variables	Variable Type	Categories
Gender	Categorical	Female- Male
Age	Continuous	Between 20 to 64
Willingness to develop DLM	Categorical	Willingness to develop DLM Not willing to develop DLM
Need for DLM development	Categorical	Feeling the need to develop DLM Not to feel the need to develop DLM
Support of colleagues for innovations	Categorical	Yes - No
Support of administrators for innovations	Categorical	Yes - No

sumptions were accepted before the analysis and it was determined that the data was suitable for multilinear regression analysis.

- 4. Coding the qualitative data: The coding of the qualitative study data was completed in two cycles. In the first cycle, attribute coding was conducted to obtain the descriptive information about the teachers from the interview forms, structural coding was conducted to determine the information pieces present in the previously determined themes, and in-vivo coding was conducted to identify other pieces of information. All the themes obtained after the first coding cycle were combined using axial coding in the second cycle and an upper category was determined. Strategies such as field triangulation, long-term interaction, expert review, and participant validation are recommended to ensure credibility of the qualitative data (Linkoln and Guba, 1985; Merriam, 2009). In the present study, an expert was included in the process to monitor and assess the process, review the raw data and provide feedback on the adequacy of the process, and furthermore, the number and demographics of the participants, selection methodology, utilized data collection instruments and the analysis techniques were disclosed in detail. The obtained data were presented in "detailed descriptions" and direct citations (Merriam, 2009) and attempts were frequently made to provide transferability for the study. Furthermore, expert opinion of a specialist was obtained during the data coding phase and expert opinions of three specialists were obtained after the coding phase on the codes and correlations among the codes.

Logistic regression analysis and qualitative coding were used to test the first sub-objective of the study. Multilinear regression analysis and qualitative coding were used to test the second sub-objective of the study. Content analysis was used to test other sub-objectives.

Findings

First present the variables: their descriptive statistics or frequency distribution. In case of constructs, present their formulation.

In this section, an attempt was made to scrutinize the study sub-objectives.

Are the Impacts of Gender, age, Willingness to Develop DLM, Support of Administrators for Innovations, Support of Colleagues for Innovations, the Need to Develop DLM Variables to the Appropriation of the Development of DLM Model Significant?

Table 4. Initial Classification After Logistic Regression Analysis

			Expected		
Step	**Actual/Observed Status**		**Low appropriation of DLM**	**High appropriation of DLM**	**DLM development Adoption**
Step 0	**DLM development Adoption**	Low appropriation of DLM	0	26	.0
		High appropriation of DLM	0	35	100.0
	Correct classification = % 57,4.				

Table 5. Classification Percentages

Step	**Actual/ Observed Status**	**Low appropriation of DLM**	**High appropriation of DLM**	**DLM development adoption**	
1	Low appropriation of DLM	22	4	84.6%	
	High appropriation of DLM	8	27	77.1%	
	Correct Classification = 80.3%				

For the first sub-objective, logistic regression analyzes of "Likelihood Ratio" and "Enter Method" were used to explore the impacts of the independent variables on the dependent variable. The observed and actual status of the participants and the initial classification percentages are presented in Table 4.

Table 4 demonstrates that logistic regression analysis initially classified all teachers under the category of high appropriation of DLM development based on the predictive variables (before the independent variables were included in the model) and the accurate classification rate was 57.4%. When the variables were included in the analysis, it was determined that the model chi-square value was significant ($p <.01$) based on the Omnibus test, which was applied to determine the presence of the correlation between the predictor variables and the predicted variable. This value suggested the presence of an impact between teachers' appropriation of DLM development scores and independent variables. The result of the Hosmer and Lemeshow test that was conducted to determine whether this impact was at an acceptable level as a whole was significant ($p = 0.784$). The fact that the value had a significance value greater than 0.05 (Pallant, 2015) suggested that there was an acceptable fit as a whole, in other words, the model-data fit was adequate. It was also found that Cox and Snell R^2 (explaining 54% of the variance) and Nagelkerke R^2 (explaining 73% of the variance) values were higher than 20% and significant (Alpar, 2011). The implementation of the regression model on the prediction of group memberships is presented in Table 5.

Based on the study findings, the classification rate of the appropriation of DLM development score by the independent variables was 80.3%. The fact that this value was higher than 50% and the classification rate in the first step (initial rate: 57.4%) indicated that the classification accuracy of the analysis was higher than the chance criterion, that is, demonstrated that the classification was accurate (Çokluk, 2010). These values as a whole demonstrated a significant impact of the independent variables and the dependent variable. The contribution of each variable to the model is presented in Table 6.

Table 6. Coefficient Estimates for Targeted Model Variables

Step	Variables	B	*SE*	Wald	*SD*	*p*	Exp(B)
Step 1	Gender	-1.563	1.378	1.286	1	.257	.210
	Age	-.180	.224	.645	1	.422	.835
	Need for DLM development	2.858	1.184	5.831	1	.016	1.433
	Support of administrators for innovations	3.153	1.434	4.837	1	.028	2.408
	Support of colleagues for innovations	2.603	1.033	6.351	1	.012	1.502
	Willingness to develop DLM	2.760	1.147	5.794	1	.016	1.798
	Constant	**-6.453**	**2.835**	**5.180**	**1**	**.023**	**.002**

Table 6 demonstrates that the contributions of the variables of the support of administrators for innovations, the support of colleagues for innovations, the need for DLM development and the willingness to develop DLM to the model were significant (p <.05). The support of administrators for innovations improved the odds of appropriation of digital instructional material development by the teachers by 2.4 times or 140% [(2.408-1) * 100]. This finding suggested that the teachers' appropriation of DLM development scores could increase in the presence of administrator support. Similarly, in the interviews conducted with the teachers, it was observed that the support of the institution in the institution administrators was important for DLM development:

T13: The support of the institution is very important, in fact, the self-support is also very important, but it is great to start with the support of the institution.
T28: .... I believe that I improved myself and I learned about new technologies thanks to the support of my administrators.

It was observed that the other variable determined to have a significant contribution to the model, the support of colleagues for the innovations increased the odds of appropriation of digital instructional material development by the teachers by 1.502 times, or 50.2% [(1.502-1) * 100]. These findings are also found in talks with teachers on qualitative findings. Findings that supported the above-mentioned data were obtained in the interviews conducted with the teachers. A large number of teachers stated the importance of their colleagues' influence on DLM development.

T18: We all know each other very well we support and complete each other and we see each other constantly and we can ask each other more stuff for example, when preparing a crossword puzzle we sat there prepared the questions, for example, we tried to develop the puzzle there, because we understand each other it is more fun we know where we will use it.
T26: After I develop my project with this individual getting help about the issues I face would be the most important problem for me, but we can resolve this within the group, as we told you, to the computer, we are all at a certain level… Since mathematics group has such a predisposition, there is development there.

It was observed that a unit increase in the need for DLM development variable, which was determined to have a significant contribution to the model, increased the odds of the appropriation of digital instruction material development by the teachers by 1.433 times or 43.3% [(1.433-1) * 100]. Similarly, in the interviews, it was observed that teachers stated that the need to develop DLM is required to develop digital instruction material and to render this process permanent.

T8: .... it is necessary to feel the need for such a thing; this is the basis of learning.
T51: For once, it is very important to feel the need for something, if you want to continue in this profession, independent of your age, whether you are experienced or not, it is not important, if you will continue in this profession you have to adapt to the requirements of the age.
T60: ...to feel the need is one of the other important things here, if the person feels the need for something, he would do it even if it is difficult...

It was observed that a unit increase in the willingness to develop DLM variable, the last variable that contributed to the model of DLM appropriation, increased the odds of the appropriation of digital instruction material development by the teachers by 1.798 times or 79.8% [(1,198-1) * 100]. Teachers indicated that it is important to be willing to develop DLM individually is an important variable for appropriation and sustenance, similarly in the conducted interviews, and that they would spare time for DLM development as long as they are willing despite insufficient resources.

T2: ...as long as you have individual desire, you can develop (DLM) even if your institution does not help you.
T10: individuals do not develop unless they want it... you are alone with your conscience for 40 minutes. No one can force you unless the teacher does not want to.
T31: It is not only about developing digital material, but individual desire is more important in everything... individual desire is always more important in everything.

It was determined that the gender and age variables did not contribute to the DLM development appropriation model ($p > .05$).

Are the Contributions of the Digital Instructional Material Development Self-Efficacy Scores of Teachers and Basic Computer Skills Self-Assessment Scores to the Appropriation of the Development of Digital Instruction Material Model Significant?

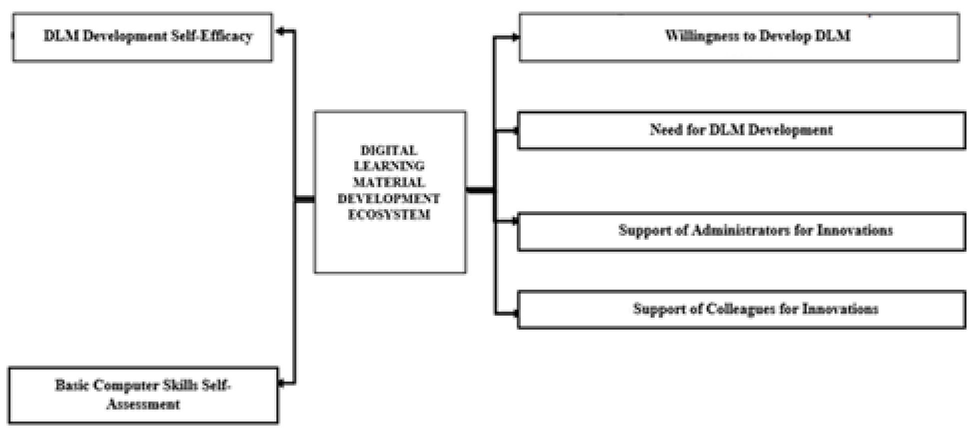
Multilinear regression analysis was conducted to determine the contributions of teachers' basic computer skills self-assessment and DLM development self-efficacy scores to the DLM development appropriation model.

Analysis of the model that included both variables demonstrated that there was a moderate and significant correlation between basic computer skills self-assessment and DLM development self-efficacy predictive variables and teachers' appropriation of DLM development scores ($R = 0.404$, $R^2 = 0.312$, $p <0.05$). Independent variables explained about 16% of the total variance in DLM development appropriation. Analysis of the standardized regression coefficients (β) demonstrated that both predictive variables significantly predicted DLM development appropriation scores ($p <0.05$), and DLM development self-efficacy scores were the first and basic computer skills self-assessment was the second based

Table 7. Multilinear Regression Analysis Results for DLM Development Appropriation Variable

Variables	B	*SE*	β	t	p	Binary *r*	Partial *r*
Constant	140.993	11.952	-	11.797	.000	-	-
Basic Computer Skills Self-Assessment Total Scores	.217	.083	.314	2.627	.011	.287	.324
DLM Development Self-Efficacy Total Scores	1.126	.470	.187	2.396	.020	.256	.298
$R=.404$ $R^2=.312$ $F_{(2,59)}$: 5.768 $p=.004$							

Figure 3. Variables determined as significant for the model



on their relative significance. In support of the above-mentioned findings, in the interviews conducted with teachers, they emphasized that they need to possess beginner level computer skills, internet and information search techniques in order to develop DLM.

T8: I mean, one must have computer knowledge, if one has computer knowledge, that person can access and develop certain things alone...

T20: ... one needs to know the computer needs to research one needs to ask. Not everyone could have computer talent, but I think she (he) could learn.

The significant variables and their impacts obtained with logistic regression and multiple regression analysis are presented in Figure 3.

Mere definition of the model variables is not sufficient for the present study. The sub-objectives of the current study include the determination of the steps that should be taken to improve these variables and identification of latent variables. Thus, the other findings that were determined to contribute to the model were obtained after the analyses of the interviews conducted with teachers.

What Should be the Contributions and Duties of Administrators in Ensuring the Sustainability of the Development of Digital Instructional Material?

Quantitative data analysis demonstrated that the first variable that was identified to contribute to the model was the support of innovations by the administrators. According to the teachers, administrators should be aware of technological developments and should lead others in this respect. They should be a role model by participating in the groups that develop DLM and should not suffice with leadership. Administrators should demonstrate the teachers that the DLM development is a requirement and raise awareness about new technologies. In order to become such an administrator, it was considered important to possess a character that is open to innovations, inquisitive and sharing knowledge. Furthermore, in order to conduct the process efficiently, it is necessary to develop an open school policy that includes a continuous and participatory learning process and includes all personnel, and all participants should know their duties and responsibilities act according to these duties and responsibilities. In order to enforce and maintain the policies, it was emphasized that an administrator should provide the necessary guidance and support to teachers.

T18: ... One should be open to innovation, in other words, one should adopt this idea, naturally, you would transfer the benefits, the importance of computer, etc. to the employee...
T29: ...the administrators should ask for it, one way or another. Their expectation must be clear.
T12: ...my personal opinion is that there should be an expert and only deal with these things, DLM development should be a policy...
T17: …if the advantages of these projects are determined and emphasized and their benefits are presented to the teacher, the productivity could be improved.

According to the teachers, the institution should have an expectation on DLM development and provide motivators. Among these motivators, teachers mentioned reduction of course hours, the provision of financial support, or the improvement of working conditions. This is because the teachers especially stated the problems related to time constraints and emphasized that the course obligations constituted an obstacle to DLM development and that the administrators should produce alternatives to solve this problem.

T44: ...after instructing thirty, forty hours of courses, one cannot tell the teacher to do this, to prepare for the course as well the teacher should instruct for twenty hours and should develop material in the remaining time.
T52: So, ultimately life is hard, even the smallest thing that can be provided for the teacher makes us really happy or motivate us more. So, I think that financial support would definitely have a positive effect.
T61: providing additional time is important for productivity since it entails additional income but financial support is important in this issue...

Furthermore, according to teachers, administrators should employ a specialist at school to ensure knowledge transfer, operation and continuity of the process.

What are the Contributions of the Experts that Would be Available at Schools to the Development of Digital Instructional Material by Teachers?

Teachers consider having an in-house expert whom they can reach at any time as an advantage in fulfilling their duties. Furthermore, they stated that they would not hesitate to ask questions to an in-house expert, and that this would prevent them from giving up DLM development when they encounter problems and would motivate and excite them.

T44: Then, work could be conducted with the expert during the class breaks that we mentioned earlier, because there is no problem if the work with the expert is interrupted. It would not be over then, but the next time it could be completed.
T47: ...there should be someone whom I should be able to consult when I want to do something. Otherwise, I do not know whom I should ask, frankly. It would be great if I could get some help from the expert.
T62: It would have been great to have someone I can consult with, to have someone that I can access easily, to ask questions because I will learn a lot of things for the first time.

According to teachers, experts could raise awareness about innovation and could save teachers' time by introducing and integrating innovations with pedagogical and content knowledge at schools. Furthermore, according to teachers, working with experts would not only save time, but could also provide a basis for the development of higher quality products.

T5: ...also, there is this, the expert would eventually monitor the newest innovations and tell us and we could present whet we are told to the students.
T16: ...I am not sufficient in technical terms, thus there should be a material development expert.
T28: It would be convenient for instruction and we would get support with them, use the time better and better products would come up.

It was determined that teachers had two different suggestions about the times they would work with the experts. It was observed that certain teachers preferred seminar period, while others preferred seminars that would be organized when a need arises. The seminar period is of two weeks before the opening of the schools and two weeks after the schools are closed. During this period, teachers participate in some training and carry out joint studies to ensure their professional development. Teachers, who preferred the seminar period, stated that in addition to these training programs, weekly meetings can be held during the semester. According to the teachers, this is important for keeping their knowledge current, transforming knowledge into practice, overcoming the problems, and it could allow DLM development to become fun. According to teachers, working continuously with experts could prevent giving up in times of difficulty, and it could allow DLM development to become fun. They also stated that they could have the chance to experience it doubtlessly under the supervision of an expert, which would in turn reduce the complexity of the process.

T12: it would be more effective if it is conducted regularly otherwise if one could not learn and use (it) it would not be complete if it is continuous if we want it to be permanent if it is planned one individual would have to do it and better things could be produced.

T30: So, I answer this as a mathematician, not as a teacher, the training you provided multiplied our knowledge by ten, that is, in such a short time, I think that if someone would train us in a short period of time we could obtain results. But when we think about people who are not predisposed to computers, I think it would be beneficial to have someone here all the time if I have to respond for all.

T60: There is a one-week lot within the seminar period, whatever we could learn within a week. So, if there is an expert, I would try to do something. Even if I have two hours a week to work on this, for example, I could develop my material in this period, I would present it to the expert, and consult the expert.

How Could Coordination be Provided to Improve the Contribution of Colleagues to Sustainability?

As a result of the analyzes, it was determined that the support of innovations by colleagues, which was identified as a significant variable, was important for sustainability and diffusion according to the teachers. Colleague collaboration allows for the rapid diffusion of the knowledge required for DLM development, allowing teachers to complement each other in areas that they are weak. It also improves the beliefs of the teachers that they could do, in other words, their self-efficacies. Teachers stated that they had confidence in their colleagues, that they could ask questions to each other without hesitation, and therefore they considered colleagues as an alternative that they could easily refer during DLM development.

T44: Especially working within groups is an advantage in reinforcing the points that are still missing or unrecognized after the training. Since the colleagues in the group constantly communicate with each other, they feel more in asking questions.

T59: Working together encourages the sharing of knowledge on DLM development.

T14: ...here, we ask each other easily, we learn more easily... We trust each other.

T1: So, while I help her (him) when she (he) has a problem, I learn about another topic that I do not know about. Because, I trust my group. Thus, we are very supportive of each other.

Furthermore, the teachers noted that collaboration with colleagues would save time and close the gap in material. According to teachers, another advantage of collaboration with colleagues was observation and experience of different and successful DLM developed by other teachers. Observing good examples would motivate the teachers on DLM development.

T28: When a teacher develops the material himself or if a nice homework is done by a student, we definitely tell each other we tell our colleagues to use it since it was very effective we could influence positively.

T32: In particular, our group leader encourages us to use technologies...

What kind of Opportunity Should be Provided for Teachers to Improve their Willingness and need to Develop Digital Instructional Material?

Other variables that were identified to contribute significantly to the model based on analysis results were the need and willingness to develop DLM. According to the teachers, a teacher who is willing to develop the DLM personally allocates the required time and maintains DLM development, even when the facilities were insufficient. If the teacher is not willing and there are external pressures, the teacher would develop DLM, however, the developed materials would be inelaborate. That is why teachers emphasized that personal willingness was important.

T2: it is individual because I do not think it would happen if you do not have it been though your institution forces you to do it but if you are willing, you can develop (it) even your institution does not provide help.

T10: People cannot improve unless they want to. It is absolutely individual. After all, when you come to the class you will be alone with your conscience for 40 minutes. No one can force you unless the teacher does not want.

According to teachers, along with the willingness variable, the need for material development was another crucial factor in appropriation of DLM development. To accomplish this, initially, the teachers should be aware of these technologies and recognize the outcomes, advantages and disadvantages of DLM development media and developed examples. That is why a teacher who wants to improve himself/herself about DLM should be open to innovations, curious and creative. Especially the teachers, who emphasized the importance of creativity, believed that teachers with a vivid imagination could develop better products.

T8: ...one needs to have a need for something, this is the basis of learning.

T51: It is very important to feel the need, if you would continue in this profession, independent of your age, your level of experience, you have to adapt to the requirements of the age if you would continue in this profession.

T16: First, you should be curious, you should investigate what you could do in this regard...

T21: First, one should have imagination and creativity, one should have imagination, so one could produce, create... I think the most important is imagination, creativity.

What is the Contribution of the Technological Infrastructure to the Process of the Development of Digital Instructional Material by Teachers?

One of the latent themes that teachers considered effective on DLM development was the technological infrastructure. According to teachers, a problem related to the technological infrastructure could make them abandon technology use, and they stated that a good technological infrastructure would encourage the development and sustenance of DLM, while a poor or inadequate infrastructure would adversely affect the motivation of teachers. Teachers considered instruction in an environment with a poor technological infrastructure as waste of time and emphasized that they would not hesitate to use the technology in a classroom with a good technical infrastructure, which would render technology use in the classroom a routine.

T1: With a computer that constantly jams and an internet that constantly disconnects, you can struggle until a certain point to create something...

T55: Even the ability to use the projection device in our schools, classrooms changed the mood and attitudes of all our teachers.

T52: If more technological opportunities like this are provided, as I said before, we can go back to our daily routine and needs, and we can apply it much more easily and quickly.

T60: I mean; it also reduces the motivation. For example, we arrive at a place to prepare something, we sit at the computer, then the internet is disconnected, we lose ten minutes

What are the Effects of Storage on the Continuation of the Development of Digital Instructional Material by Teachers?

Another latent theme that teachers noted as effective on the appropriation of DLM development was the storage facilities. According to the teachers, storage facilities technically facilitate their jobs and prevents the loss of time. It also sets the stage for the dissemination of good practices among teachers and encourages other teachers to develop DLM. Thanks to storage facilities, teachers could also observe their improvement by monitoring the materials they stored. Teachers were convinced that storage facilities would improve material sharing not only in their own group, but also among different groups.

T2: It would make our job incredibly simple technically. I do not know, I think it is something that grows as I share information. For example, if I share something like a common pool, if I share it, they would benefit from my material, I would benefit from theirs, it would be great I mean it would be more beneficial...

T22: I can certainly save time, it is a great convenience I can store and download it immediately.

T47: it would encourage me to see the materials developed by different teachers naturally! It would help me to look at it from different angles.

T3: ...we check it out who made what and synthesize, we come up with an idea.

Although the vast majority of teachers agreed that storage facilities was a requirement, it was observed that there were two different views about sharing their own material in storage facilities. Certain teachers indicated that they could share their material with everyone since the material were developed for education and students and should support the teachers with disadvantages, while others stated that there should be an institution-specific storage area where they could share their material only on these media.

T33: Of course. I mean, if I develop this, for example, I think that it would be OK for my friend to benefit from it.

T31: ...due to the prevailing conditions, everything could get out of hand as soon as you share... Maybe labor theft, anything could happen not that I would come up with wonderful things but as I said we would spend time even on that, this is valid for all of us, maybe for that reason I might not end up sharing it I do not know.

T19: ...I could create a password the teacher could not change it but use the way I use it.

T26: It would be nice if copyrights are granted... I would share after that guarantee is provided in the sense of respect for labor.

Teachers considered online storage facilities more functional since they are accessible from everywhere, provide freedom and store the material securely preventing the risk of loss. Teachers emphasized that the labeling in storage areas should also be conducted with a certain ontology, and that such an application would reduce complexity. According to the teachers, if the storage areas are considered on an institutional basis, the sustainability of the material is ensured and even when the school staff changes, an institutional storage area could facilitate access to the previous material and resources. For this purpose, it is necessary to appoint special individuals to administer these facilities.

T34: I think that internet storage is great because you can access and use it from anywhere easily. You can forget the hard disk somewhere but you can access your material everywhere if they are on the internet.
T37: Frankly, I would like (it) to be divided into categories, they should not be collected in one space, but (storing them) in different sections under folders would be comfortable. I would access whatever I want more easily.
T43: It is very important to divide into accurate categories, I think they could be divided based on groups. Then, topics can be established (under the groups) and structured as units.
T50: There should be a certain storage space. If tomorrow one day teachers and experts could leave the materials could remain. Because both the expert and the teacher are paid for it.

What Should be Done to Improve Teachers' Self-Efficacy in Digital Instructional Material Development and their Basic Computer Skills?

Self-efficacy and basic computer skills in DLM development, which were determined to be among the variables that contributed significantly to the model after the analyzes, were important variables for DLM development according to the teachers. Teachers considered that a teacher who wants to develop DLM should possess simple computer skills, internet and information search techniques. This would allow them to easily overcome computer problems and prevent loss of time. Teachers indicated that training and working with experts would be effective way to improve their computer knowledge and self-efficacy. According to teachers, training could raise awareness and clarify DLM development and allow teachers to acquire computer skills.

T8: I mean, there should be computer knowledge, if there is computer knowledge, one could access and develop certain things...
T31: I think that one must be very good at using the internet I think that one needs to know how to find something and what to find under where and what to search.
T16: Thanks to the seminars, we had an idea gained awareness... If I did not attend the seminar, I would not know the problem but now at least it would be useful or not but because of this.
T32: during the seminars we attended certain things; oh, it was so easy, we did not even realize that it is such a thing, we had laughed a lot among us.
T47: now I can comfortably develop. I can add certain things and get certain things out that is a great freedom for me.
T1: I gained confidence with the education, for the first time I felt like I could do it.

According to the teachers, the training could be instructed in small groups based on the fields or could be grouped based on computer knowledge. The main advantage of grouping based on fields was the idea that the training would be more functional and productive since the teaching fields have common areas of interest and needs. One of the most important reasons why the teachers requested that the training should be conducted during the seminar period was the fact that they are usually busy during the semester and could not spare time for professional development and the other reason was the fact that their workload is low during the seminar period and the idea that developing material and obtain concrete outputs using the newly acquired knowledge would be beneficial while preparing for the next semester. The training content should be structured based on the teacher views after the needs analysis and content customized for the needs and fields should be developed. This suggested that the training should be planned in a flexible manner based on the needs.

T4: ...For example, we can only instruct the software that can be developed in the mathematics course. It could be something like that, I think that the fields can be grouped and an environment with a high technical prowess could be created.

T8: Field by field... Mathematics has its own needs. FCB has its own needs. Foreign language has its own needs. I think like that.

T21: …One who knows nothing and one who does should not be in the same thing. One who knows would be bored and the one who does not would experience an incredible challenge since she (he) could not follow...

T6: In my opinion, a needs analysis should be conducted. Apart from the needs analysis, initially, whose knowledge is at which level what does one want to know and one's needs should be determined. Needs analysis should be conducted and a formation should be designed accordingly.

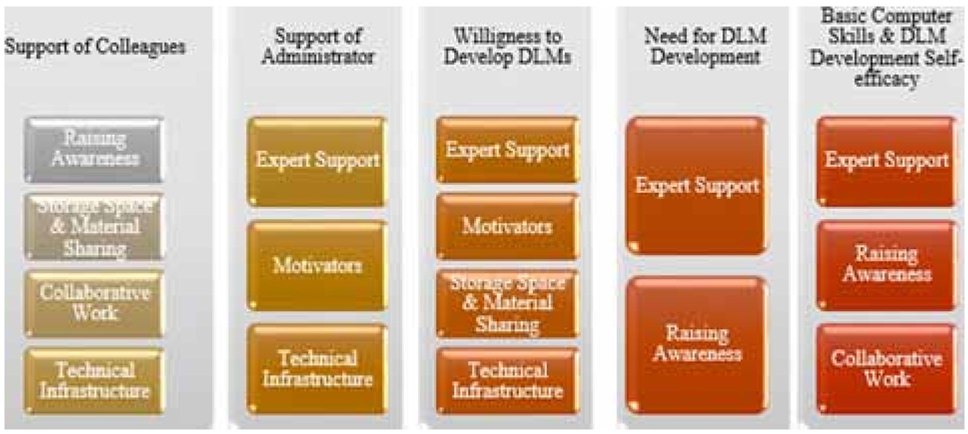
T36: It seems to be right to conduct the training during the seminar week… I do not have time to spare for it with the 27 hours (of instruction) during the year and I already completed my preparations.

T40: For example, in the seminar early in the year, preparations can be made for the topics that would be instructed in the preceding year. Seminar periods are more suitable for us. At the beginning of the year, for example, if one would instruct the second grade, materials for the second grade can be prepared.

Based on the Overall Study Data, how Should the DLM Development Ecosystem be Constructed for Teachers?

Overall, it was determined that the most important key variables in appropriation and sustainability of digital instructional material development were the support of the administrators, the support of colleagues, personal willingness, the perception of a need, self-efficacy and computer knowledge. Among the most frequently recurring themes under the administrative support variable were providing expert support, improving technical infrastructure, motivating teachers, and producing and supervising school policies. Among the most frequently recurring themes in colleague support were conducting collaborative work, raising awareness and sharing material; in willingness variable, the most frequently recurring themes were expert support, motivators, improvement of storage facilities and the infrastructure, and in the needs variable, the most frequently recurring themes were raising awareness, demonstration of the advantages and support of experts. Finally, in the variables of self-efficacy and computer knowledge, studies, seminars and collaborative work with experts were among the most recurring themes.

Figure 4. Matrix of Correlations Among Variables and Themes



Although the variables and the related themes were described separately, when the themes were analyzed based on the interviews, it was observed that some themes were correlated despite the fact that they were grouped under different variables. Thus, the matrix that includes the common themes based on all available data and their cluster under different variables is presented below (Figure 4).

When the Figure 4 is examined, it was observed that the theme of 'expert support' provided by administrators was also present under the variables of need, willingness, self-efficacy and computer knowledge. The presentation of motivators under the willingness variable was also under the support of the administrators' variable. In addition, the theme of 'storage space and material sharing' was present under both the variable of 'support of colleagues' and the variables of 'willingness to develop DLMs' variable..

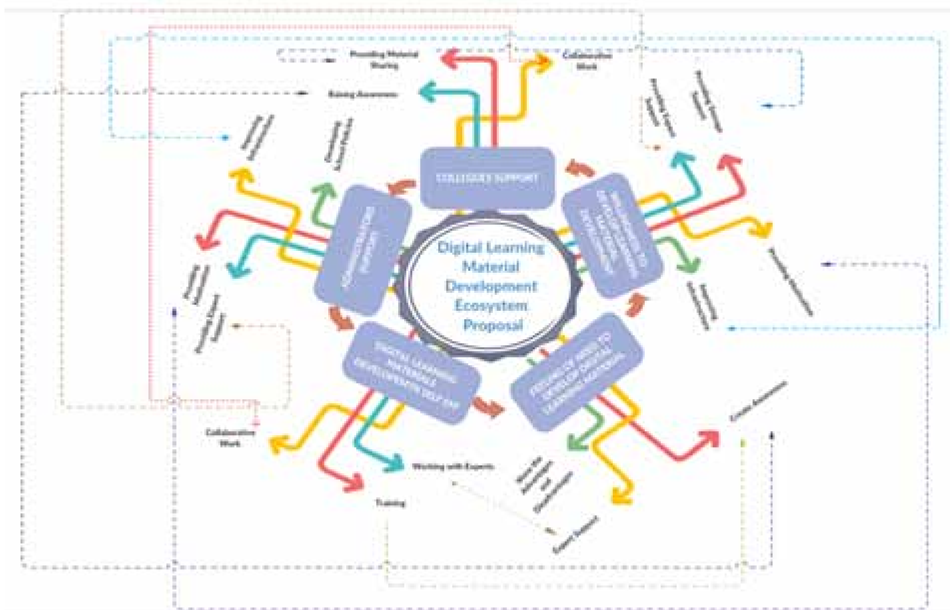
The digital instructional material development ecosystem for teachers based on the matrix presented above was constructed as demonstrated in Figure 5 below.

DISCUSSION

The study findings demonstrated that the variables that were determined to have an impact on the appropriation and sustenance of digital instructional material development by teachers were the support of administrators and colleagues, the willingness and the feeling of a need to develop DLM, computer knowledge and self-sufficiency for DLM development. When the variables were analyzed based on sustainability, it was observed that these variables could contribute to the economic, environmental and social dimensions, the three principal dimensions of sustainability.

According to the teachers, the administrators are quite important in the process of providing institutional support for DLM development. It was stated that administrators were particularly important in implementing open school policies, administration and maintenance of these policies, and controlling their applicability to each stakeholder. Literature review demonstrated that the vision that administrators would develop with a rational approach is important to maintain the change within the organization (Chang, Chin and Hsu, 2008; Tiwana, 2000). Open school policies could reduce complexity in diffusion of innovations and complement the social dimension of sustainability in DLM development process.

Figure 5. DLM Development Ecosystem Proposal



It was obvious in the interviews conducted with teachers that teachers desired to see administrators as active leaders in the DLM development process. In different studies in the literature, it was reported that school administrators play a key role as technology leaders in active technology use (Anderson and Dexter, 2005; Chang, 2012; Wu, 2009). The teachers considered these leadership roles as learning about and using innovations, raising awareness and presenting motivators that would lead teachers to these innovations. Similar to teacher statements, it was observed in the literature that the administrators should provide teachers the time necessary to implement the innovations (Ehrmann, 2010) and should provide guidance on the subject (Schrum and Levin, 2013).

It was observed that improvement of working conditions, financial support and expert support were among the motivators mentioned by the teachers. This also indicated that there was a need for specialists to assist teachers in DLM development at schools. Experts, who were considered as motivators by the teachers, could complement the economic and social dimensions of sustainability. Working with specialists could save teachers' time in producing quality material, raising awareness, and innovation diffusion. Furthermore, it can also facilitate the transfer of knowledge, reduce complexity and the economic burden of purchasing materials. Experts can break the resistance against technology in schools and pioneer the change (An and Reigeluth, 2011). In addition, the presence of the experts at schools could motivate teachers and increase the relative benefits by combining innovations with pedagogy and content. It was observed that similar studies in the literature supported this argument (see Crippen, 2005; Darling-Hammond, LaPointe, Meyerson, Orr and Cohen, 2007).

Another significant variable for the sustainability of DLM development was the colleagues. According to the teachers, the presence of individuals who can ask technology questions without hesitation and with confidence could prevent withdrawal and increase their motivation. Studies in the literature emphasize that teachers should be provided with environments where they could learn from each other and establish healthy communications (Eilers and Camacho, 2007). While collaboration among colleagues supports the social dimension of sustainability, it can also be argued that it could contribute to relative benefits, observability and reduction of complexity with respect to innovation diffusion. Furthermore, seeing and experiencing good DLM examples could clarify the process. Seeing successful examples produced by other teachers could provide an incentive for teachers to develop DLM. Because, in a study by Cerit (2009), it was emphasized that teachers transferred better examples they observed to their classes faster. According to the teachers, teachers should be willing and feel a need to in order to ensure the sustainability of the DLM development process. In fact, the relative benefit that was considered important in the diffusion innovation was reemphasized in this context. Similarly, in a study conducted by Uslu and Bumen (2012), it was observed that there was a direct correlation between the willingness of teachers and the integration of various technological innovations in classroom environments. According to the teachers, in order to increase their willingness to develop DLM, they first needed to be aware of DLM development media and to experience these. A teacher, who is not aware of DLM development media would not feel need and would not be willing to use it. According to the teachers, the status of the technological infrastructure in the classrooms was also among the variables that affected their willingness and need to use the DLM. Teachers indicated that presence of good equipment in the classroom would make the routine use of technology in the courses, otherwise the teacher would tend to withdraw from using technologies, which would remove the need for the DLM. Literature review that included studies on sustainability of technology demonstrated that the sustainability of the technological infrastructure at schools was an important dimension in technology use in the classroom environment (Beglau et al.,2011; Ertmer, 2005; Kopcha, 2012: Kusano et al., 2013).

Furthermore, the significance of storage facilities in improving teachers' willingness and need to develop DLM was also emphasized. Storage facilities could increase the visibility of material and reveal relative benefits and improve their observability. Teachers could be motivated by observing the products of other teachers and monitor their own development. It can also complement the economic and environmental dimensions of sustainability by preventing the waste of the material. Previous studies suggested that storage facilities were important in preventing the waste of teachers' labor (Benson, Farnsworth, Bahr, Lewis and Shaha, 2004; Donovan, Hartley and Strudler, 2007, cited by Miles, 2013). Teachers had two different views on storing materials in storage facilities. While certain teachers indicated that their materials could be open for all since they were developed for educational purposes, certain others stated that they did not want to store their material online except in an in-house storage facility due to the labor they spent and the fact that this would lead teachers to utilize ready-made material. It was determined in previous studies that other teachers had similar preferences as well (Cohen, Kalimi and Nachmias, 2013; Hilton, Lutz and Wiley, 2012). Furthermore, teachers noted the importance of online configuration of storage facilities and expressed the need for proper labeling based on the needs using an adequate ontology.

It was determined that the other variables that affected DLM development process were computer knowledge and self-efficacy perception about DLM development. According to the teachers, having a certain degree of computer knowledge would make it easier for them to develop DLM. When a problem is encountered during DLM development, the ability to cope with that problem would motivate them and prevent withdrawal. Previous studies demonstrated that the ability of teachers to integrate technology in their classrooms was proportional to their computer knowledge (Cullen and Green, 2011; Miles, 2013; Saad, 2012). In order to increase their computer knowledge and self-efficacy, the teachers recommended training sessions during seminar period and the semester. The training sessions organized for small groups, and structured with the required content would reduce complexity and increase the trialability of the process according to the teachers. Studies in the literature demonstrated that technology-based training would create a positive perception for technology use in the classroom (Levin and Wadmany, 2008), improve technology use skills (Young, Young and Hamilton, 2013) and save time (Lamb, 2011).

CONCLUSION

In conclusion, the ecosystem (Figure 5) was developed based on the innovation diffusion theory, the three dimensions of sustainability and innovations and constructed with the main variables of support of administrators, support of colleagues, personal willingness, the feeling of need, self-efficacy and computer knowledge. Future dissection studies could improve the themes indicated within the above-mentioned main variables. Furthermore, future studies could be conducted on employment of experts in schools, the employment details of this specialist, open policies that could be developed at schools for DLM development, increasing colleague collaboration, creating institutional storage facilities and the solutions obtained in these studies could be integrated with a broad perspective.

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Section 2
Digital Competences and Skills

Chapter 5
Data Science is Here:
Are We Ready to Benefit From the Opportunities It Provides?

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ABSTRACT

With the advent of big data, the search for respective data experts has become more intensive. This study aims to discuss data scientist skills and some topical issues that are related to data specialist profiles. A complex competence model has been deployed, dividing the skills into three groups: hard, soft, and analytical skills. The primary focus is on analytical thinking as one of the key competences of the successful data scientist taking into account the trans-discipline nature of data science. The chapter considers a new digital divide between the society and this small group of people that make sense out of the vast data and help the organization in informed decision making. As data science training needs to be business-oriented, the curricula of the Master's degree in Data Science is compared with the required knowledge and skills for recruitment.

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“Heads or tails, gentlemen?” said Swift.

—Isaac Asimov, *The Machine that Won the War,* 1961

INTRODUCTION

The recent evolution of information technologies reaches the point allowing different entities to accumulate “Big Data” as well as to offer tools to process such data in a manageable way. This offers great opportunities for deeper understanding of causes and effects, driving forces, influencing factors, and circumstances. But there are many challenges hindering the real benefit of exploring Big Data. About 60 years ago, the famous scientist and science-fiction novelist Isaac Asimov wrote a short story “The Machine that Won the War” pointing out the challenges we are facing now: the volume, variety, and velocity of data and the need of a huge computer – Multivac – to put all those data together, to optimize processing, and to predict outcomes. But the story pointed out many other problems as reliability of the supplied data, data processing algorithms, interpretation of results, and trust toward the results in making the final decisions. Now this science fiction vision is technological reality, but the challenges to benefit of those achievements are still the same: the many V‘s (Laney, 2012; Normandeau, 2013) associated with Big Data, the reliability of data, the bias in developing algorithms, the bias in interpreting results, and the most important – the trust in making decisions based on results acquired via this technology.

In the last decade we are witnessing an unprecedented explosion of organizations’ attention toward data and how to benefit from data. Understanding of the value of data, together with availability of technologies allowing to process huge amounts of data objects in a meaningful time-frame, resulted in appearing of a new scientific field – Data Science. Today, Data Science is one of the most-discussed in research and practices as many organizations are striving to use the data they possess or control in a way to improve effectiveness and efficiency of their operations (Kowalczyk and Buxmann, 2014), and to gain competitive advantages. In a nut shell the issue is whether society as whole, different entities – commercial or public, and individual citizens are ready to benefit of the opportunities provided. What are the obstacles, success factors, and how to address the Big Data challenges?

Currently Big Data is defined by expanding Gartner’s original **3V** definition *“BD is high **volume**, high **velocity**, and/or high **variety** information assets that require new forms of processing to enable enhanced decision making, insight discovery and process optimization (Laney, 2012*).” by adding more **V**s as **Veracity** – the biases, noise and abnormality in data; **Validity** – whether the data are correct and accurate for the intended use; **Volatility** – how long is data valid and how long should it be stored; etc. (Normandeau, 2013) BD definition must also address the ability to explore data of a given amount and complexity by given IT – “a set of data objects represents BD if it is close to the upper bound of the volume and complexity of data that a human can manage to manipulate for purpose with the aid of available information technology” (Christozov and Toleva-Stoimenova, 2015). This definition addresses also human ability to learn via use of technology and also allows expanding further with appearing new dimensions of what represent “complexity”.

The information technologies nowadays allow registering and storing practically all facts associated to any event happen within the scope of an entity in searchable repositories. This naturally leads to accumulation of a huge volume of heterogenic data, known as “Big Data”. In many cases, this kind of storages are designed in a way to support efficient retrieval, but they do not support extracting useful patterns and relations – learning – in the needed level of convenience. In order to gain knowledge from the accumulated complex and complicated data a special class of computer applications are emerging marked with terms as data mining, machine learning, business intelligence. This in turn limits the number of people who have the necessary expertise to take advantage of these opportunities (see Christozov and Rasheva-Yordanova (2017); Christozov and Toleva-Stoimenova (2015)). Thus, the Big Data phenomenon imposes a new social divide between those capable of benefiting from Big Data ("Big Data Elite") and those relying on intermediaries in order to "study" data. This new divide adds new aspects to the already existing in society digital divide. These elite are capable of combining and applying expertise and diverse competences associated with multiple disciplines.

The opportunities and challenges of technological evolution create many issues which need addressing:

- What competences an individual, either an individual or an institution, needs in a way to benefit from those opportunities?
- What is the social impact of lacking those competences? What is the social price of "Data Science Divide" as the next round of the well-known phenomenon of Digital Divide?
- What are the effect on overall economy, industries, job market, and the way people are working? What to expect in the near, visible future? And how to prepare ourselves to this future?
- Whether society and especially education industry is ready to address those challenges in training students to this future and especially the risks associated with the emerging global connectivity, data availability, and, of course, the side effects of democratizing information creation, sharing, and accessing?

This list can be continued further.

The chapter tries to address some of the issues related to readiness of educational industry to the Era of Big Data. In the background section, by reviewing literature, the key competences associated with Data Science are identified. Analytical reasoning was identified as the key integrating component of the profile of a successful Data Scientist. The understanding, that Data Science is a trans-discipline, an umbrella area, synergized by expertise generated by multiple disciplines, is justified as well. The main focus of the chapter is on sharing results of conducted research on the way universities in Bulgaria address the demand and challenges of Data Science. This allows instilling guiding principles in designing curriculum to train professionals, on master level, suitable to move forward effectiveness of exploring data. Discussion is dedicated to approaches in adjusting university education curricula to offer adequate training under high uncertainty about the evolution of job market demand in the next few decades.

BACKGROUND

Rational, data driven behaviour is assumed to be the fundamental for success nowadays. It requires learning from past experience, understanding cause-and-effect relationships, creating, and retaining obtained knowledge. The two aspects, necessity and possibility, of explore Big Data represent the major challenge faced by the business nowadays. This results in a constant growth of demand for qualified data professionals, but also in various, not clearly defined, and continuously expand expectations regarding their knowledge and skills.

The "learning from data" process itself also includes activities of diverse nature, and needed diverse expertise, including technological, mathematical, organizational, statistical, and, of course, the data domain and context knowledge. Exploring Big Data can respond to challenges of the day and to help suggesting effective evidence-based solutions. It provides opportunity to convert complex, often unstructured data into relevant information as a strategic resource (Daniel, 2015).

The role of Data Scientist is to create products from the available data, that instils their value (Loukides, 2010), but also to add value via own expertise. Data Scientist's competences are transdisciplinary in nature, creating value via synergy of multiple knowledge areas (Lotrecchiano and Misra (2018);) Such specialists rely heavily on the scientific methodology for systematically approaching problems and need research experience.

Mikalef at al.(2018) note that data skills are perhaps the most sought-after resource in companies that have BD, as the skills captured by the scientists' profile allow companies to ask the right questions and convert data into practical insights. They conclude that software, infrastructure and data are insufficient to provide value if personal skills and knowledge are not available to instil knowledge from data. The set of competences needed in BD Era are summarised next.

Literature Review of Data Scientist's Competences

Table 1 summarizes the requirements and therefore the competences a data scientist need to possess.

Although in many cases when evaluating essential Data Scientist's competencies, the focus is on technical skills, working with data requires the mastery of a variety of skills and abilities. In fact, a combination of analytical, statistical, algorithmic, engineering, and technical skills have to be possessed to mine relevant data by involving contextual information.

Data Science Competences: A Synergy of Diverse Expertise

Different views on composition of competences of a Data Science professional is presented in Figure 1 as Venn Diagrams.

Figure 1 shows the scientific fields contribution in composing Data Science expertise.

Clearly, Data Scientist is a professional with many qualifications. The expectation that a single individual would be capable of conducting such many roles is unrealistic in most practical cases. That is why Geringer (2014) call the Data Scientist "a unicorn." Some authors believe that Data Science is "a team sport." If there are many individuals, they can get excellent results quickly by good communication. According to Gartner (2012) a Data Science team consist of Digital Archivist, Information Manager, Data and Information Visualization Designers, Legal IT Professional, Data/Information Steward. To this list a Social Scientist have to be added, as suggested by Samuel Greengard (2014). Some authors claim that a Data Scientist doesn't need domain expertise, but Data Scientist needs to ask the right questions, to be curious and have analytical and critical thinking in the domain context.

The composition of competences as presented on Figure 1 clearly identifies Data Science as a trans-discipline area. The term "Data Science" appears recently to mark all activities related to managing Big Data and learning, discovering, and creating new knowledge from data. Scientists are exposed to leave the boundaries of the narrow discipline and to adopt methodologies allowing holistic view on complex problems, by heavy dependence on computers to process data. Inter/multi/trans disciplinary research is becoming a common practice. Data Science is a typical example of a trans-discipline, synergized by different scientific approaches, practices and discovery methods. The term "trans-discipline" was firstly introduced by Piaget (1972) as "higher stage of succeeding interdisciplinary relationships…which would

Table 1. Definitions of Data Scientist

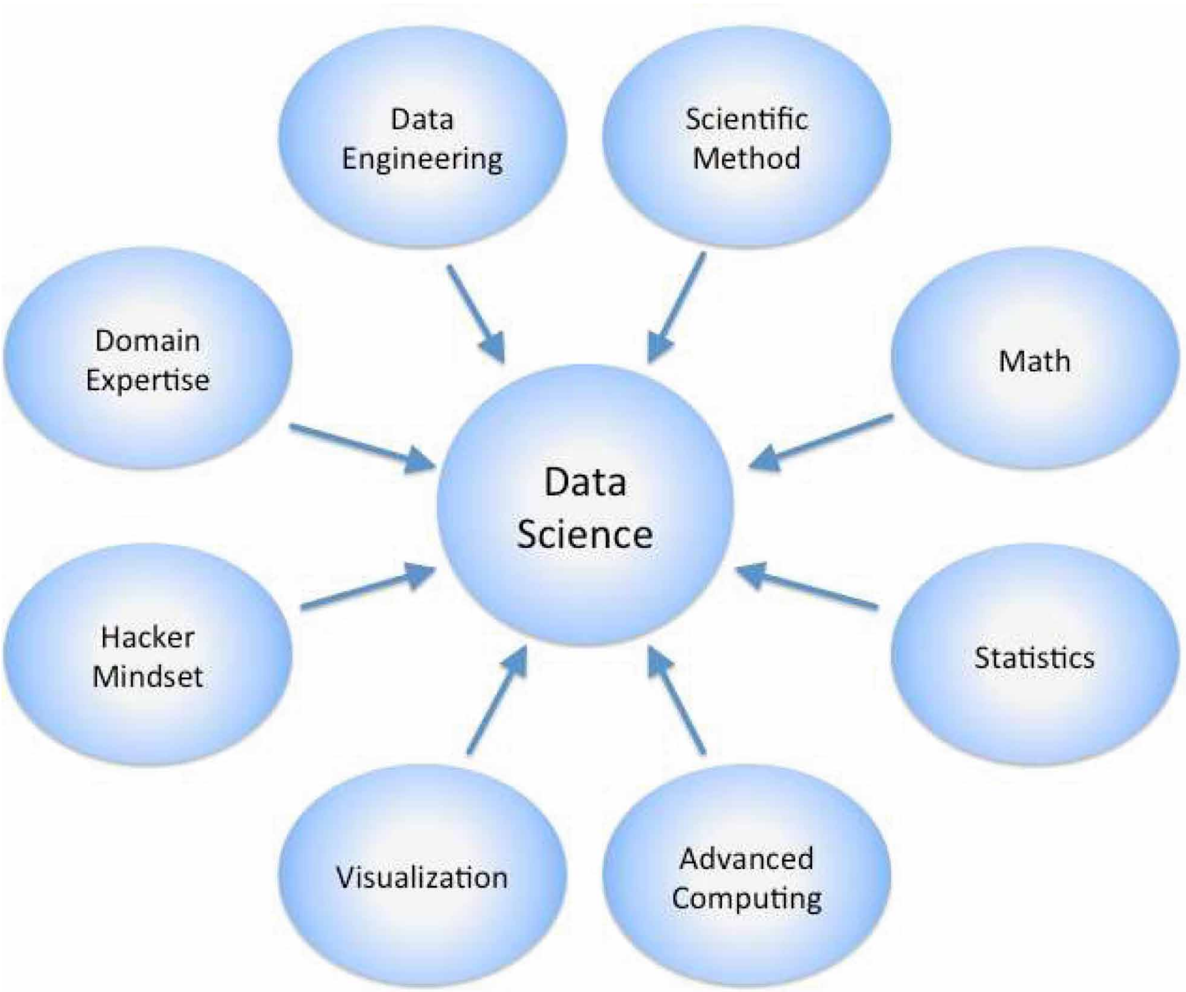
Author	Definition
Davenport and Patil (2012)	understand how to fish out answers to important business questions from today's tsunami of unstructured information
Dhar (2013)	requires an integrated skill set spanning mathematics, machine learning, artificial intelligence, statistics, databases, and optimization, along with a deep understanding of the craft of problem formulation to engineer effective solutions
van der Aalst (2014)	an engineer that has quantitative and technical skills, is creative and communicative, and is able to realize end-to-end solutions
Cao (2014)	learn from heterogeneous sources and inputs, parallel and distributed inputs, and their infinite dynamics in real time; support on-the-fly active and adaptive learning of large data volumes in computational resource-poor environments (such as embedded sensors), as well as multisource learning, while considering the relations and interactions between sensors; enable combined learning across multiple learning objectives, sources, feature sets, analytical methods, frameworks, and outcomes; learn non-IID data-mixing coupling relationships with heterogeneity; and ensure transparency and certainty of learning models and outcomes.
Ayankoya et al. (2014)	a combination of three basic areas: computer science, statistics and domain knowledge.
Granville (2014)	Not statisticians, nor data analysts, nor computer scientists, nor software engineers, nor business analysts. They have some knowledge in each of these areas but also some outside of these areas.
Manieri et al. (2015)	an expert with the ability to manipulate and retrieve knowledge and turn it into significant value.
Sicular (2015)	a widely-applied specialist within a variety of organizations; therefore it's difficult to provide a complete and consistent list of required skills, but points to mandatory data storage, data analysis, data conversion and communication skills.
Costa and Santos (2017a,b)	the knowledge base expected from a Data Scientist goes beyond the skills of a computer scientist, or a statistician, or even the coupling between these two. ….in order to communicate Data Scientist findings and integrate the results into data artefacts deployed in business environments, Data Scientists must have strong social and personal capabilities, like communication, business acumen and curiosity.
Bharadwaj (2000)	to IT skills is a critical resource for building measurable business value, but nowadays the combination of technical with soft skills is recognized as the most valuable for organizational knowledge management
Wamba et al, (2017)	traces its roots in the socio-technical framework
Schoenherr and Speier-Pero, (2015).	ability to generate vision that guides organizational decisions
De Veaux et al., (2016)	To summarize, the recursive data cycle of obtaining, wrangling, curating, managing and processing data, exploring data, defining questions, performing analyses and communicating

not cover interactions or reciprocities between specialized research projects, but would place these relationships within a total system without any firm boundaries between disciplines". Currently the term is used as an applied model of problem solving emphasizing the need of trans-discipline to understand the complexity of reality.

Multy-, Inter-, and Trans-Disciplines' Teams (or Research)

Multidisciplinary teams involve individuals from two or more disciplines working together on a common problem. Each participant brings own theories, methods, and techniques and provides insights within the

Figure 1. Data Science Venn Diagrams



confines of their own discipline. Multidisciplinary teams incorporate multiple perspectives to understand or address a problem to put forth new techniques or models, to modify mainstream approaches, or to construct new frameworks.

In both cases (multi- and interdisciplinary teams), a new level of discourse does emerge which ultimately leads to a further integration of knowledge While multidisciplinary and interdisciplinary teams focus on exchange between disciplines, transdisciplinary knowledge producing teams work across disciplines and non-disciplinary knowledge systems engaging in participatory knowledge-creation across epistemic and methodological boundaries (Lotrecchiano and Misra (2018);). Maasen and Lieven (2006) describe transdisciplinarity as a new mode of governing science where "…practices are directed toward solving complex policy issues and address scientific knowledge production proper. It promises to circumvent the schism between scientific expertise and policy-making by… the involvement of stakeholders [that] make sure the 'right problem' gets addressed 'in the right way". Transdisciplinarity, therefore, moves us from a consideration of science as bound by disciplines and gravitates to a more holistic and systemic schema that considers the dynamics of entire systems of actors and concepts Maasen and Lieven (2006) characterize TDKPTs as "extending expertise", and "legitimation through participation" rather than "legitimation through knowledge".

Because of its transdiscipline nature, communication skills and team spirit are essential for professionals in the field of Data Science.

Technical skills combined with soft skills in the presence of analytical thinking and analysis skills form the general framework of competencies essential for a data professional.

The following dependencies are noticed:

- The presence of hard skills is a basis for data retrieval and formation of new knowledge.
- Without the availability of analytic skills, the retrieved data is merely converted data that has no informational value and cannot acquire knowledge useful for developing business strategy.
- Knowing the business plan and the main directions of the company's development are an important prerequisite for implementing the right algorithm for data research and for achieving the desired results.

In the next section is made an attempt to identify the key competences associated with Data Scence.

FRAMEWORK OF DATA SCIENTIST'S PROFILE

The framework of knowledge, skills and competences that shape the Data Scientist's profile has evolved over the years. Numerous authors define it by distinguishing this profession from other professions such as Data analyst (Perumal, 2015), IT specialist, Information broker (Rasheva-Yordanova et al., 2018). Another part of the researchers concentrate their efforts on defining the scope of competencies that build the profile of the modern data specialist.

(Dhar, 2013) emphasizes that machine learning (ML) is the most important skill and necessary for all data scientists. Data Scientist also requires knowledge in text mining, markup languages, mathematics, and artificial intelligence. A Data Scientist metromap was created in Chandrasekaran (2013). It covers 10 areas/domains: Fundamentals, Statistics, Programming, ML, Text Mining/NLP, Data Visualization, BD, Data Ingestion, Data Minging, and Toolbox. Each area is represented as a "metro line," with the stations depicting the topics to be learned and understood in a progressive fashion. Core DS competences/skills groups defining profile of the DS according to EDISON (2017) are:

- DS Analytics (Statistical Analysis, ML, Data Mining, Business Analytics,etc.)
- DS Engineering (Software and Applications Engineering, Data Warehousing, Big Data Infrastructure and Tools, etc.)
- Domain Knowledge and Expertise (Subject/Scientific domain related)
- Additional common competence groups demanded by organisations
- Data Management and Governance (including data stewardship, curation, and preservation)
- Research Methods for research related professions and Business Process Management for business related professions.

Chatfield et al. (2014) identified six attributes required for a Data Scientist:

- Entrepreneurship and business domain knowledge,
- Computer scientist,
- Effective Communication skills,
- Create valuable and actionable insights,
- Inquisitive and curious, and
- Statistics and modeling.

Furthermore, they categorized these attributes into three categories:

- 1,2 and 3 form personal attributes which a data scientist brings to the organization as a person;
- 4 and 5 are analytical and technical attributes required to perform expected roles of a data scientist in the organization;
- 6 is a combination of diverse attributes required by a data scientist to produce desired outcomes that creates value to the organization.

Burtch (2014) emphasizes technical (incl. Analytics, SAS, R, Python, Coding, Hadoop, SQL, and Database), as well as non-technical skills (such as Intellectual curiosity, business acumen, and communication skills). Ismail (2016) reduces the Data Scientist's skills to: business, statistics, machine studies, communications and analysis.

In summary a Data Scientist is expected to possess 3 generic skills' categories.

- hard skills;
- soft skills;
- analytical skills.

The hard skills cover foundational and technical skills and represent ability to perform a certain type of task or activity e.g. mathematics and statistics, programming, machine learning, etc. Soft skills are non-technical skills, personal attributes, that enhance an individual's interactions and his/her job performance, such as storytelling, collaboration and teamwork, knowledge regarding organizational behaviour and driving processes communication and ethics skills, etc. Analytical skills include abilities to ask the right questions, good data intuition, curiosity, critical thinking, reasoning (both deductive and inductive), problem solving. Analytical skills represent the cross-point of all other hard and soft skills in data processing, especially in the BD context.

In the Table 2 are summarized key hard, soft, and analytic skills and competences, which compose the framework for Data Scientist's profile. The three categories of skills are considered as mutually dependent. In other words, the skills of one of the categories complement or are the basis for the successful accomplishment of a task requiring skills of the other categories. This creates the necessity of close cooperation of professionals holding dominating expertize in different categories.

The combination of abilities to think analytically, creatively, critically, and inquisitively are the core of Data Scientist's skills. Or data analytics is the keystone of DS.

Table 2. Framework for Data Scientist's Profile – tasks, skills and competences

	Soft skills	Hard skills	Analytic skills
Tasks	Create and sell stories based on data, verbally and visually	• integrate heterogeneous; data from multiple sources; • assure data quality; • build statistical models; • compute similarity; • create data; products/platforms; • data visualizations.	• identify rich data sources • use and analyse data • draw causal conclusions engineer effective solutions • find answers to important business questions • improve decision-making • analyse expected value • suggest new business directions • think data analytically
Skills	• intellectual curiosity • business acumen • communication skills • entrepreneurship	• Computer science; • Artificial intelligence; • Automated analysis of data; • Statistics; • BD; • Databases; • Machine Learning; • Mathematics; • Networking • Programming; • Cloud computing; • Distributed computing; • Data processing; • Data ingestion; • Data mining; • Data preparation;	• academic research; • formulation of hypotheses; • transdisciplinarity; • scientific method; • data analysis design and interpretation; • data visualization; • data warehouses
Competences	• understand the basic business objectives and strategies, • understand stakeholders and support decision-making; • communicate and disseminate the findings	• statistical processing to apply in designing and interpreting experiments, modelling and forecasting. • create data artefacts or optimize existing ones.	• know methods of data analysis that automate the construction of analytical models; • improve business management and achievements by enhancing decision-making.

Analytical Competences as the key DS Competence

During the last decades, in the area of data analytics, we have witnessed the transition from using small data sets and hypothesis driven processing toward using huge data sets and hypothesis free knowledge discovery. This can help identifying critical issues, and improve decision-making . Analytical discoveries can lead to more effective marketing, new revenue opportunities, better customer service, improved operational efficiency, gain competitive advantages, and other business benefits. Generally, the main purpose of large data analyses is to help companies make better-informed business decisions (Begum et al., 2017).

Data analytics form a comprehensive map that covers:

- the whole lifecycle of the data from the past to the present toward the future,
- transition from explicit (known) analytics and reactive understanding to implicit(unknown) analytics and proactive early prediction and intervention, and
- from data exploration (by descriptive and predictive analytics) toward delivery of actionable insights and decisions through prescriptive analytics and actionable knowledge delivery (Cao, 2017)

Shum et al. (2013) stated that DS is the extraction of useful knowledge from data to solve business problems that can be systematically treated following a process with relatively well-defined stages. The results of the scientific data require careful consideration of the context in which they will be used in the relationship between the business problem and the analysis decision. The available means of analysis can be used to find informative data elements within the BD.

Rabhi at al. (2018) consider large data analyses as a process of extracting meaning from BD by using specialized software systems. Theyadded that analysts can use data to generate value. Data scientists may have access to raw data, convert them and conduct analyses to understand the data that is useful to institutions in making decisions.

Data analysis requires a complex process and includes several steps such as business understanding, data collection, cleaning and pre-processing, integration, pattern recognition, analysis and interpretation of results.

From one side, data analysis is one of the major components of DS activities. From the other side, analytical competences are identified as the required common skill to form a team able to propose innovative solutions to problems in the context of BD. In that way, professionals lacking proper analytical training and/or capacity will be difficult to contribute in a trans-discipline DS team.

All these place competences of "Analytical Inquiry" as the key for a successful Data Scientist, but also as the cross-point to build a DS team with members holding different background expertise.

In a nut shell the analytical skills include abilities to (Christozov et al., 2018):

- Identify and assess the problems;
- Assess whether the problem is decomposable;
- Assess whether s/he is able to solve the problem OR only parts of it;
- Assess what is relevant information;
- Locates information sources and apply techniques to evaluate available information resources – to assess their quality and credibility (correctness, trustfulness, completeness, precision, comprehension, consistency, timeliness);
- Judge whether the information obtained is relevant to the problem, consistent and useful;
- Synthesizes solution to the problem by applying formal reasoning, rational, logically coherent, and data/information driven technique as mathematical or statistical methods;
- Assess how applicable is the solution derived;

The above skills are in two categories. The first one includes all analytical skills dependent on hard skills – ability to apply mathematics, statistics, and IT. The other (soft) includes (a) the ability to build logical chains; (b) the ability to set priorities; (c) a clear statement of thoughts and a sequence of conclusions; or the group of non-technical analytical skills consists of critical and logical thinking. Different aspects are closely related.

Table 3. Knowledge base in seeking to employ a Data Scientist

Education	Hard skills	Soft skills	Analytical skills
BSc in Statistics, Applied mathematics, Computer science or related field. **Master's degree** in Statistics, Mathematics, Computer Science or related field **Ph.D.** in Statistics, Mathematics, Computer Science or another quantitative field	**Scripting language** (Python, R) **Objective oriented programming language** (Scala, Python, Java, C++) **Databases** **BD frameworks** (Hive, Spark, Hadoop) **Statistics** (SPSS, SAS); **Machine learning techniques** (clustering, decision tree learning, artificial NN, etc.) **Statistical techniques and concepts** (regression, properties of distributions, statistical tests, and proper usage, etc.)	**Communication skills** - ability to translate technical language to a non-technical audience. **Organizational and leadership skills** - self-motivated, organized	**Creatively thinking** **Analytical and problem solving skills**

SOCIAL DEMAND AND READINESS OF EDUCATIONAL INDUSTRY IN BULGARIA TO RESPOND

The McKinsey Global Institute claims that the U.S. economy could be short as many as 250,000 Data Scientists by 2024. According to a LinkedIn (Columbus, 2018) report on the extent of demand for newly emerging job vacancies in the USA in 2017, Data Scientist comes second among 20 professions right after Machine Learning Engineer. According to the same survey for the period 2012-2017, there is an unprecedented increase in demand for Data Scientists. Data shows that interest in Data Sscience grew nearly 6.5 times within the survey period.

Tendency indicates a deepening of the problem. Data Scientist demand will not only continue to grow but according to Davenport and Patil (2012), Data Scientist is expected to be the most sought-after professional in the industry in the years to come. Projections regarding job market (Markow W., S. Braganza et al, 2017) show grow of about 28% of new positions for such professionals in next 2 years.

The aim of this section is to address the emerging problem of lack of Data Scientists and to examine the difference between business needs and what education in Bulgaria offers by the middle of 2018.

Big Data Divide: Next Round of Digital Divide

In order to define the sought-after knowledge and experience in the job of a Data Scientist the job advertisements offered on one of the most popular search and employment sites in Bulgaria - jobs.bg were reviewed. Nearly 100% of Data Scientist search listings are published by international companies operating on the Bulgarian market and abroad. The candidates must, after obtaining the below listed qualifications in Table 3 have acquired between 2-4 years' experience. The analysis of the required knowledge and skills was based on the three-dimensional model "hard skills-soft skills-analytical skills", as suggested by Rasheva-Yordanova et al. (2018). The summery is presented in Table 3.

Considering the education and qualification factors, businesses require the Data Scientist candidate to hold at least a BA degree (about 24% of job listings). The most common condition for the same indicator was the possession of an MA degree (62%), and the most rarely stated requirement is that the Data

Scientist should have a PhD (only 14%). What brings together all the ads by the "education" indicator is the specialty: all employers require the candidate to be a specialist in Statistics, Mathematics, Computer Science or related field. As far as the hard skills factor is concerned, demand limits the scope of Data Scientist most often to scripting language, objective oriented programming language, BD frameworks, statistics, ML techniques, statistical techniques and concepts. In their advertisements, the possible employers seek soft skills like communication, organizational and leadership skills.

In order to complement the general framework presented by our available job offers, we believe it is necessary to review the most popular software in the field of DS. According to a survey by KDnuggets (2016) the popularity of some tools increases proportionally, while others have seen a sharp decline. The picture presented in this study can tell us what the trends will be in the next few years and what tools should be put in the training courses for Data Scientists. The survey confirms that the most sought-after hard skills in the past few years are Python, R and SQL, which are currently part of the hard skills list.

Key factors for the increased demand for Data Scientist are, on the one hand, the availability of BD that is too large and complex for processes using traditional storage and analysis technologies. (Debortoli et al., 2014) On the other hand, managers have an understanding that the knowledge gained from the accumulated data has a strategic importance for the development of the organization they represent.

It is a fact that organizations use their data to improve the efficiency and effectiveness of its operations (Kowalczyk and Buxmann, 2014). Providing human capital with high analytical skills for working with BD allows for more efficient and effective solutions and undoubtedly increases the overall performance of organizations. Despite the great potential of new technologies, tools and applications for analysis, the biggest problems faced by practitioners in using these technologies are finding employees with the necessary skills (LaValle et al., 2011; Mikalef et al. 2018)

Nowadays we speak of the existence of a new digital divide between those who meet the indicators demanded by the business sector and those who do not meet the full range of the requirements. Although many universities and academies offer training courses and master programs for the training of Data Scientists, there is a shortage of these specialists on the labor market today. Moreover, against the backdrop of the great demand for specialists with the necessary expertise in Data Science and despite the production of new experts from universities, there is now a gap between demand and supply. It turns out that fewer specialists fully meet the demands of the business. As a result, digital divide is at the level of skills, knowledge, qualifications and experience. (Rasheva-Yordanova et al., 2018).

This gives a reason to believe in the discovery of a new form of digital divide, manifested at different levels within and outside organizations. We disclose three cases of the DS divide:

- a division between firms that have human capital with better analytical skills and those that do not have it;
- IT specialists who can learn from BD and others who can only manage, modify, and read data;
- citizens who apply analytical skills and can handle BD drawing useful information and those who need a mediator to take advantage of the large data and are exposed to the risk of misinforming, because the the mediators do not possess the same domain knowledge.

The DS divide can be overcome in making the right choice of human capital. The serious problem here is the lack of trained specialists holding this expertise. This opens up new questions related to the training of data professionals. DS training needs to be business-oriented. This will increase the quality of the staff on the one hand, and on the other – increase the company's productivity.

The State of Data Science Related Training in Bulgarian Higher Education

Two issues need considering in assessing how Bulgarian higher education industry responds to market demand: current education is based on studying in deep, but narrow disciplines; and trends in developed countries show that the young generation is withdrawing from studying topics related to data analysis such as mathematics and statistics. These generations rely on mediators – either human information brokers or computer applications as data mining tools – in coping with BD, usually without the necessary understanding of the limitations of application of the tools and the level of relevance of the results to the essence of the problem. This way of researching Big Data does not generate adequate knowledge about objects and events described by the data. Only a certain elite will be able to take full advantage of the accumulated data, understand the cause-effect relationships in the processes.

The shortage of Data Science training will lead to a crisis in the labor market caused by high demand and low supply of specialists with the necessary competences. This will respectively have an adverse effect on the economy.

Based on the analysis presented in the previous section, one of the most frequent requirements for candidates is to have a Master degree in corresponding fields. As result, the analysis include both qualification courses and university Master programs that train Data Science related comptences.

The following summarize findings:

- Qualification courses in Data Science related fields have a total duration of less than 2 months of intensive training. The courses include concepts and tools that are used throughout the data collection and processing: from asking the right questions to publishing a result. The form of training as well as the short-term and non-deeper plunge into the problem area, along with the access to the subjective assessment of one or mostly two lecturers is the main shortcomings of those courses. In this way the training focus is on hard skills, undermining the rest of identified needed competences – analytical and soft skills.
- The length of training in a Master degree program in Data Science varies between 2 and 3 semesters (about a year, a year and a half). The curriculum covers a number of courses, some of which are purely theoretical, and others are beyond the scope of the professional profile of Data Scientist. Majority of programs emphasize the available resources within the institution offering the program, mostly instructors' expertise. Additionally the form of training is mostly "knowledge transfer", and as a rule undermined developing soft and analytical skills.

The two types of training are compared in Table 4 according to the three-component competence model "hard - soft – analytical" skills.

The content of different programs is summarized in Table 5:

As can be seen qualification courses cover about 40% of the core hard skills shaping the professional profile of the Data Scientist. Master programs cover larger percentage of basic hard skills (about 60%). With regard to the other two types of skills, soft skills and analytical skills, it is clear that neither of the two types meets the expectation of the labor market.

Table 4. Knowledge and skills included in the DS training programs in Bulgaria

Course type	Hard skills	Soft skills	Analytical skills	Other
Qualification courses (QC)	**Statistical techniques and concepts** Data acquisition **Data tidying and cleaning** Data visualization, Reading spatial data, Databases, SQL databases	**Organizational skills** Organizing research	**Analytical and problem solving skills** Analytical graphs, Exploratory data analysis	EDA and processing
Masters programs (MA)	**Programming, Data Mining, Algorithms, Machine Learning**, **Data Quality,** Database Systems		Data Analytics Methods, Social Network Analysis	Semantic Data, Information Management, Information Management, Systems, Cryptography, High Performance Scientific Computing, Security, Neuroscience, NLP

Table 5. Knowledge supply analysis

	Hard Skills					Soft Skills	
	Scripting language	Programming language	Databases	Statistics	Machine Learning	Communication skills	Organizational and leadership skills
QC	No	No	Yes	Yes	No	No	Yes
MA	No	Yes	Yes	No	Yes	No	No

Discussion on Curriculum Design

Two issues need to address in designing curriculum – expectations of the market, and existing competition. The first issue defines the scope and content, the second – attractiveness of the program. The study of the Bulgarian case, as presented above, shows significant deficit in the both aspects. Traditional education lack experience in training skills by emphasizing knowledge transfer, and market expectation is not well and fully defined. Dynamics in development of the field is accelerating, the speed of growing the volume and complexity of stored data grows unprecedentedly, and the market pressure to utilize data is becoming more severe. The rapid change of market expectations and required content challenges the educational industry, which in principle is conservative with relatively long time horizon of decision making. Looking on curriculum design from this point of view identifies those issues which are relatively stable in the context of those changes – soft and analytical skills. Hard skills are more influenced on rapid changes of available technologies and markets.

Aspects need addressing in designing curriculum of a Master Program in the area of Data Science:

- Content of the program: The program has to cover the three areas of competences by emphasizing developing of skills. In the area of hard skills critical is learning skills – ability to learn how to explore emerging new technologies. In soft skills the stress is on communication – developing skills to communicate effectively with diverse categories of peoples, with diverse background. Developing analytical skills emphasizes holistic approach in problem solving.

- Composition of audience: To achieve the objectives of the program, the audience has to include students with different background, having as diverse as possible bachelor's degree. As minimal, the cohort needs to have students with bachelor in areas of science or technology, social science, and humanity.
- Pedagogy: The pedagogy requires to overcome several challenges – deserted from knowledge transfer toward training competences; working with students with diverse background makes impossible to apply equal criteria in assessing and grading; stressing on collaboration between students challenges assessing individual's contributions.

The objectives of the program require completely new education paradigm. Composing audience is the major challenge. The program needs diverse background of students as the success factor in developing mutual understanding and building abilities to explain ideas in acceptable way, but students with no quantitative background are usually scared to apply and to study technology oriented subjects. From other side market conditions works in supporting decisions to obtained degree which will help to join the IT industry.

Curriculum Recommendations

Training hard skills in audience with diverse background – using computer technology for data analytics needs competences on three different levels:

- Black-box approach, suitable for students with no or limited computer science and math background. Training requires that students are able to import data prepared in different formats, by using different applications as spreadsheets or databases, into given data analytics tool (as RapidMiner or Weka); to find how to use specific technique; and most important how to interpret results in the data domain context. Understanding data, problem domain, context, how data are collected, how comprehensive is data sample is essential. This level is suitable for all students including those with no technical or math background.
- Understanding the analytical methods, their limitations are essential to conclude whether given technique is applicable to given problem and data availability. To build such competences students need significant mathematics and statistics in their background. Social sciences usually include such training in their bachelor programs. This level of competence is also suitable for students with natural science background, who have limited computer science experience. Selecting the right data analysis method for given problem is the role of professionals reaching this level of competences.
- The third level requires expertise in developing algorithms and software to execute in efficient way data analysis in the case of Big Data. Selecting efficient data analytic technique or developing such a technique is among the objectives of professionals reached this level.

Students in Data Science Master Program have to develop hard skills, but may reach different level of competence depending on their background. All students have to be capable to understand data, data domain and to interpret results; some of the students may understand and explore the analytical methods constraints; and few will be able to address problems from performance point of view.

Developing Soft skills requires forcing students to communicate effectively in a heterogeneous team. In general, those skills are marked as "communication skills". The majority of institutions stress the active side of communication, literally efficient writing and presenting, undermining its passive aspects – listening, hearing and understanding, according to Christozov & Toleva-Stoimenova (2015) the passive role of communication is essential. The ability to hear and understand the ideas expressed by different members of the team, with different backgrounds, using different jargon, different logic, and emphasizing different reasons, is becoming one of the key success factor of efficient work of a data science team. From pedagogical point of view, this means that the class has to be split in teams by applying some stratifying approach, avoiding pure random selection, and self-organizing selection. Forming teams in such manner is essential to overcome professional bias and even arrogance.

Analytical skills are the core of a Data Science professional as showed above. Analytical thinking is not a property solely to students with quantitative background. An empirical study, conducted by Toleva-Stoimenova S. et al (2019), shows that students with bachelor degree in different areas demonstrated similar results in solving analytical problems. In that way, analytical skills represent the common background of students in a team. The emphasis of assignments is developing ability to extract knowledge from data collected within different domains. Applying holistic problem solving approach values different point of views. Also, the Big Data phenomenon is associated with indirect observation of data, or data are seen only as summarized statistics produced by IT applications.

CONCLUSION

Over the past decade there has been an unprecedented explosion in the organizations interest toward getting value from data in case of "Big Data". Data Science, as a field trying to accommodate complexity of issues related to explore data, is facing a number of challenges. At a time when Big Data is available in all areas, the divide between entities who are capable to learn from data and those who needs a mediator to take advantage of them becomes more and more tangible. The specific challenges of Big Data in the terms of digital divide give us reason to speak about "Big Data Divide". Educational industry is exposed to address this by educating professionals capable to respond to the challenges of the time and to serve industry and society as a whole to benefit from the advancement of technology.

This study targets the demand for Data Science professionals, as identified within the job market, and supply offered by educational industry in Bulgaria. The key competences of such professionals have been identified and classified in three categories – hard, soft and analytical skills. Analytical skills were recognized as the key competence essential for effective knowledge discovering in Big Data by applying holistic, oriented to problem solving, data analysis.

A curriculum framework is proposed emphasizing the needs of diverse view on problem domain, which allows developing both active and passive communication skills.

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Chapter 6
Digital Skills and Behaviours of Youth That Are Relevant for Digital Culture:
A Two-Country Self-Evaluation Perspective

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ABSTRACT

With the proliferation of ICT and ubiquitous access to the internet, the cultural sector has been strongly affected. It had to rethink its new role by moving from a process of transforming from analogue to digital, to more engaging actions within the digital transformation. Here, one of the most important constituents was digital competencies of cultural sector employees. There is a need to provide the cultural sector with an insight into digital skills of youth that are relevant for digital culture, both in terms of their future employability and the way they consume culture. To this end, the chapter introduces the basics of digital culture and skills needed in the digital era. An exploratory study in two countries was done

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– Serbia and Bosnia and Herzegovina based on the self-evaluation of youth digital skills. This chapter evaluates basic, specialized, and advanced digital skills and identifies the gaps and gives propositions relevant to the cultural sector.

INTRODUCTION

The computerization of culture, seen as the translation from analogue to digital sphere, is a permanent process in many countries (Ruthven & Chowdhury, 2015). In particular, the cultural heritage of Europe is a rich and diverse mix of cultural and creative expressions, inheritance from previous generations that is seen as a legacy for the future (Rochards, 1996). The year of 2018 has even been proclaimed by the EU as the European Year of Cultural Heritage aiming at enabling more people to discover and engage with Europe's cultural heritage (Schreiber, 2019). Here, digital technologies are seen as an important asset in reaching this goal, having in mind that previously quite expensive techniques, such as 3D scanning, multi-spectral imaging, virtual reality (VR) are now becoming more affordable to institutions and citizens as well (Ruthven & Chowdhury, 2015). However, digital competencies often pose a significant limitation, both from the side of potential end-users of digital cultural goods and from the side of cultural providers (Stankov & Filimonau, 2019). For example, 44% of Europeans lack basic digital skills necessary for everyday life and 37% lack digital skills for work (Filippaios & Benson, 2019). At the same time, ICT prevalence also reshapes the understanding of the role of a cultural institution in the digital era. Most importantly, there is a need to equip a growing young workforce with skills required for the jobs of the future, not to mention re-equipping the current workforce with the skills required to keep up with a changing world (Cedefop, 2016).

On the highly competitive labour market, cultural institutions in Europe have to compete for skilled workers within more competitive sectors. While this is still a major issue for the EU, there is a need to understand the problem in the pan-European context. Therefore, this two-country study was conducted in Serbia (115 students) and Bosnia and Herzegovina (101 students) in order to investigate digital skills and digital behaviour of youth that are relevant for digital culture employability.

Despite existing efforts on establishing holistic reference models to measure digital skills, there is a constant need for evaluation considering the dynamic nature of digital technology, educational settings where a significant part of the digital skills are created and characteristics of a specific area of applications. For example, several studies found that the chosen vocation of students interferes with their online behaviour. For example, the study of Stankov, Jovanović, and Dragićević (2014) found out significant differences between students of tourism and psychology in terms of their Facebook travel related usage patterns that could indicate that this behaviour of tourism students is influenced by their tourism educational orientation. Similarly, geography students showed an understanding of the importance of using geographical information systems (GIS) before their actual engagement with the subject after their enrolment in the geography studies (Stankov, Durdev, Marković, & Arsenović, 2012). Therefore, this study will primarily evaluate digital skills and behaviours of youth relevant for digital culture, and secondly, it will look for the influence of chosen type of education of students on their digital competencies, starting from the premise that the needs for different types of skills will be more diverse than ever in the future of digital culture (Tibbo & Lee, 2010; Vaikutytė-Paškauskė, Vaičiukynaitė, & Pocius, 2018)

The chapter first examines basic computer literacy that refers to hardware, software and online operations. The second part focuses on specialized IT skills that allow youth to critically evaluate the technology or create content using specialized software. Thirdly, advanced skills related to specialists in ICT professions and digital entrepreneurship are examined. Finally, the chapter also evaluates the preferences towards learning digital skills.

Based on the results of the questionnaires, this chapter provides propositions for enhancing digital skills towards better employability of youth in digital archiving, museums and heritage sector interpretation, curation and education i.e. in the cultural heritage sector. This chapter also provides valuable insight for educators in the field of humanitarian studies and other related disciplines on the necessary amendments for formal and informal education.

BACKGROUND

The Notion of Digital Culture

In the digital era we live in, it is worth noting that 70% of 15-24-year-olds around the world are linked to the Internet (ITU, 2019) with over 4 billion users and it is believed that this number will be growing by 7% every year (Dragović, Stankov, Vasiljević & Vujičić, 2019). Thus, it is evident that participation in 21st-century society is increasingly dependent upon competencies related to the use of digital technologies for a wide variety of purposes (Mihelj, Leguina, & Downey, 2019; Van Oostveen, DiGiuseppe, Barber, Blayone, & Childs, 2018). Nowadays, most the modern societies are connected online over ubiquitous Internet access and mobile devices removing time and space constraints in communication and various types of daily and work activities (Hill, 2016) holding important repercussions for the culture in this digital era. The simplest view on digital culture would suggest that it describes the dynamic relationship between ICTs and the creation and consumption of culture and the arts (Giovanelli, 2019). Digital culture or e-culture is often associated with the relationship between new media and culture, emphasizing that this phenomenon has emerged with the new media and the digitalization process (Yegen, 2019). This view is factually correct; however, a deeper inspection of its' components reveals possibilities for deferent interpretations. The definition includes ICTs as one consisting component and the creation/production and the consumption of culture and the arts. By its nature, ICTs are a constantly changing field that frequently offers new opportunities for the improvement of various processes. On the other side, culture and the arts are even more heterogeneous as being present in various forms and being created in various ways and by various types of creators. Finally, the consumption process is even more complex, as it is largely dependent on the consumers' characteristics and preferences (Stankov, Pavluković, Alcántara-Pilar, Cimbaljević, & Armenski, 2018).

The prevalence of ICTs in everyday life allowed culture and the arts to exist in a solely digital form, i.e. numerical code. Still cultural creation, production and consumption do not obey strict technological nor physical (for example, space or location) limitations. Thus, digital culture also includes the existing cultural forms and organizational units, that digitize their funds, make use of ICT for better-supporting services and transactions related to cultural consumptions, mixing both digital and physical worlds (Rajić, Stankov, & Vujičić, 2017; Vujičić, Stankov, & Besermenji, 2010). The most notable example is the cultural heritage and its relation to ICTs. Here, the question of how digital technology could add value to cultural heritage and hopefully enhance access and starts the conservation between stakeholders and consumers is a critical one (Ioannidis, Toli, El Raheb, & Boile, 2014).

In general, cultural heritage encompasses variety of tangible objects and materials in the funds of cultural institutions but also the heritage found in landscapes and in the built environment, together with intangible, living heritage such as cultural traditions, customs, authenticity or local knowledge (Borowiecki, Forbes, & Fresa, 2016; Salerno, 2019). Cultural heritage may be mediated through, for example, the exercise of institutional practice or it may be unmediated in nature, as is the case with traditional practices carried out day by day (Blešić et al., 2013; Borowiecki et al., 2016). ICTs created a whole new business philosophy for the organization by creating opportunities for the differentiation of a cultural organization from others and for the execution of the digital transformation (Ulusoy, 2019). Digital technologies allow the dissemination of critical information and as such have the power to add to a better understanding of all types of cultural heritage, allowing them to reach their cultural and economic potential (Salerno, 2019). For example, the European Digital Agenda states that digitization of Europe's cultural resources turns it into an important pillar of the digital economy providing Europe's third-largest employer sector - Cultural and Creative Industries (CCIs), which already generate around €509 billion per year (5.3% of the EU's total GDP) and employ 12 million full-time jobs (7.5% of the EU's employment) a fertile ground for further growth and the stimulation for the innovation in other sectors as well (European Commission, 2014, 2018). Not just within inter and intrasectoral interchange, the prevalence of digital culture could be of relevance for geographical redistribution of culture. In particular, internationally less-known countries (including Bosnia and Herzegovina and Serbia) could leverage the potential of digitally mature citizens and institutions that could be engaged in the promotion and dissemination of local cultural heritage (Salerno, 2019).

Cultural institutions were among the first, to begin with the process of digitalization, i.e. use of existing technologies to improve its performances. However, for the sustainable operation of cultural institutions in a dynamic digital environment, it is necessary to step forward significantly in the process of digital transformation, as a process of acceleration and deep transformation of organizational activities, processes, competencies, and business models to make full use of the changes and opportunities that digital technology brought to the society (Matt, Hess, & Benlian, 2015). In other words, digital transformation implies the use of digital technologies to innovate business processes and thus become more effective. The main premise is not to use technology in order to replicate existing services in digital form, but to transform that service into something significantly better, more efficient and easier to use (Herbert, 2017; Samuels, 2018).

While academia and some parts of the cultural sector clearly recognized the need for digitization and digitalization, the adoption of digital transformation as a business model somehow was lagging behind in many countries. One of the main reasons can be looked at within the lack of advanced in-house digital skills within institutions of the cultural sector.

Digital Skills for the Cultural Sector

The cultural sector is facing a digital revolution, which brought new requirements for employees' skills and competences. In connection to this, Hartley (2017) emphasized the potential of popular productivity through analysis of the use of digital media in various domains, including creative and cultural industries, digital storytelling, YouTube, etc. He also claims that the time has come for education to catch up with entertainment and for the professionals to learn from popular culture. In the context of this study, this means that cultural institutions are to implement new technologies in their activities, while educational institutions should follow this direction, providing necessary digital skills for employees. The importance of proper digital literacy training adapted to the digital age is of paramount importance, as stressed by the European Commission, who's suggested training include "digital competence" referring to a set of skills, knowledge and attitudes favouring the "promotion of digital literacy, training and inclusion" coming from formal education (European Commission, 2010).

In order to fully grasp the variety of digital skills needed for the cultural sector, here the requirements of the jobs related to cultural heritage sites will be tackled. First, a distinction should be made between the terms: "presentation" and "interpretation". According to ICOMOS, interpretation refers to the "full range of potential activities intended to heighten public awareness and enhance understanding of cultural heritage site. These can include print and electronic publications, public lectures, on-site and directly related off-site installations, educational programmes, community activities, and ongoing research, training, and evaluation of the interpretation process itself" (ICOMOS 2008, 2). The other term presentation "more specifically denotes the carefully planned communication of interpretive content through the arrangement of interpretive information, physical access, and interpretive infrastructure at a cultural heritage site. It can be conveyed through a variety of technical means, including, yet not requiring, such elements as informational panels, museum-type displays, formalized walking tours, lectures and guided tours, and multimedia applications and websites" (ICOMOS 2008, 2). As can be seen from ICOMOS's formulation, the presentation is largely a one-way mode of communication while interpretation refers to the totality of activities related to a cultural heritage site (Silberman, 2006). In terms of job requirements, although that professionals play an important role in both activities, in term of digital skills a wider range is needed in case of interpretation, including not just cultural sector job-specific skills (for example, 3D scanning), but also a variety of skills related to digital marketing and management, social media content creation and other.

There are different approaches to how digital skills for cultural heritage education can be acquired, as it is quite evident that with the dynamic nature of digital technologies, digital culture and digital society, just sticking to the traditional ways of education, would not be concurrent anymore. For example, according to Ott and Pozzi (2008), in the field of cultural heritage education, innovative approaches to teaching and learning leverage ICT potential allowing the several approaches, such as personalized, inquiry-based learning from vast amount of available resources online; on-site and anywhere learning that is based on educational experiences out of schools; interdisciplinary learning that facilitates the inclusion of different subtopics related to the primary one; and collaborative learning, that brings students together using online tools. All those approaches can be applied at various levels (from basic to advanced) of the digital skills needed for the cultural sectors.

There has been a lot of researches and initiatives to evaluate digital skills among the general population. Most of them were motivated by the fact that some digital goods and services cannot be (effortlessly) accessed by the intended audience. In this case, the digital medium represents the main barrier, as the audience does not have enough skills to access and use the benefits of the digital era. In that context, in 2016, the Steering Committee for Educational Policy and Practice (CDPPE) of the Council of Europe (CE) started the project Digital Citizenship Education with the aim of reshaping the role of education in the digital era in order to enable all children to take an active role in the democratic society (Frau-Meigs et al., 2017). To this end, the European Commission has developed *DigComp*: the European Digital Competence Framework as a reference framework to practically explain what it means to be 'digitally competent'. As such, *DigComp* is "a flexible reference framework that can be adapted to support the development and understanding of digital competence in any setting" (Stefano and Laia Pujol 2018, 7) with five competencies in mind: information and data literacy, communication and collaboration,

Table 1. Digital skills of youth relevant for employability in the cultural sector

Level of digital skill	Description
Basic digital skills	Related to basic computer literacy that refers to simple hardware, software and online operations
Specialized digital skills	Allow youth to critically evaluate the technology or create content, software or they are specific job-ready skills
Advanced skills	Related to specialists in ICT professions and digital entrepreneurship

Source: DiCultYouth internal documentation.

digital content creation, safety and problem-solving. With the same idea in mind, the UK developed the essential digital skills for life and work, that have been distinguished in five categories: communicating, handling information and content, transacting, problem-solving and being safe and legal online (UK Department for Education, 2018).

In terms of digital culture, there are several practical endeavours to tackle the problem in the European context. This chapter will focus on the experience of *DiCultYouth* Erasmus+ project aimed at preparing young professionals to open new pathways to careers into the cultural sector by developing essential IT knowledge and skills required in heritage-sector careers. The project tries to enhance the employability of non-degree and unemployed young people as well as young people with an educational background in humanitarian studies who are prone to work in digital archiving, museums and heritage sector interpretation, curation and education i.e in the cultural heritage sector (DiCultYouth, 2019).

Based on the approach developed for *DiCultYouth* project this chapter distinguish three types of digital skills relevant to the cultural sector (Table 1). A set of practical digital skills within each type is presented in the Results section. In essence, the presented approach will cover skills easily understandable for the self-evaluation by the youth. They range from the essential to the most advanced skills needed for multiplying opportunities for change, acceptability, and participation for an audience. The study of Silvaggi and Pesce (2018) found out that increasing the use of ICTs in the museum sector is starting to allow the emergence of new job profiles. Their study emphasized that more advanced skills are needed for successful digital transformation, in particular, the skills related to the job profiles of digital strategy manager, digital collections curator, digital interactive experience developer and online community manager.

METHODOLOGY

The survey was conducted with an aim to explore the digital literacy of young people in Serbia and Bosnia and Herzegovina as well as their current level of skills and knowledge related to digital technology use. One of the goals was also to explore their preferences and attitudes towards acquiring digital skills.

Study Area

Serbia and Bosnia and Herzegovina experience a similar current state of ICT development. For example, according to the number of households that have access to the Internet, those two countries were above world average (51.5%), but still significantly below the average for developed world (82.2%) (Agency for Statistics of Bosnia and Herzegovina, 2018; ITU, 2019; Kovačević, Pavlović, & Šutić, 2016). Table

Table 2. Selected indicators of ICT usage in Serbia and Bosnia for 2016.

ICT indicators	Serbia	Bosnia and Herzegovina
Households having access to the computer	65.8%	63,6%
Percentage of persons who used the computer….		
… in the last three months	67.2%	59.9%
… more than three months	0.9%	2.1%
… more than a year ago	4.7%	6.3%
Percentage of persons who never used a computer	27.2%	31.6%
Share of computer users (in the last three months), by the age of 16-24	*Female* 97.7%	92.5%
	Male 96.5%	
Households have access to the Internet	64.7%	66.0%
Persons who used the Internet during …		
… the last three months	67.1%	64.9%
… more than a year ago	1.6%	1.5%
… more than a year ago	2.2%	3.1%
Percentage of persons who never used the Internet	29.2%	30.5%
Share of Internet users (in the last three months), by the age of 16-2	*Female* 97.7%	97.8%
	Male 98.5%	
Percentage of Internet population aged 16 to 24 who have an account on social networks (*Facebook*, *Twitter*)	90.3%	94.2%

Source: Agency for Statistics of Bosnia and Herzegovina, 2018; Kovačević, Pavlović, & Šutić, 2016.

2 shows the basic indicator of ICT use in Serbia and Bosnia for 2016. However, the data clearly shows that youth has the highest performance in comparison to the other age groups. Here, the share of computer users, Internet users and youth that have an account on social networks is in all cases over 90%.

Questionnaire Design

The questionnaire was designed to measure the current state of skills related to digital technologies of youth in Serbia and Bosnia and Herzegovina, as valuable information for cultural institutions having an increasing need for digitally competent and literate employees. The instrument used as a basis for creating this questionnaire was *DigComp into Action: Get inspired, make it happen: A user guide to the European Digital Competence Framework* which demonstrates the practical application of European Digital Competence Framework (DigComp), developed by the Joint Research Centre (JRC) of the European Commission (Kluzer & Priego, 2018). For the purpose of this study, this questionnaire was modified in order to reflect very diverse digital skills and competence that cultural institutions need nowadays.

The questionnaire consisted of five parts. The first part included socio-demographic characteristics of respondents (e.g. gender, age, education, country of residence, employment status). In this part, the respondents were also asked if their education is related to culture and humanitarian studies.

The second part of the questionnaire was related to the respondents' basic computer literacy / using IT where respondents evaluated their proficiency in using some basic software, frequency of using certain digital devices, smartphone apps, social media, etc. Also, they evaluated the importance they give to certain aspects of their digital behaviour.

The third part focused on the evaluation of their specialized IT skills: their competence in using specialized software.

The fourth part evaluated advanced digital skills of respondents and their applicability for digital entrepreneurship.

The scale used for evaluating the level of digital knowledge and skills was: 1 – beginner, 2 – developing, 3 – competent, 4 – advanced, 5 – expert. Respondents also had an option to choose 0 – I don't have such skills.

The fifth part of the questionnaire intended to explore the respondent's preferences towards digital learning. This part was developed by the authors of this chapter, considering these questions useful for offering future formal and informal education for improving digital skills.

The data were processed by IBM SPSS 20. Descriptive statistics (frequency analysis) was used for data analysis. In order to analyse the differences in digital literacy between respondents who have an education related to culture and humanitarian studies, the ANOVA test was performed. The assumption was that people having an education in culture and humanitarian studies will show a higher level of digital literacy compared to those who do not have.

Using frequencies is not enough for an original scientific paper. Add more statistical tests in order to test the research hypotheses (that are missing at the moment).

Procedure

The research was conducted from April to June 2019. For data collection, the online Google doc survey was used. The survey was shared via email but also via social networks such as Facebook. The respondents were also asked to send the link to the survey to their colleagues. Thus, the snowball technique of sampling was also applied. The respondents were introduced with the main purpose of the project and that their participation is voluntary and anonymous.

A comparison of the two countries shows that the baseline for the ICT usage indicators is quite similar. Preliminary testing between two sets of data gathered in the surveys also showed no significant differences. Thus, the results are presented jointly as average for both countries.

Study Sample

The target group of respondents for this research was from 18 to 40 years old. The questionnaire was filled out by 219 respondents (age range 18 to 38 years old). The majority of respondents have completed faculty (college/bachelor) and high school and their education is, in most cases, completely or partly related to culture and humanitarian studies. The detailed sociodemographic characteristics of respondents are shown in Table 3.

Table 3. Socio-demographic profile of respondents % (N=219)

Gender **Male 21.2** Female 78.8	**The current level of education** **high School – completed 18.2** **high School - not completed 8.3** **college/bachelor 59.3** master/PhD 14.1
Age **Age range 18-38,** Average age 22.74, Std. 3.474	**Is your education vocationally related to the culture?** yes completely 34.3 yes partly 52.5 not at all 18.3
Country of residence **Serbia 52.5** Bosnia and Herzegovina 47.5	**Monthly income:** Average income 395€, Std. 359.591 Range 50 – 1700€
Employment status: **student 71.7** **employed 21.0** unemployed 7.9	**Is your education vocationally related to other humanitarian studies?** yes completely 30.2 yes partly 45.6 not at all 24.2

RESULTS

Basic Digital Skills

The first part of the questionnaire was related to respondents' self-evaluation of basic digital skills and the use of IT (software, hardware and online operations).

Self-evaluation of proficiency while using the listed software/operations was done first. The answers were measured on a 5-point scale, while they also had an option to choose 0 if they do not have such skills.

The results shown in Table 4 indicate that they evaluate themselves **mainly as competent and advanced in using basic software and operations**, but still, not many of them evaluate themselves as experts in basic skill level (exceptions are web browsing and email and *PowerPoint* with a higher number of respondents declared as experts).

In addition, regarding their self-evaluation of basic digital literacy, the respondents were also asked to estimate the frequency of using digital devices listed in Table 5. The answers were measured on a 5-point scale (1 (Once a year), 2 (Once in a couple of months), 3 (Monthly), 4 (Weekly), 5 (Daily)), while they also had an option to choose 0 if they never used a device.

Table 4. Self-evaluation of proficiency while using the listed software/operations (%)

Software/operations	0	1	2	3	4	5
Text processing software (e.g. *Microsoft Office*)	0.9	7.8	8.7	24.7	43.4	14.6
Spreadsheets software (e.g. *Excel*)	3.7	16.4	15.5	34.7	24.2	5.5
Software for presentations (e.g. *PowerPoint*)	1.8	5	7.8	20.5	43.4	21.5
Web browsing and email	1.4	4.1	5	17.4	37.9	34.2
Scanning image and text documents	10.5	15.1	15.5	21.5	23.3	14.2

Table 5. Frequency of using the listed devices (%)

Device	0	1	2	3	4	5
tablet	64.4	5	9.1	7.8	5.9	7.8
PC computer	17.4	8.7	16	15.1	13.2	29.7
laptop	4.6	0	5.9	5.5	20.5	63.5
printer	26.5	5.9	15.5	26	15.5	10.5
scanner	36.5	7.3	21.9	18.3	7.8	8.2
smart watch /fitness tracker	86.8	4.6	1.4	1.8	2.3	3.2
VR goggles (e.g. *Samsung Gear VR*, *Oculus*)	89.5	7.8	2.3	0	0	0.5
3D printer	95.9	2.3	1.3	0	0	0.5

The results show that the majority of respondents used daily only laptops, while a high % of them never use devices such as smartwatch /fitness tracker, VR goggles, 3D printer, and tablets.

In the next set of questions, respondents were asked to mark which smartphone application they use. The frequency of choosing different applications is shown in Table 6. According to the results, most of the respondents use email, lifestyle apps, and communication apps. On the other hand, news, productivity apps and games apps are rarely used.

The respondents were also asked which digital/social media they use. The frequency of answers is shown in Table 7. *Facebook*, *YouTube,* and *Instagram* showed to be the most popular social media by young respondents.

In the next question (Table 8), we wanted to explore for which purpose our respondents use digital/social media tools. Predominantly, they use it for communication, publishing images, finding news and networking.

Table 6. The use of smartphone applications by young people in Serbia and Bosnia and Herzegovina

Smartphone app	Frequency	%
Email app	208	95.0%
Lifestyle (fitness, dating, food, music, travel. For example, Spotify, Shazam, TripAdvisor)	204	93.2%
Communication app (e.g. *WhatsApp*, *Viber*, *Facebook Messenger*, *Skype*, *SnapChat*).	198	90.4%
Apps of cultural institutions or events	158	72.1%
Social media apps (ex., *Facebook*, *Instagram*, *Pinterest*)	123	56.2%
Utility apps (ex., reminders, calculator, weather, flashlight)	87	39.7%
Games/Entertainment Apps (ex., *Angry Birds*, *Clash of Clans*)	69	31.5%
Productivity apps (ex., *Docs*, *Wallet*, *Evernote*)	56	25.6%
News/information outlet	28	12.8%

Table 7. The use of social media by young people in Serbia and Bosnia and Herzegovina

Social media	Frequency	%
Facebook	209	95.4%
YouTube	211	96.3%
Instagram	183	83.6%
Twitter	36	16.4%
Reddit	10	4.6%
Pinterest	66	30.1%
Tumblr	22	10.0%
Flickr	2	0.9%
LinkedIn	54	24.7%
Snapchat	5	2.3%
Skype	1	0.5%

Table 8. Purpose of using digital media by young people in Serbia and Bosnia and Herzegovina

Purpose of using digital/social media	Frequency	%
Communication	209	95.4%
Publishing images	174	79.5%
Finding news	163	74.4%
Networking	150	68.5%
Uploading files	113	51.6%
Collaboration with others	122	55.7%
Shopping	92	42.0%
Publishing videos	98	44.7%
Evaluating news, information on products	96	43.8%
Publishing text	82	37.4%
Sharing locations and event attendance	67	30.6%
Managing professional digital identity	47	21.5%
E-Government services	18	8.2%

The respondents were also asked to evaluate how the listed items are important for their digital behaviour (Table 9). The distribution of their answers is shown in table 8 (1 - not important, 2 - slightly important, 3 - moderately important, 4 – important, 5 - very important).

All the items have been evaluated as quite important for digital behaviour, with an emphasis on protecting personal data and privacy, protecting devices, protecting health and well-being and using proper grammar.

Table 9. The importance of selected elements for digital behaviour

Digital behaviour	1	2	3	4	5
Internet etiquette	3.2	6.4	17.8	29.7	42.9
Copyright and licenses	4.1	8.2	19.2	32	36.5
Protecting devices	0.9	1.4	7.8	21.9	68
Protecting personal data and privacy	0.9	0.9	4.1	11	83.1
Protecting health and well-being	1.8	3.7	11.4	20.5	62.6
Protecting the environment	1.8	5.5	11.4	29.7	51.6
Using native language on the internet	8.7	15.5	24.7	24.2	26.9
Using proper grammar	2.3	3.2	8.7	25.6	60.3
Promoting national culture, art, values, customs, etc.	7.3	5.9	19.6	30.6	36.5

Table 10. Self-evaluation of proficiency in specialized software

Software type	Beginner/or don't use it	Developing	Competent	Advanced	Expert
image and graphics creation and processing	34.2	28.8	20.5	11	5.5
audio processing	59.8	20.5	12.8	4.6	2.3
video processing	54.3	20.5	16.9	4.6	3.7
3D rendering	85.4	11	2.3	0.5	0.9
3D printing	86.3	10	1.8	0.9	0.9
web-map creation	69.9	16.9	7.8	4.1	1.4
web marketing (e.g. Google Analytics	68	18.7	7.3	4.2	1.8
data management	38.8	25.1	18.7	12.8	4.6

Specialized Digital Skills

The respondents were also asked to do the self-evaluation regarding their proficiency in specialized software. Their self-estimation was done by using the following scale: 0 (I don't use such software), 1 (Beginner - I have some basic knowledge of using such software), 2 (Developing - I'm learning additional capabilities of the software), 3 (Competent - I can work on project on my own), 4 (Advanced - I know more of software's capabilities than the average user), 5 (Expert - I can critically evaluate the results base on the software characteristics, find errors, notice common bugs). The results presented in table 10 show that the majority of respondents are beginners in specialized software or even do not use it.

Advanced Digital Skills

In this part, respondents were asked to estimate their **general knowledge and skills** that can be of use for someones' digital entrepreneurship on a scale from 1 (very poor) to 5 (very good). The results, shown in Table 11, indicate that they consider they lack marketing and financial skills the most, while communication, adaptability, customer handling skills, social media skills, and foreign language skills are best rated by respondents.

Respondents were also asked if they are willing to acquire a new skill in order to work in the cultural sector or pursue a career in the cultural heritage sector. The majority of respondents positively (85.4%), 4.6% of them responded negatively while 10% of respondents that they do not know.

Table 11. Self-evaluation of knowledge and skills that can be used for digital entrepreneurship

Knowledge and skills	1	2	3	4	5
Marketing	13.7	14.6	39.7	20.5	11.4
Finances (accountancy, financial planning etc)	23.3	26.5	31.1	15.5	3.7
Communication skills (oral or written)	2.7	2.7	24.7	33.8	36.1
Problem solving skills	3.2	5	29.2	39.7	22.8
Customer handling skills	4.1	8.2	30.1	33.3	24.2
Foreign language skills	0.5	4.6	25.1	40.6	29.2
Risk-taking	5	13.2	37	30.6	14.2
Adaptability	0.9	6.4	21.9	35.6	35.2
Social media skills	4.6	6.8	27.4	32.4	28.8

Respondents also rated some specialized digital skills they have (0 - I don't have such skills, 1 -beginner, 2 – developing, 3 – competent, 4 – advanced, 5 - expert). Similarly, to the previous question, they mostly declared an option is that they do not have such skills (Table 12).

In connection with this, they were also asked how they would like to acquire those skills. The distribution of answers is shown in Table 13. Respondents show some preferences towards formal education and face-to-face training, but a high number of respondents also state e-learning and volunteering in cultural institutions as the preferred way of acquiring new digital skills.

Furthermore, each respondent had to write three digital skills he/she considered important for working in the sector of culture. The following answers were obtained, sorted by frequency of choosing in Table 14.

Marketing and promotion, together with communicativeness connected to the digital sphere were identified the most frequently as the skills important for working in the sector of culture. This is followed by the set of skills related to the creation, digitalization, and presentation of arts and culture.

Finally, respondents were asked whether they are willing to work in the cultural sector or pursue a career in the cultural heritage sector (Figure 1). Positive response to this question gave over half of the respondents, while about a third of them said that they are not sure. Less than 10% of respondents said they are not willing to work in the cultural sector or pursue a career in the cultural heritage sector.

Table 12. Self-evaluation of digital skills

Digital skill	0	1	2	3	4	5
IT networking	74.4	14.6	2.7	5.9	1.4	0.9
Cybersecurity	54.3	21.9	10.5	6.8	4.6	1.8
Artificial intelligence (AI)	73.1	11.4	9.6	5	0.9	0
Big data and Internet of Things (IoT)	79	8.2	6.4	3.7	2.7	0
Virtual reality	73.1	14.6	5.9	3.2	2.3	0.9

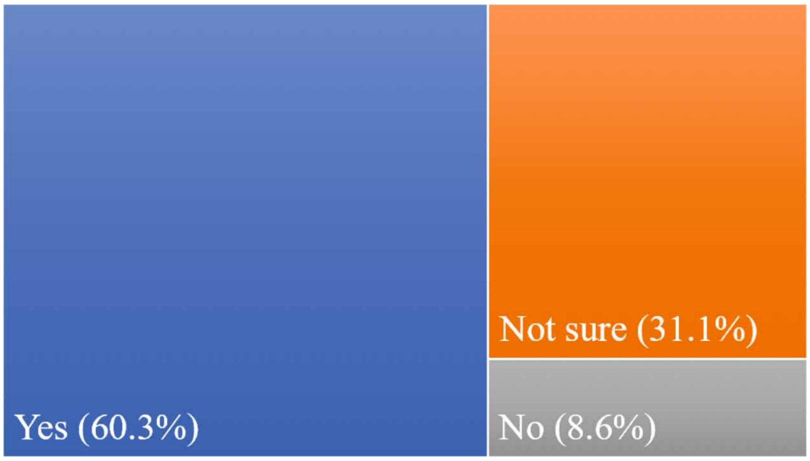
Table 13. Preferences for acquiring new digital skills

Way of skills acquisition	Number of respondents	%
Part of a formal education	109	49.8%
Face to face training sessions	139	63.5%
E-learning or webinars mentoring	73	33.3%
By volunteering position in cultural organizations	97	44.3%
More support from my existing job manager	36	16.4%
Informal peer to peer support	22	10.0%

Table 14. Digital skills considered important for working in the sector of culture

Skills	Frequency	%
Communicativeness	48	21.9%
Marketing and promotion	68	31.1%
Text, images and sound procession	45	11.4%
Social media communication and promotion	18	8.2%
Data creation and processing	11	5.0%
Data presentation	30	13.7%
Digitalization of cultural heritage	34	15.5%
Basic computer literacy	26	11.9%
Mobile application creation	14	6.4%
Social media management	33	15.1%
Graphical design	8	3.7%
Internet search	12	5.5%
Data security maintenance	14	6.4%
Financial management	8	3.7%
Team organization	7	3.2%
Virtual tour creation	25	11.4%
Digital map creation	4	1.8%
Big data management	5	2.3%
Market research	7	3.2%

Figure 1. Willingness to work in the cultural sector or peruse a career in the cultural heritage sector.



Analysis of Differences in Digital Skills in Relation to Education Field

With an aim to analyze the difference in variance regarding basic digital skills of those who have and those who do not have education vocationally related to the field of culture and humanitarian studies ANOVA test was performed.

The analysis showed that statistically significant difference only in web browsing skills (F=3,060, p=.05), indicating that those who have education which is vocationally completely related to humanitarian studies compared to those whose education is not related to this filed (MD=.465) show more web-browsing skills. Regarding those whose education is completely vocationally related to culture, the results indicate that they show more skills in Microsoft Office Word (F=4,553, p=.013) than those who do not have an education related to this filed (MD1=.527).

Another ANOVA test was performed in order to analyze the difference in variance regarding **specialized digital skills** of those who have and those who do not have education vocationally related to the field of culture and humanitarian studies.

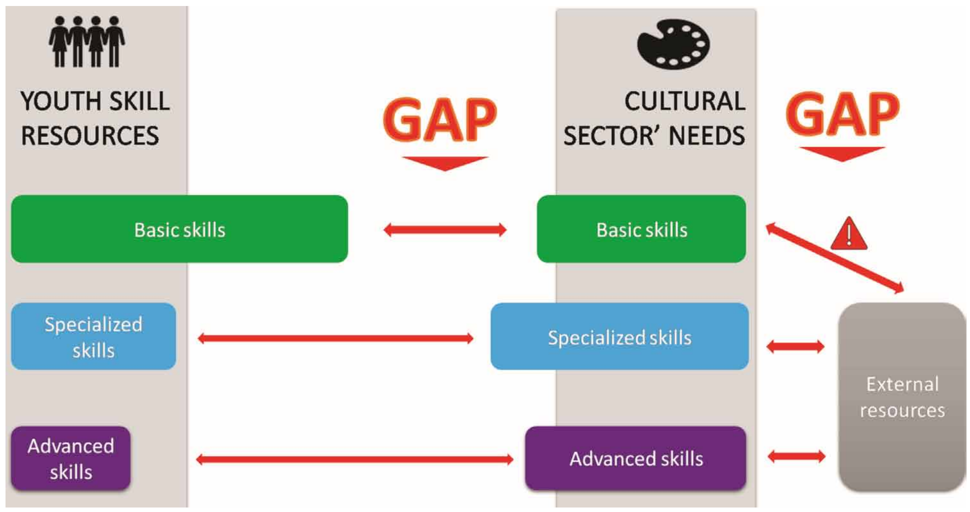
The analysis showed that statistically significant difference in *image and graphics processing skills, audio processing, video processing, and data management skills*, showing that those who have education vocationally related to humanitarian studies have less specialized digital skills than those whose education is not related to this filed (Table 15).

Table 15. The results of the ANOVA test (specialized digital skills and education related to humanitarian studies)

Specialized IT skills	F test	p	Post hoc*
Image and graphics	9,683	.000	3>1,2
Audio processing	3,484	.033	3>2
Video Processing	3,957	.021	3>2
Data management	3.433	.034	3>1

*3-vocationally completely related to humanitarian studies, 2 – partly related, 3 – not at all

Figure 2. The logical framework for GAP analysis between youth skill resources and cultural sector' needs base on tree levels of digital skills (Source: DiCultYouth internal documents)



When it comes to the differences in specialized skills regarding education related to the field of culture, ANOVA test showed statistically significant differences only in the case of image and graphics processing skills (F=3.571, p=.031). Post hoc test indicates that those whose education is completely related to the culture have better skills in image and graphics processing than those whose education is only partly related to culture (MD=.5079).

Testing the differences in **advanced digital skills** of those who have and those who do not have education vocationally related to the field of cultural studies showed significant differences in terms of ***Artificial intelligence skills*** (F=4.087, p=.019) and ***Virtual Reality*** (F=3.339, p=.039). Post hoc test indicates that those whose education in partly related to the culture have fewer skills in artificial intelligence than those whose education is completely related to culture and those whose education is not related to this filed (MD=.363). Moreover, those whose education is completely related to the culture have higher virtual reality skills than those whose education is only partly related to this filed (MD=.443). In terms of respondents' education related to humanitarian studies, no statistically significant differences were found regarding advanced digital skills.

SOLUTIONS AND RECOMMENDATIONS

Based on the literature review and the results of the analysis, this study will provide solutions and recommendations as a final result of this research. In order to make a clear point, the logical framework for a gap analysis between youth skill resources and the cultural sector's needs base on three levels of digital skills, developed by *DiCultYouth* project, is introduced (see Figure 1).

In terms of basic digital skills, the results found out that the majority of youth find themselves mainly as competent and advanced, but rarely associate themselves to expert levels of basic skills. This goes in line with the fact that the majority of youth use digital technologies, both in terms of different types of hardware and software, the Internet and social media on a regular basis (ITU, 2019). However, this is primarily related to the high use of laptops and desktop computers. The use of more specific devices, such as VR goggles and 3D printers, that are often associated with the presentation and interpretation of cultural heritage, is quite rare (Rossi & Barcarolo, 2019). This can be explained by the fact that those devices are still scarce within daily life use, however, the lack of tablet use, came as a surprise. Similarly, youth are frequent users of most popular social media sites, such as *Facebook* and *YouTube*, while more specific one, such as *Twitter*, *LinkedIn* or photo-sharing sites are less frequently used (Božić & Jovanović, 2017; Jovanović, Božić, Bodroža, & Stankov, 2019). On the other hand, employees of cultural institutions skilled in basic digital knowledge are needed in most of the job positions, however, in terms of digital transformation; their contribution could be limited to basic operation (service delivery, assistance, data gathering, etc).

As expected, specialized IT skills related to proficiency in professional software that will allow youth to critically evaluate the technology or create content, showed less existing competence, comparing to basic skills. Here, work skills in specific software for 3D rendering or 3D printing are less known. This is followed by web-map creation and web marketing. Again, youth are developing image processing skills and data management skills, together with skills for work in software for audio and video processing. In general, we can argue that the cultural sector will need these skills, both in absolute and relative numbers, as the majority of job positions will require them in the process of content creation, marketing, business transactions, that are relevant for many types of cultural institutions.

Furthermore, advanced skills that are tightly related to specialists in ICT-related professions and digital entrepreneurship are surveyed. Despite the rise in popularity of technology-related formal and informal education diffusion of advanced specialized digital skills, such as big data analytics or cybersecurity, are quite rare to detect. These specific skills are still left to be found at a higher level of formal education. On the contrary, in the case of general knowledge and skills related to digital entrepreneurship, the youth mainly evaluate it as good and very good, with the expectation of marketing and finance skills. For the digital transformation, those skills are essential for higher management positions in cultural institutions, as they will allow youth to be able to grasp in the process of digital transformation (Peng, 2017). While advanced digital skills can be imported from external sources, higher management still must be able to "see the bigger picture" and create a competitive cultural offer.

Here, it can be noted that importing advanced and specialized skills from external resources, thus avoiding the direct use of youth's skills available on the market, could be a straight-forward process, if there are enough financial resources to back it up. On the other side, this study presumes that outsourcing basic digital skills can be quite inefficient. This fact could be an additional push for a cultural institution to direct their efforts in fulfilling this need by employing skillful young workers willing to work directly in the intuitions.

Finally, the research also found an interesting result that most of the youth would prefer to acquire new digital skills related to the cultural sector within a face-to-face training session, formal education or volunteering positions in a cultural organization. Despite the positive attitude toward digital technologies, lesser youth would like to acquire new digital skills within the digital world itself, using e-learning opportunities or help by their peers in the online world. This could lead to the necessity for more formal guidance in this matter (Van Oostveen et al., 2018). Again, the lack of expertise level within the basic digital skills also could point to the fact that just bare or even frequent use of digital technologies would not necessarily lead to more skillful future workers without proper training and guidance for specific needs of the cultural sector.

On balance, the analysis of differences in digital literacy between respondents of different education fields showed that those having education vocationally related to culture and humanitarian studies in some cases show higher basic digital skills, while this is not the case in terms of specialized IT and advanced digital skills. The analysis indicated that formal education in culture and humanitarian studies still does not provide enough necessary specialized and advanced IT skills needed in this sector, while these skills are more developed at educational courses not related to this field.

CONCLUDING REMARKS

Based on the presented study, clear conclusions can be made. The digital culture requires skill-sets that can keep up the pace with its dynamic nature. Those skill-sets can be acquired both internally and externally. The focus of this chapter was on the youth that can be a fruitful poll for a cultural institution, which can tailor skillful workers according to their own needs within the digital era. In order to do so, a survey of existing skills was needed with the aim to determine its structure by the level of expertise, from basic to most advanced ones.

The important contribution of this study is the fact that this is the first research of such kind in Serbia and Bosnia and Herzegovina, with significant practical implications. The chapter revealed the significant gap between cultural sectors' needs and youth skills resources in terms of advanced and specialized digital skills. This indicates that the cultural sector is facing the challenges of the digital era which brings new requirements and competence much faster than education currently follows. Thus, the results of this chapter clearly indicate the future direction of formal and informal education courses and training needed for people willing to work in the cultural sector, as well as the learning preferences of youth. Moreover, the chapter sheds light on the current state of digital literacy of the youth in two countries. It indicates the major lack of skills and competence that young people need to develop in order to efficiently work in the sector of culture, thus increasing their opportunities for employability but also entrepreneurship in this sector. Practically, if the results are implemented as suggested, this could be a tool of regional economic development based on the improved digital skills of young people willing to work in the culture.

Moreover, the questionnaire we used in this study could be beneficial for cultural institutions in terms of selecting new employees for the job positions that require high digital literacy including highly advanced and specialized digital skills. Specifically, in this way, cultural institutions could easily evaluate are the skills and competence of potential employees in line with their requirements and needs.

This two-country study showed expected results for countries such as Serbia and Bosnia and Herzegovina, that currently hold a position below the EU average in terms of ICT usage, but still above the world's average. It would be interesting to find out if there are more significant pan-European differences, or even on a more global scale. Nevertheless, this chapter tackled an important issue for digital culture and how digital technologies are used among the youth, allowing enough space for further research.

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ENDNOTES

[1] MD=Mean Difference.

Chapter 7
Digital Literacy in Special Education:
Preparing Students for College and the Workplace

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ABSTRACT

Digital literacy is essential for individuals entering college and the workplace. Students with disabilities experience a greater challenge in acquiring the skills necessary to succeed. This chapter explores the disability digital divide, success factors for acquiring digital skills, and the implications of a digital literacy curriculum developed for special education classrooms in Idaho. It demonstrates how leveraging human performance improvement (HPI) models, incorporating universal design for learning (UDL) principles, and supporting classroom teachers resulted in a curriculum to help young people with disabilities to acquire the digital skills they need to be prepared for college and the workplace.

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INTRODUCTION

Digital literacy is essentially the acquisition of the skills and abilities needed to read, write, and communicate in the 21st century using current and emerging technologies (Buckingham, 2015; Gilster, 1997; Museum and Library Services Act of 2010, 2010; Spencer, 1986; U.S. Department of Labor, 2016). While scholars have studied *digital literacy* and developed multiple models for how best to acquire these skills for decades, Margaret Spencer (1986) and then Paul Gilster (1997) were the first to define the concept of digital literacy (Buckingham, 2015). Subsequent researchers have expanded upon that early work of defining what it means to be digital literate (Knobel & Lankshear, 2006; Koltay, 2011; Merchant, 2007; Russo, Watkins, & Groundwater-Smith, 2009). Some of these researchers focused mostly on the technical skills needed to be digitally literate because computer use at the time was primarily focused on basic "operational skills" (e.g., mathematical calculations and word processing). Now that computers are ubiquitous, more recent definitions often focus on higher-level cognitive processes such as communication skills and critical thinking skills (Battelle for Kids, 2007; Belshaw, 2012; Educational Testing Service, 2002; Janssen et al., 2013; Neumann, Finger, & Neumann, 2017). An often-cited, more expansive definition by Eshet-Alkalai (2004), claims that "digital literacy involves more than the mere ability to use software or operate a digital device; it includes a large variety of complex cognitive, motor, sociological, and emotional skills, which users need to function effectively in digital environments" (p. 93). However, Belshaw (2012) has argued that Eshet-Alkalai's conception of digital literacy does not account for how digital literacy changes as digital tools and contexts change over time. Belshaw, instead, conceptualized digital literacy as lying on a continuum with skills broken down into levels, akin to The Levels of Digital Literacy Model created as part of the DigEuLit Project (Martin & Grudziecki, 2006). Low-level skills, sometimes called functional digital literacy skills, are learned quickly with practice and feedback. Higher level-skills are more complex and take time to develop. Belshaw argued that these skills are difficult to develop in a one-time, non-contextualized, instructional experience. In parallel, Eshet-Alkalai (2012) updated the model to include "real-time-thinking"; this update recognizes that people need to be more adept at processing and evaluating large quantities of information due to the pervasive nature of the Internet.

These various definitions illustrate that digital literacy is not a singular entity, but instead a combination of intertwined skill sets, competencies, and attitudes (Bawden, 2008). The literature makes clear that digital literacy is complex and evolving, and, as such, a difficult concept to pin down. Two recurring themes arise in the literature. One theme is that digital literacy changes as technology changes; therefore, it must be continually defined and redefined. The second theme suggests that no definition accurately defines digital literacy for every organization and setting (Belshaw, 2012, p. 44). For this chapter, we conceptualize digital literacy as a necessary but evolving skillset needed for communicating and interacting in the 21st century. Here, we will illustrate how important digital literacy skills are in college and the workplace and why special educators in particular need to focus more on helping special education students acquire these needed skills.

The Role of Digital Literacy in College and Career Readiness

Digital literacy skills are vital to student success in college and the workplace. In fact, in the United States, the Workforce Innovation and Opportunity Act (WIOA) recently highlighted the importance of digital literacy skills in the workplace (U.S. Department of Labor, 2016); WIOA emphasizes that the skills used to read, understand, and navigate information online has become essential in the workplace. Similarly, a recent report conducted by the World Economic Forum (World Economic Forum, 2016) explains how technological advances will continue to impact all types of work. In fact, Schwab (2017) argues that we are now entering a new age of work, which he coined "the 4th Industrial Revolution." This shift in the workplace Schwab (2017) explains is characterized by "a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres" (p. 99). The shift is more than the introduction of new tools and technologies, but also the reality that digital is becoming embedded in society, impacting how individuals learn, work, and socialize.

Students face a similar challenge going to college. The initial college application, to applying for financial aid, to registering for courses, all require a certain set of digital literacy skills. Leiberman (2019) even boldly stated that "[n]o student will pass through higher education without seeing or using digital technology" (para. 1). In one study of 397 adult learners aimed at addressing barriers to transition to college and careers, Goodman and Kallenbach (2018) concluded that most participants would benefit from programs with explicit digital literacy instruction in order to complete tasks including navigating the college admissions process and financial aid systems. There are those who do not make a distinction between the digital skills needed for the workplace and those needed for college as shared by Duffy (2018) in a study of an elementary school's instructional technology initiative for college and career readiness. The initiative evaluated in that study noted a need to focus on among other things, communication, keyboarding, and technology skills, even in the elementary grades.

Acquiring Digital Skills

The literature leaves no doubt as to the importance of digital literacy skills for individuals to thrive in education and the workplace. However, questions remain on how individuals should acquire those skills (Voogt, Erstad, Dede, & Mishra, 2013). It is not just a result of classroom learning, though classroom learning does play a strong role. Although it is common for young children to experience technology before even walking, most kids begin to learn digital literacy skills in grade school. Children first begin learning how to use technology informally by observing those around them (Plowman, McPake, & Stephen, 2008; Plowman, Stevenson, McPake, Stephen, & Adey, 2011). They not only learn these early digital skills through observation and practice but also by adopting "shared social practices with family and friends" (McTavish, 2009, p. 21). At the same time, parents influence children's attitudes and interest in technology (Lankshear & Knobel, 2011). Still, how children's digital literacy skills develop over time depends on a number of internal and external factors including access to technology, self-efficacy, number of hours spent using technology, and support from parents and teachers (Ba, Tally, & Tsikalas, 2002).

While there is not a commonly accepted measure of digital fluency, some researchers have studied students' perceptions of their own digital literacy skills. In one study by Kaminski, Switzer, and Gloeckner (2009) found that students' self-reported proficiency with some digital skills diminished from entry to completion of their college undergraduate studies. The study measured students' perception of their fluency with technology by surveying incoming freshmen and then later surveying the senior class four years later. While perceptions of fluency increased in basic skills--such as using presentation software and spreadsheets--the researchers discovered students did not engage in enough advanced applications. Specifically, students did not have as much experience creating original content using digital tools based on what they were learning (Kaminski et al., 2009). This is significant because a number of digital literacy definitions and frameworks emphasize the importance for students to develop application skills and the ability to synthesize information in digital environments and basic technology functions (Belshaw, 2012; Dudeney & Hockly, 2016; Eshet-Alkalai, 2004; Kurtz & Peled, 2016). We are interested in how this gap in skills manifests for young adults with disabilities.

The Disability Digital Divide

For students with disabilities, a gap in digital skills is sometimes referred to as the disability digital divide; this refers to the difference in access to computers and the Internet between those with disabilities and those without (Gorski & Clark, 2002). Kim and Doh (2006) identify disability as both a direct and indirect cause of this divide. The direct aspect is how the disability itself affects a person's ability to see, hear, or manipulate devices. People experience difficulties using technology when they are unable to read text on a screen due to a vision impairment, unable to hear the audio in video explanations because of a hearing loss, or unable to use functions that require clicking or using a button for individuals with limited dexterity. Indirectly, people with disabilities are impacted due to the low income and limited education and career opportunities that can result from having a disability (Kim & Doh, 2006). Research by Vicente and Lopez (2010) supports this finding, showing that people with disabilities are less likely to use the Internet due to the added costs for adaptive technology tools. Further, an individual is less prepared to use digital tools that are not easily accessible. Kim and Doh (2006) add, however, that socioeconomic factors are only part of the cause. Confidence is also a factor. Vicente and Lopez (2010) point out that people with disabilities are less likely to feel confident in their online abilities than those without disabilities. Overcoming the disability digital divide remains a challenge for educators. Despite the barriers, though, young adults with disabilities transitioning from school to college, the workplace, or other adult services can, and do, have success interacting with information and individuals online. Williams and Hanson-Baldauf (2010) investigated the usability of a web portal with support information for individuals with exceptionalities transitioning to independent activities. Key among their findings is that those with mild learning difficulties can successfully navigate online learning environments. The ability of individuals with disabilities to adapt to digital tools may be due, in part, to the existing use of technology tools they use in their personal life (M. Hall, Nix, & Baker, 2013). Seok and DaCosta (2017) concur that the regular use of digital technology can improve students' digital literacy skills. Young people with disabilities have been successful at learning and maintaining these functional skills with daily practice.

Digital Skills Success

While there is limited research focused on how adolescents and young adults with disabilities develop digital literacy skills in the classroom, the results from these studies are mostly positive. An encouraging study by Cihak, Wright, Smith, McMahon, and Kraiss (2015) examined whether high school students with intellectual disabilities could acquire and maintain functional digital literacy skills. They focused on three students in a high school special education classroom. Each using identical computers, the students completed a variety of tasks including emailing, using job-search websites, bookmarking those sites, and storing and retrieving documents in cloud storage. The researchers then examined how the students performed on those tasks. The researchers found that the students could acquire the skills with direct instruction and then maintain their skills over time. Another study by Park and Buford (2013) examined tablet use and whether using tablets could improve digital media literacy of young adults. The researchers found that tablets could improve digital media literacy, but how individuals used a device had a greater impact than the specific device they used. For example, individuals who simply played with the device did not experience the increased skills that those who used the devices for information retrieval and for socializing experienced (Park & Burford, 2013, p. 276).

Research also suggests that besides being able to apply functional skills successfully (such as operating a device, searching the web, or interacting with software), students with disabilities also possess digital agility--the familiarity, flexibility, and confidence in using digital tools to make decisions regarding the use of technology. A study by Seale, Draffan, and Wald (2010) addressed digital inclusion in higher education regarding digital agility. Seale et al. (2010) recommended educators focus on empowering students' use of technology by "recognizing and utilizing the digital agility of disabled students as well as their strategic fluency in negotiating complex decisions" (p. 459). They concluded that with the right supports, students with disabilities can be just as digitally literate as students without disabilities (Seale et al., 2010). In another study, Park and Nam (2014) compared the digital literacy skills of people with and without disabilities in South Korea; they concluded that "people with disabilities are just as capable as anyone else to become digitally literate when technical barriers are overcome" (p. 410).

The digital literacy skills that people learn and practice throughout their education carry through to the workplace and life skills. For example, online communication, which is commonplace in today's environment, is valued by students with disabilities. In a study of college students at the United Kingdom's Open University, Hall, Nix, and Baker (2013) found that "disabled students are more likely than those without a declared disability to believe that digital skills are important" (p. 216). They investigated the perception of student's digital skills development and relevance along with their motivation. While they expected to find little difference between the views of disabled and non-disabled students, their results indicated students with disabilities perceived greater importance of digital skills, including information literacy and information communication technology skills, versus their non-disabled counterparts. The researchers concluded a potential reason for the difference includes, "that these students already see technology as something that can help with problems resulting from their disability" and that "digital literacy skills may be valued as a means to facilitate person social interactions" (M. Hall et al., 2013, p. 224).

While researchers affirm that people with disabilities place value in digital skills (M. Hall et al., 2013; Jelfs & Richardson, 2010), it also holds that they may learn technology faster than those without disabilities when provided with a supportive learning environment. For example, a study by Badge, Dawson, Cann, and Scott (2008) showed students found and used controls within a learning system more quickly than those without disabilities. The researchers observed the students may have been "used to customising their own learning experiences and personalising their computing environment" and were "more self-aware than the control group" who had little interaction with the tools previously (Badge et al., 2008, p. 111). The learning environment the institution creates, however, impacts success.

Teacher and student interaction, as well as the collective efficacy and collaborations between the teacher and student are one of the key factors for student learning whether in a traditional face-to-face classroom environment or via an online environment (Donohoo, Hattie, & Eells, 2018). Trust, in particular, is extremely important. Wang (2014) addressed the issue of trust in her research, which includes having confidence not only in the e-learning system but also in the instructor and institution. Wang (2014) writes that "by implementing strategies and features that enhance the trustworthiness of online learning environments, online instructors can be more effective ... helping students with disabilities succeed in online learning" (p. 356). Social interaction between instructors and learners also increases learning goals as discovered by Alamri and Tyler-Wood (2016) who share, "[t]he extent to which the students will participate in online courses depends on the way instructor will facilitate and provide appropriate directions to their students" (p. 67). All these findings underscore the importance of the teacher-to-student relationship.

While high interaction to build trust is important, it does not necessarily imply a need for physical proximity. New approaches in education may assist by removing the visibility of disabilities. While learning can break down geographic barriers like access, as Straub (2012) points out, it may also diminish the stigma experienced by those with disabilities. Barnard-Brak and Sulak (2010) studied attitudes about requesting accommodations by college students. They stated that "individuals with visible disabilities may simply prefer online courses given that their classmates would possibly never know that they have a disability unless they chose to disclose this information online" (p. 87).

The confidence built by the use of technology tools and online communication isn't limited to education. It helps people with disabilities succeed in social engagement. Good and Fang (2015) recognize the social connections young people make using the Internet. Yet those with learning disabilities (LDs), autism spectrum disorders (ASD) and attention deficit hyperactivity disorder (ADHD) may need additional support to interact with others online safely and effectively as they transition to becoming independent adults. That support can result in improved social interactions. Good and Fang (2015) argue that young people with LDs or ASD actually benefit from online interactions where they can rely on text for communication without confusing social cues. Once in the workplace, this becomes advantageous as technology becomes a crucial component of business communications.

Research supports the need for students with disabilities to develop digital literacy skills to help them later succeed in entering and functioning in higher education and the workplace. The question remains, what can we do to help bridge the disability digital divide? Some research suggests that the answer might be by starting with the teachers and students in the classroom.

Using digital technology in the classroom provides many benefits for all students, including those with disabilities. In grades K-12, evidence suggests that digital technology can improve knowledge acquisition, engagement, student achievement, and self-improvement (Alsalem, 2016). One device studied extensively is the use of the tablet as an instructional tool. Tablets in the classroom have been shown to improve reading outcomes for students with intellectual disabilities (Coleman, Hurley, & Cihak, 2012) and reading comprehension and vocabulary of students with attention deficit disorder (ADD) (Retter, Anderson, & Kieran, 2013) and autism (Jennifer B. Ganz, Margot B. Boles, Fara D. Goodwyn, & Margaret M. Flores, 2013; Whitcomb, Bass, & Luiselli, 2011). Coyne, Pisha, Dalton, Zelph, and Smith (2010) argue that tablets are appealing to researchers and educators alike because of how easily this technology suits individuals' learning needs with modifications, which helps to provide the learner more control over their learning experience. Researchers have also found learners have shown more motivation using digital technology, like tablets, due to the personalization of the instruction over traditional classroom activities; among other things, it enables students to have more freedom to explore content independently (Hodis, Hattie, & Hodis, 2017).

Developing a Digital Literacy Curriculum for the Classrooms of Idaho

Due to the need to help students with disabilities develop digital literacy skills in the classroom that will later help them continue on to post-secondary education and/or land gainful employment, the Idaho Department of Vocational Rehabilitation (IDVR) partnered with Boise State University to develop some digital literacy curriculum. The curriculum--which the Boise State researchers often refer to as the Col-

Table 1. Digital Literacy Curriculum

	Track 1: Entering the Workplace	Track 2: Going to College
Module 1	Introduction to Communicating Online	Introduction to Communicating Online
Module 2	Building Your Employment Profile	Choosing a School
Module 3	Finding Your Next Employment Opportunity	Applying for College and Housing
Module 4	Applying for Jobs Online	Applying for Financial Aid
Module 5	Following Up	Following Up

lege and Career Prep Digital Literacy Training Program because it can be used by classroom teachers, individual students, or even IDVR counselors with customers--is a flexible, blended learning solution for individuals with learning disabilities. The curriculum consists of two tracks: one track is focused on the digital literacy skills needed to get a job and the other is focused on the digital literacy skills needed to go to college. Table 1 lists the names of each module in each track. To more adeptly meet the needs and diversity of this target audience, the curriculum was developed to be delivered in a classroom (facilitated by a teacher) or completed in a self-study format at any time or place. Each module consists of the following:

- An online video, taking a scenario-based approach, introducing the module (built-in Articulate Storyline)
- An interactive online video pretest (built-in Articulate Storyline)
- The module content (either in a PowerPoint/handout or Self-Study Guide format)
- An interactive online video posttest (built-in Articulate Storyline)

Developing a curriculum for such a diverse audience and varied contexts can be challenging. Given this, the research and development team took a design-based research approach when developing this curriculum; this involves iteratively developing and implementing an instructional intervention in authentic contexts to iteratively improve the intervention over time.

For instance, a couple of researchers worked with IDVR to present the first iteration of the modules at some local secondary classrooms. They focused specifically on getting feedback on the first module, Introduction to Communicating Online. They used two approaches: one approach had members of the research team lead a lesson on communicating online; the other approach had the classroom teachers (after a quick introduction to the content) lead the lesson. Overall, the researchers found that leading the lesson themselves was not truly testing the curriculum in an authentic setting because they did not know the students the way the students' classroom teachers did. They also learned a number of things about the curriculum through some of these design experiments of the curriculum, such as the curriculum was too long, the reading level was inappropriate, it was too text-based, and finally, many of the teachers themselves lacked digital literacy skills.

As a result of these lessons learned, the curriculum was updated and further introduced to other teachers. However, the researchers found that many teachers still lacked the digital literacy skills needed to use this curriculum in their classroom. Given this, as well as some IDVR policy changes, the researchers collaborated with IDVR, the Idaho State Department of Education, and the University of Idaho to develop a professional development online course focused on teaching teachers the digital literacy skills needed for entering the workforce or continuing on to post-secondary education. This online professional development course will be offered for the first time in the Fall of 2019. Once teachers complete the online professional development course, they will be able to download the classroom version of the curriculum to use in their own classrooms.

Implications

Through reviewing the literature and our own experience developing digital literacy curriculum for students with disabilities and special education teachers, we learned a few things that might help other teachers, instructional designers, and/or researchers, which we will briefly address in the rest of this chapter.

Leverage HPI Models

One way to approach the challenge of introducing digital literacy skills to young adults is by taking a human performance improvement (HPI) approach (Rothwell, 1999). HPI applies methodologies and strategies drawn from behavioral psychology, instructional technology, and organizational development, among others, to help people improve people's performance in the classroom, job, and elsewhere. There are several reasons we think using HPI tools for digital literacy improvement projects is worth considering. The first reason is they provide guidance for working through complex problems that involve human behavior. Changing human behavior is a difficult endeavor. Many HPI tools were designed using theoretical and empirical evidence and then tested in practice so they can be used to reliably change how people learn and behave. Another reason is the tools provide guidance for different elements of a project. HPI tools help to provide an organized framework for completing the many tasks and processes involved with such an undertaking. In practice, it could help minimize the taxation on educator's time developing instructional materials. Finally, HPI helps to keep the focus on results. The tools are designed so that the end results are always at the forefront, which is important because it makes it easier to stay on target and within budget.

Take a Universal Design Approach

Another way to approach this problem is by utilizing A Universal Design for Learning (UDL) instructional framework, an evidence-based approach to help accommodate individuals with special learning needs. Often referred to simply as UDL, it is an approach that attempts to address the needs of all learners to create; including, removing, and lowering barriers to self-actualization (Mace, Hardie, & Place, 1991). Moreover, UDL represents a growing set of design principles aimed at supporting learners while interacting within a digital learning and non-digital environments (Edyburn, 2010; Iwarsson & Ståhl, 2003; Spooner, Baker, Harris, Ahlgrim-Delzell, & Browder, 2007). The abilities or disabilities of the students do not need adjustment, but rather, the design of the curriculum and learning environment. In a case study conducted by Meo (2008), a classroom instructor noted that he typically blamed students for failing his classes thinking they were not prepared or had some personal limitations. After following UDL guidelines to develop instruction, the same instructor realized it was the curriculum that was creating barriers, and it needed to be adjusted to increase options for learning for his students (Meo, 2008). This is supported in a study by Hall, Meyer, and Rose (2012), who pointed out that UDL enables educators to "recognize that variance across individuals is the norm" and that curriculum should be "adaptable to individual differences rather than the other way around" (p. 4). Researchers welcome this concept suggesting educational institutions "place too much emphasis on the disabilities in students, not enough on the disabilities in the learning environment" (Rose, Harbour, Johnston, Daley, & Abarbanell, 2006, p. 150).

For all its advantages, it is important to remember that UDL is not a panacea. Hitchcock and Stahl (2003) prognosticate that "it is not a replacement for effective classroom practices" (p. 49). In implementing a UDL approach to learning, Hall et al. (2012) cautiously state that UDL is not a magic solution that fits for everyone. Rather, it means that all learners with all their individual differences have equal and fair access and opportunity to learn the same content in ways that work best for them.

Support the Teachers

While adapting the learning experience to fit the individual can improve learning outcomes, it is only a solution if those in roles who create instruction can apply the approach. The literature suggests that students with disabilities can successfully learn digital skills, but incorporating digital literacy in the classroom is a challenge for both general and special education teachers (Alsalem, 2016; Voogt et al., 2013). Preparing lessons that apply digital literacy in meaningful ways like (Ertmer & Ottenbreit-Leftwich, 2013) suggest, can be time-consuming. For example, one study surveyed 682 teachers, general and special education teachers, about their experiences teaching digital literacy. The top challenge among teachers was the time it took to prepare content for digital consumption (Alsalem, 2016). Combining inadequate access to technology tools and restrictive computing policies exacerbates these time constraints (Alenezi, 2017). Borthwick and Hansen (2017) suggest professional development programs may fill the gap. Alenezi (2017) identified that teachers' comfort level with technology impacted their use of it in the classroom, however, fear of losing instructional time with students prevented teachers from participating in professional development programs offered by their institutions. The College and Career Prep Digital Literacy Training program research team took this into consideration in ultimately designing a digital literacy curriculum that supports teachers' professional development while providing the curriculum they can implement in their classrooms.

CONCLUSION

In conclusion, it is possible, with the right support, for young learners with disabilities to achieve their life goals. Just like everyone else, they want to pursue their goals, dreams, and hopes in an effort to be global citizens. It is evident digital literacy skills are essential to be able to do so. They are necessary to participate in higher education, to apply for jobs, and to complete job tasks. People with disabilities, however, are at a disadvantage when it comes to learning these skills. While the barriers do exist, though, individuals with disabilities want to learn and can learn digital literacy skills when the learning environment supports their needs. The digital literacy curriculum and the corresponding online professional development teacher training explained in this paper demonstrated the need for the learning environment to adapt not only for learners but for the teachers as well. The research cited in this article also shows that educators, instructional designers, and administrators can help young people with disabilities acquire the digital skills they need to be successful in the classroom and in the workplace. The authors recommend building learning with a Human Performance Improvement approach, incorporating universal design for learning elements, and supporting the teachers with professional development and a ready-to-implement curriculum.

We have over one million young people with disabilities in our education system today. As such, it is imperative they are prepared for the transition to college, the workplace, and adulthood in our technology-rich world. They have a future filled with digital tools not yet defined; their success is built upon the digital literacy skills they develop now.

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Chapter 8
That Was Then, This Is Now: Literacy for the 21st Century Student

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ABSTRACT

This chapter focuses on the history and evolution of texts in the 21st century classroom. Authors explore the similarities and differences between print and digital texts before reviewing the latest trends and innovative literary spaces students use to make meaning and mediate academic understanding in a digitized world. At a time when literary platforms are shifting in education, it is important to recognize the juxtapositions between texts and textual operations. This chapter reviews the habits and attitudes of students towards print and media-based literacies, as well as tips and ideas on how to meet the needs of digital learners across various contexts including issues of access. Authors present a list of new literacies and practical examples for classroom implementation across K-12 settings that highlight recent learning strategies embodying a modernized approach to teaching students how to read and write. Authors conclude more research must be conducted with new literacies in the classroom to better understand the needs of digitally driven students in the United States.

INTRODUCTION

The field of literacy studies has made many educators take a deeper look into the similarities and differences between print and digital texts (Coiro, Knobel, Lankshear, & Leu, 2009). It seems not only through literature, but also by observation as a classroom practitioner, that there are certain elements and conflicts between digital texts and print-based texts that need to be combed through by educators and scholars in the field (Kist, 2005). So, what does the field need to know about this new generation

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of literacy, and perhaps more importantly, how can recognizing the similarities and differences between print and digital texts improve the way students learn to read and write in the K-12 classroom?

It begins by looking at the current scene of literacy studies and its relation to the current educational practices of teachers today. Current conditions of literacy studies have become inundated with new literacies, and because of it, Gee (2001) suggests, "…that if someone wants to know about the development of literacy, he or she should not ask how literacy and language develop. Rather, he or she should ask how a specific sociocultural practice (or related set of them) embedded in specific ways with printed words develops" (p.31). For the purpose of this chapter and discussion, a focus will be on controversy in the juxtapositions given between digital and traditional, print-based texts. This, after all, is the study of new literacy, and to some, newness is often met with distrust and avoided (Baker, 2010). This chapter will discuss print and media-based approaches to getting students literate for a new age of literacy. It appears to Millennials that a well-balanced literary diet contains both print and digital texts (Gerber, Abrams, Onwuegbuzie, & Benge, 2014). This means students should sample different ways of making sense of the world through multiple operations in the classroom. Later, suggestions are made for incorporating into educational settings many of the new literacies students are using away from school.

New literacies are inspiring refreshing changes in their wake, not in small increments, but across the educational landscape at large. As the field of new literacies continues to grow, so too does the need for researchers to zoom in and examine what brought education to its steepest literacy precipice yet. "It is in this world that national reports find a literacy crisis, and that nonstandard literacies and language forms are regarded as deficits rather than differences" (Dagostino & Carifio, 1994, p.4). With education companies like Pearson and McGraw-Hill shifting literary paradigms and moving content into digital formats, it means big changes for education. Ng (2012) discusses how, "digital technology tools are advancing and proliferating the marketplace at an increasing pace" (p.28). The relationships between digital texts and print literacy are affected by sociocultural components like politics, big business, privilege, oppression, and many others (Gee, 2017). However, for many educators their questions about how to tackle these literary issues find answers beyond the classroom (Harvey, 2018). Educators, who, considering all social components, must ask themselves: What will be the most effective literacy learning approach for the students? What does the data say about the students' reading and writing habits, and what do they need from their teacher? It is easy to get lost in the questions, and literature on the subject often falls short of good examples of what quality print and digital texts look like in K-12 classrooms across the United States (Marlatt, 2019).

Changes in the way we make meaning in the world through literacy have not always been easy to recognize, but one only needs to observe a classroom and watch students learn for a day (Harvey, 2016). Take some time to look at the pieces of text they are reading and writing. How are they using digital texts and print literacy, or how are they not using them? Watch the students make meaning from their literary experiences. Then, ask yourself if those students are reading and writing the appropriate texts that will help them prepare for the real-world, the outside-world, their world, or even the next grade level. Are the literacies being used old, current, innovative, or a mix? Kajder (2010) says, "Research shows that out-of-school literacies play a very important role in literacy learning, and teachers can draw on these skills to foster learning in school" (p.x). However, digital texts in particular need to be better integrated into the average classroom to foster such out-of-school connections to the student's literate and culturally unique lives (von Gillern, 2016). Print literacy plays a role in this, but with the increase in the use of digital media, especially among children and adolescents, there is good reason to start paying closer attention to digital texts. Educators must scan their own classroom and cultural environments to see how much print and digital text is necessary for their students (Marlatt, 2018). There is no one perfect formula for literacy learning, it depends on many factors, but considering the use of both print-based texts and multimedia-based texts is a great place to start when designing a curriculum for any subject and grade level.

OBJECTIVES FOR CHAPTER

The objectives of this literature review and discussion are to compare and contrast the important elements of digital texts to print-based texts, as it pertains to teaching K-12 students. The purpose of this literature review is to inform educators how to transition their classroom to a more culturally responsive effort towards improving literacy education for their students.

"Culturally specific institutions such as schools, homes, and libraries systematically structure the interactions that occur among people or between people and cultural artifacts such as books or computers. One cannot develop a viable sociocultural conception of human development without looking carefully at the way these institutions develop, the way they are linked with one another, and the way human social life is organized within them" (Forman, Minick, & Stone, 1997, p.6).

It is from these social connections to the world that teachers must understand cultural frameworks from which we operate, and everyone, including students and teachers, should consider how these frameworks can be challenged or changed by others to benefit learners (Fang, Fu, & Lamme,1999). Print and digital texts both relate to unique sociocultural groups, themes, and skills that set them apart from one another (Gee, 2012).

To be literate in the 21st Century, one must acquire a wide-variety of literary skills in both print and digital domains, which will be discussed in detail later in this review. If students do not acquire these necessary skills, they are at risk for becoming illiterate in the social world that demands both the ability to read and write across platforms (Howell, 2017). The term "illiterate" suggests that persons belonging to the class it designates are deviants, defined by something they lack, namely the ability to communicate. Moreover, in high-technology cultures – which, more and more, are setting the style for social domains ss across the word – since literacy is regarded as so unquestionably normative, the deviancy of illiterates tends to be thought of as a lack of simple mechanical skill" (Ong, 1986, p.190). The fact of the matter is, to be literate requires the human mind to call upon a complex network of learned skills, many in which are not innate to our being. This means the reader and writer must not only draw upon their oral language skills, but also the rules made by technologies like written text itself. When it comes to print illiteracy, school entities have been addressing it for hundreds of years. The neglect towards the digital needs of students is a relatively new concern in the history of education.

The reality is, if educators were positioned in a variety of classrooms at random in the United States in 2019, they would see a mix of print and media literacies, at a range of grade levels, being used in a wide variety of methods, in a wide variety of sociocultural contexts. According to Christenbury, Bomer, and Smagorinsky (2011), there is no substantial model or continuum for teaching digital texts like there is for print literacy development. However, Kinzer and Verhoeven (2008) describe how educational settings are changing, and more research is being done in the field to learn more about such frameworks. The work of Shute and Towle (2003) lays the basic groundwork as they describe a three component-based model for technologically-enhanced literacy learning environments; however, more work in the field is needed, especially in classroom spaces, to better understand how to teach print and digital texts in more effective ways (Donhauser, Stutzman, & Hershey, 2018). So, why does it matter that we recognize the similarities and differences of both literacies? The answer is simple: the more we know about the world of print and digital texts, the better we can teach students of all ages how to read and write better than ever before.

BREAKING DOWN LITERACY, THEN AND NOW

The inclusion criteria for literary evidence found in this review focused on scholarly peer-reviewed articles, informative texts, practitioner guides, blogs, YouTube videos, and popular video games. A variety of digital texts were reviewed in order to collect a wide scope of reference. The methodology for this literature review involved breaking up literacy learning into nine elements, which are:

- *Defining* both print and digital texts.
- Understanding the *social construction* of print and digital texts.
- Seeing print and digital texts as *technological tools.*
- Understanding the *evolution* of print and digital texts.
- Juxtaposing the *interactivity* of print and digital texts.
- Recognizing *multimodalities* of print and digital texts.
- *Acquiring* print and digital texts.
- Building print and digital texts *skills.*
- Understanding popularity and *demographics* of users of print and digital texts.

These nine elements were formed from the interpretation of three popular theoretical frameworks used when discussing education and learning. First, the structuralist model was used to explain the social structures found in both print and digital texts in and out of the classroom (Culler, 2008). Second, the constructivist theory helped to assimilate the varying ideas about how social and cognitive aspects of the meaning-making process relate to acquiring a language, contextualizing, interacting, and problem solving using print and digital texts (Page & Painter, 2018). Third, the transactional theory of reading and writing was applied to better recognize the similarities and differences between the transactions of thought that occur while readers use print and digital texts (Rosenblatt, 1988).

DEFINITIONS OF PRINT AND DIGITAL TEXTS

Print literacy may still be the most widely used form of literacy found in schools in the United States, but digital texts are expected to continue to rise in popularity and prevalence. Print literacy has evolved over the last five thousand years, and much like digital texts, it has a seemingly long life ahead of itself as more content becomes digitized (Mihailidis, 2014). It is still believed by many, like Purcell-Gates (2001) who defend the idea that children who enter schooling with a greater exposure and knowledge of print literacy, are more successful in school. This may be due to the emphasis placed on written language in schools. What if schools acquired a new emphasis on print and digital texts in their classroom? The continuum of literacy has evolved and print literacy has done its job in helping readers and writers expand their ideas and uses of language into new realms. "Only then does the technology come into its own, no longer imitating the previous forms given to us by the earlier communication technology but creating new forms and new possibilities for communication" (Baron, 1999, p.1).

Researchers like Glister (1997) have taken the stance that using and understanding digital texts should not be seen as a technical skill, but rather, as "the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers" (p.1). Lankshear and Knobel (2008) agree the most immediate and obvious facts about the use of digital texts is that there are many of them, and that they are all different in what they can offer their readers and players. Print and digital texts are defined in various ways, but it is the use of these definitions in action that affect the construction of what literacy learning looks like in the classroom. It is the job of our students to define literary needs, and it is the role of educators to implement those definitions into the learning spaces of those students.

CONSTRUCTING MEANING WITH PRINT AND DIGITAL TEXTS

One popular arena in the social sciences for us to look at the similarities and differences between print and digital texts is constructivism. "The constructivist theory is one perspective, one lens through which we can see the world" (Willis, 1995, p. 16). Constructivism is a popular theoretical framework that many educators use to assimilate their varying ideas about how social and cognitive aspects of the meaning-making process relate to acquiring a language, contextualizing, interacting, and problem solving (Bozkurt, 2017). These aspects all play a role in the literate lives of students in and out of school. Regarding print and digital texts, the question is, how does social constructivism play a role in the literary learning of K-12 students?

Both print and digital texts are socially constructed components to our daily lives. Lynch (2009) says, "In understanding literacy as a social practice, the focus has shifted from viewing language and literacy as a set of rules to using literacy in authentic events" (p.192). Either type of literacy can be used by an individual, but it is often the use of that literacy within that individual's life that makes it a social event. In short, literary events, both print and digital, are often social events that construct themselves by the participants involved. Gonsalves (2008) defends such a thought by saying, "the socialization process is a means through which children acquire the language norms, values, beliefs, of their culture" (p.3). The ways in which we use both print and digital texts in our lives to share, express, learn, defines the very social nature of literacy itself.

D'agostino and Carifio (1994) explain that as children acquire literacy skills, printed or digital, they begin to use them in a variety of ways. These ways of using literacy are found to be similar to the structuralist model of literacy, which highlights five spheres of literacy that interrelate both print and digital texts to the social environment of its users. These five spheres are: functional literacy, specialized literacy, multicultural literacy, critical literacy, and composite literacy. "Each of the spheres of literacy represents a set of skills, attitudes, and proficiencies that are needed to function in a particular context, sphere, or environment that makes particular demands" (p.3). These domains find commonality in the idea that, "Words, symbols, images and artifacts have meaning that are specific to particular semiotic domains and particular (contexts)" (Gee, 2007, p.25). It is here in these contexts that lines of literacy blur with sociocultural components as agents of power. For example, it is often in the first of these environments, the sphere of functional literacy, where we find a restrictive view of literacy at work. "It is an environment where students are expected to acquire specific technical, almost mechanical skills related to reading, writing, and speaking as measured most often by current standardized reading tests"

(Dagostino & Carifio, 1994, p.4). In the future, the technical literacy skills required for students to be competent and digitally literate might be very different. Students might be expected to navigate a three-dimensional space while narrating digital self-created stories or asked to create a digital diramana about the last chapter they read with their augmented reality headsets. The skills needed to be literate in 2019 are deeply rooted in the sociocultural aspects of society and are certainly considered places of controversy within the field of literacy studies (Bodomo, Lam, & Lee, 2003). Educators play a large role in creating literary expectations and change because they are the primary representatives of the educational system.

Meyer and Whitmore (2010) discuss what it means to reclaim the joy in the literary spaces of learning where students and teachers need it most, the classroom. "Perhaps the most egregious insult to reading teachers and learners in the current legislative and policy climate is the marginalization of the rich sociocultural capital within the communities that schools serve" (p.287). The field of literacy is a socially constructed place that intertwines with the good, the bad, and the ugly of any community. Thus, it is fair to say that the field of literacy is a socially mediated place where both print and digital texts serve as regular modes of communication and learning. Meyer and Whitmore (2010) explains, "We argue in this chapter that joy is not a simple feeling of euphoria or pleasure; it is also found in moments of intensity when dealing with something powerful and important" (p.280). Print literacy has offered itself a great stage for students to express themselves through different forms and genres of print composition like narratives, poetry, journaling, reflections, and so on. The narratives and counternarratives of students today may not necessarily be found on classroom walls, household refrigerator doors, or crumpled up under a desk, but in the virtual spaces where students feel safe to let their voices be heard; such are the places like blogs, Twitter feeds, Snapchat stories, Instagram posts, Facebook threads, and other media that students interact with on a daily basis.

THE EVOLVING NATURE OF PRINT AND DIGITAL TEXTS

Print literacy has played an extremely important role in helping humans understand how to read and write in the world. As Burke (2001) describes it, the technology of the written word has been around for roughly five thousand years. He makes the case that the invention of the alphabet up to forty-five thousand years ago has pushed the boundaries of human consciousness to our current status today. He also describes how the last three thousand years have changed the way humans read and write. Landow (1992) describes technologies like the Gutenberg printing press that changed the way print literacy could be accessed by the masses. Since then, many schooling systems slowly adapted such technology and began to rely on print literacy to disseminate their often didactic curricula. Print literacy itself can be championed with bringing literacy to where it is now. Picking up in the 1980's, media-based texts began offering new ways in which students could generate meaning through texts. Technology has continually given students new ways to access inquiries and communicate with the world.

The evolution from print literacy to media-based literacies has changed the way educators and students think about writing as an act of composition. The number of hours spent using paper and pencil in the classroom are beginning to decrease, but what is taking its place? Portable electronics like tablets, laptops, smartphones, and various other gadgetry are occupying the reading and writing spaces in and out of the classroom. For many students in the United States, their digitally literate lives require them to type, print, click, search, scroll, track, etc. on a daily basis. Media-based texts are shaping the way students compose their ideas in the real world and in the classroom (Burke,2001).

PRINT AND DIGITAL TEXTS AS TECHNOLOGICAL TOOLS

Print and digital texts are similar in that they are both technological tools. Ong, (1986) discusses how writing is a technology, and that it restructures thought for those who construct it, and those who read it. He expresses his belief that writing is a technology that separates the knower from the known. He uses an example from Plato's condemnation of writing in the *Phaedrus* and *Seventh Letter* to explain how the uprising of certain technologies, like written text, were believed to regress one's ability to internally retain their own thoughts. Instead of keeping their thoughts inside their head, they would share them, not orally, but in written form through text, and then eventually lose them. This is in part true now today. If a person only shares their ideas and language orally, meaning can be lost from one generation to the next. The act of writing using printed text contains a sense of permanence on the writer's behalf because the ideas and language accessed by others later in time, even if no one hears or reads it during one's lifetime.

Nearly three thousand years ago, Socrates described writing as inhuman in its manner of pretending to establish outside the mind what in reality can only be known in the mind. Ong (1986) explains this inhuman way of thinking in relation to numerical literacy with the rise in the use of pocket calculators in the 1980's. Then, parents feared their children would not develop the internal structures necessary to support the advancement of their mathematical ability because their pocket calculators were providing them with an external resource for conceptualizing simple math operations, such as multiplication. The same argument can be made with word-processing programs like *Microsoft Word* and *Pages* that auto-correct spelling mistakes for students who have not yet internalized their ability to spell words correctly in the first place. The same can be said for smartphone apps with auto-correct features for writing. Are some of the world's digital texts hindering the development of traditional reading and writing skills?

Printed literacy, or that in which has been made to be read in a traditional format like a book, journal, clay tablet, scroll, etc., have now provided students with text (new and old) that has two-handedly changed the way students learn to read and write in school. Traditional printed literacy affords a higher degree of permanence over digital texts, as is it remains, physically, in this world, whereas digital texts require another step into the virtual realm to access them. It should also be noted that traditional print-based literacies do not require electricity or the internet to operate. This is why traditional print-based texts might always be the most accepted form of literacy for learning, as it is the easiest to access in a wide-variety of sociocultural contexts.

MULTIMODALITIES OF PRINT AND DIGITAL TEXTS

The multimodalities found in print and digital texts express an evolving relationship between both discussed forms of literacy. Mahiri (2006) explains, "Traditional conceptions of print-based literacy do not apprehend the richness and complexity of actual literacy practices in people's lives enabled by new technologies that both magnify and simplify access to and creation of digital texts" (p.61). Students, especially the millennial generation, make meaning of the world in multimodal ways. Different types of digital texts that students commonly encounter in their educational environments in print form are picture books, information books, newspapers and magazines. It is not just the millennial generation who interacts with one another this way, older generations have adapted these skills needed to function in the concurrent literary world. The millennial generation was born with media-based literacies like the Internet, computer programs, and video game consoles. This has indeed shaped the way people read and write in and out of school. However, chances are high that the richness of new technologically driven literacies are not experienced in the classroom.

Gee (2007) says, "…there really is no such thing as learning "in general". We always learn *something*. And that something is always connected, in some ways, to some semiotic domain or other" (p.23). Every Digital Game Based Learning environment is a different semiotic domain, and it requires its user to not only intake information through multimodal ways, but also output such information back into the semiotic domain as a producer or writer. Pulling from Rosenblatt (1988), it is the transaction of thought between the reader and writer that fosters such meaning-making found when exploring digital environments. Approaching digitized environments with a purpose relates to what Dewey (1938) believed to be a crucial component to learning in any context. To learn in any DGBL environment is to first acquire an experience, an understanding, or a simple awareness of the semiotic domain itself. To learn using a multimodal text means operating as an active agent in the semiotic domain.

Gee (2007) explains that both digital texts and print literacy can be viewed as multimodal, meaning texts can be mixed with words, sounds, movement, and bodily sensations that make reading and writing come to life. Gee (2007) says:

"Once we see this multiplicity of literacy, we realize that when we think about reading and writing, we must think beyond print. Reading and writing in a domain, whether it is law, rap songs, academic essays, superhero comics, or whatever, are not just ways of decoding print, they are also caught up with ways of doing things, thinking about things, valuing things, and interacting with other people – that is, they are caught up with different sorts of social practices" (p.18).

A common place to share print texts with students is the classroom, or any real space where students and educators can meet to share ideas about literary pieces of text. A common place for digital texts may very well be the classroom, but the classroom (or learning space) is now virtual, which allows students to immerse themselves somewhere else related to the digital text environment. Examples of this can be seen with students in a classroom reading a piece of text as they are taken on a virtual field trip via the computer, or with a virtual reality headset using augmented reality. This example should help paint the picture of how digital texts in virtual spaces detached from the physical space, engage students in literary practices that cannot be entirely experienced by print literacy. Even though digital and print-based texts are multimodal, they are different in the ways they are acted upon by readers and writers. Palfrey and Gasser (2008) argue that digital natives see and navigate through the world differently than those who do not develop the skills needed for digital texts.

POPULARITY OF PRINT AND DIGITAL TEXTS

Nearly all of today's readers and writers will face both print literacy and digital texts in their education and especially in their social lives outside school. For educators, the most accessible form of literacy is printed literacy. However, educators are using more and more digital texts in schools, and it is changing the way students make meaning with their curricula. Dagostino and Carifio (1994) explain how, "…the expectations and goals of literacy education must change as society changes and makes new demands on its citizens" (p.2). As society changes what it means to be literate, so too should education, and that change has been slowly lagging behind since the 1980's with the rise in media-based technologies that would soon become synonymous with the millennial generation like the internet and console-based video games. As the scene of literacy continues to change, here are some questions for us to consider:

- What are the needs of the readers and writers at the present moment, and what might they need in the future?
- How much print and digital texts do they need?
- What are the trends with print and digital texts and how do they compare and contrast with one another?
- How do these media-based spaces influence and change the way students read and write?

The popularity and demographics of both print and digital texts are interesting aspects of study for this review as they illustrate talking points that can help educators create a literary environment that lends itself to the *now* of literacy, while tastefully infusing the literacy of yesterday--print literacy. When it comes to digital texts, the world of video games is a great place to start looking into the demographics of digital readers and writers today. According to the Education Software Association's 2018 annual report, 60% of Americans play video games daily. The average age of a gamer is thirty-four, and 61% are male. The report also concluded that 67% of parents play video games with their child at least once weekly. It also explains how 56% of the most frequent gamers play multiplayer games at least once a week, spending an average of seven hours playing with others online and seven hours playing with others in person. These data highlight the importance of understanding digital spaces as places of situated meaning-making, and that within these spaces, students are learning how to read and write like never before.

The world of the Internet, a place accessible by computer, tablet, smartphone, or any other web-based device, is another great place resource to study the habits of the digitally literate. According to Lenhart, Purcell, Smith, and Zickuhr (2010), the use of Internet-based features being utilized by media-based technology has increased in recent years, especially amongst children and adolescents. "Three-quarters (75%) of teens and 93% of adults ages 18-29 now have a cell phone. In the past five years, cell phone ownership has become mainstream among even the youngest teens. Fully 58% of 12-year olds now own a cellphone" (p.4). Furthermore, nearly two-thirds of teen internet users (63%) go online every day – 36% of teens go online several times a day and 27% go online about once a day. Also noted in the report, "white teens were also slightly more likely to go online frequently – several times a day – compared with Hispanic teens, who are more likely to report going online once a day" (p.7). These numbers help practitioners and researchers better position themselves and their practices within the current state of literacy.

In 2012, the Pew Internet group conducted a survey and found that, "The volume of teen texting has risen from 50 texts a day in 2009, to 60 texts a day in 2012, for the median teen texter" (p.31). The amount of digital texts that students are consuming each day is a highlighted concern because research appears to reveal very little about the long-term effects of these trends. In addition, data is suggesting that more attention needs to be given to the exposure to such digital texts found on the internet like blogs, wikis, social media, and video games just to name a few (Benko, Guise, Earl, & Gill, 2016). More than social media: Using Twitter with preservice teachers as a means of reflection and engagement in communities of practice Benko, Guise, Earl, & Gill, (2016). The facts are there, digital texts are growing, and K-12 learners are using it more and more, but how does that compare with print literacy in the United States?

The scene of print literacy in education remains strong in the United States. In 2014, the Pew Internet Group conducted a survey with 6,224 students, age sixteen and older, and found, "As a group, younger Americans under age 30 are more likely than those 30 and older to report reading a book (in any format) at least weekly (67% vs 58%). In 2016, The Pew Internet group claimed that printed literacy still remained the foundation for America's reading habits, but they suggested in time that the popularity of e-books and other digital texts may trump print literacy. However, there are large publishing corporations involved in education and publication that impact the staying power of print-based texts.

For many college students, buying textbooks is a routine aspect of school, but the Internet makes it easier to get digital copies of texts, which has reduced the overall price of college texts. It is unclear whether shifts in classroom literature, packaged and sold by big businesses, will continue to be disseminated in the form of printed literacy in the future, but Clive-Matthews (2015) explains:

"The textbook has been a staple of education since the dawn of the age of writing. Designed as overviews of knowledge and introductions to fields of study, textbooks were intended to give a base level of knowledge in a subject for students (and teachers) who lacked access to libraries, expert instructors, or time to browse. One of the earliest known examples, a medical textbook known as the Edwin Smith Papyrus, dates back to as early as 3,000 B.C" (p.1).

Will the day come when printed texts are seen as a second-hand literacy among classrooms in the United States, or will they maintain their place in the classroom for years to come?

SKILLS FOR EXPLORING PRINT LITERACY

The skills required to be literate using print and digital texts are both similar and different. The wide-variety of uses involving both print and digital texts warrant the need to examine the required skills students need in and outside of school to function in the world. These skills, and their accompanying tools, will help students better navigate printed texts, while also interacting with the ever-evolving field of new literacies. The process of learning how to read and write printed texts begins during early childhood.

Mahn, (2012) discusses Vygostky's often misrepresented conceptual paradigm of the meaning-making process involved in acquiring language. (Vygotsky, 1987) expressed in, *Thinking and Speech,* that the speaking/thinking system required to make meaning in the world relies heavily on the sociocultural contexts and constructs in which language learning is occurring. As these social constructs become increasingly digital, it has become difficult to understand how or what specifically is influencing the ways students learn to make sense of the world.

Learning language does not prescriptively operate in the minds of the learner. It is through this connection between human thought and our environmental experiences that we make meaning of the world around us through language (Vygotsky, 1987). It starts with the skill of being aware of one's surroundings. From there, it grows from a child's inner thoughts, self-talk, utterances, and oral talk. From there, children learn to decipher and decode symbols for meaning using their prior knowledge to build connections of meaning in the brain. Tankersley (2003) explains how, "…little by little they begin to understand that there is a separate written symbol that corresponds to each sound in our language. Then they learn that these sounds can form words and that words can be put into sentences for other to share" (p.166). As children progress with their exposure to printed texts, they recognize and decode simple words and sentences. Children will practice what they hear and fill in the gap with generative meaning-making. Children will practice retaining what they read, see, hear, and make up themselves as they reinforce their modes of thinking and functioning in the world using print literacy. Children must be able to relate their inner thoughts into writing through simple sentences and ideas as they progress through early grade levels. It is the goal that students become fluent in their ability to express themselves through writing that pushes the process of learning to read and write in a natural manner inspired by inquiry and experience.

By middle school, students are expected to start creating strong connections between content, background knowledge, and new learning (Zoch, Myers, & Belcher, 2016). They are now expected to summarize, discuss, synthesize, evaluate, analyze, and interpret literature and informative texts. The list of skills needed to be a reader and writer in the classroom is extensive. The Common Core State Standards (CCSS) address many of these skills in their K-12 reading and writing standards. It has not been recognized until recently that skills like digital publishing and analyzations of different digital texts are to be expected to be featured in the common classroom. However, there are many digitally literate skills that are still not included CCSS. In 2015, the International Society for Technology in Education revisited their learning standards with the hopes of filling gaps where politically driven standards, like CCSS seemed to fall short (Lynch, 2017).

The widespread use of technology has spawned the need to identify what students are doing cognitively when they participate with digital texts (Lynch, 2015). The use of such skills may not be explicitly known by users of digital media, but it is certainly attracting more attention from researchers and educators in the field. Those who read and write with media-based texts will interact with that text in very different ways than users who are accustomed to using print-based texts (Rust, 2017). Grainger (2010) provides some of the key differences in the way readers must address print and digital texts. He highlights the following key skills as modes of thinking for approaching print and digital texts. First, printed words *tell* readers and digital texts *show* readers. Second, some digital texts require the use of kinesthetic and listening activities. Third, interpersonal meaning from digital texts is developed by the positionality of the reader instead of printed text itself. Fourth, digital texts can replace verbal imagery with visual imagery and motion. Last, readers of digital texts will often navigate in non-linear fashions while reading, versus the often linear process of reading traditional texts.

SKILLS FOR EXPLORING DIGITAL TEXTS

It can be noted that the skills needed to read print-based texts can be used with digital texts. Leu et al. (2004) defends this notion by explaining that identifying important problems, locating information, analyzing usefulness, synthesizing information, and communicating these things to others are some of the skills that students need. Many of the skills used to navigate digital texts derive from the medium of the technology itself (Mills, 2010). Although all digital texts contain their own semiotic domains and ways of being in their environment, it is important to factor in what participants do as they interact with that world (Gee, 2007). The acts of being in that world instigate the nature of what it means to navigate through the world, making-meaning and creating connections that change the way its users think. Such is the task of understanding how digital texts can be taught in ways that are similar to how printed literacy has been disseminated for years. Even video games can be considered literature, but it would not be appropriate to say that a video game has been read, but rather, experienced and played. When students mediate meaning of the digital narrative in a digital, game-based environment, they are practicing what it means to read and write with digital texts. This perspective is based on the construction of knowledge through experience as an acquired skill set that some children have and others do not. The authors of this chapter believe an expectation of all educators is to prepare all students with the skills necessary to be literate members of society, and this might mean that educators need to modify their methods in how they reach students using print and digital texts, across disciplines, in all grade levels.

The millennials who now fill the school systems grew up when digital texts were rising in popularity and capability. It was also the millennial generation who grew up in a position to start making sense of the world alongside the explosion of technology that was occurring at the same time. Millennials grew up acquiring the necessary reading and writing skills for digital texts without any real strategy or research-based instruction. Some of the skills they learned included mediating three-dimensional spaces in video games, using software, replying to social media applications, or even just browsing the Internet to name a few skills that are different than the traditional print-based reading and writing skills students needed to know just a decade ago.

According to Palfrey and Gasser (2008), the very nature of how millennials use literacy in the 21st Century is a clear example of how their children will grow up in an environment where virtual communications and digital texts are used regularly and will most likely have an effect on the child's meaning-making process. For educators who grew up using digital texts, there seems to be less is struggle when it comes to sympathizing with students about their literary needs.

It would be foolish to think that printed texts by themselves are responsible for the progression of a student's ability to read and write in the world. It is safe to say the process of learning how to read and write digital texts also begins during early childhood. One study on reading skills and comprehension with young children in the United Kingdom stated, "…not all forms of print exposure are equally associated with reading skill, it would be interesting to examine the skills that are being developed by different texts, as students reading habits reflected a shift towards more time spent engaging in digital texts than more traditional texts" (McGeown, Duncan, Griffiths, & Stothard, 2015, p. 565).

It would make sense that students simultaneously get exposed to and are influenced by digital texts while they learn how to read and write using printed texts. It must be said that students who are exposed to digital texts and printed texts at an early age may be more likely to be better prepared to make-meaning and communicate in the world. Here are some questions to think about as the chapter continues:

- With technological media and device exposure at an all- time high in the United States, how has the environment children make meaning in changed?
- How has this new environment changed the way a child makes meaning?
- How do students make meaning with digital texts?
- How do we know if a student is media literate enough in third grade for example?

EXPERIENCING PRINT AND DIGITAL TEXTS THROUGH IMMERSION

As the field of literacy continues to evolve, it is important to think about how students experience both print and digital texts in their daily lives outside of school and what that means for their learning inside school. Theorist Louise Rosenblatt (1988) believed there was much to learn about the way readers experience a text. In the digital age, this belief appears to still hold relevance. Educators seek to better understand how adolescent readers experience digital narratives and mixed reality experiences in the classroom. For current researchers interested in understanding how student immerse themselves with literature using digital texts, the relationship between the reader, the text, and the meaning elicits further exploration such as those found in video games and mixed reality applications. Educators should help forge student relationships with the literacies they use in and out of the classroom. Whether an educator chooses to use primarily print-based texts, mostly digital texts, or a healthy mixture of the two, they will

Figure 1. Students solving a mystery in a video game as Sherlock Holmes in The Devil's Daughter

Figure 2. Comparison of mobile games like Snake (1997) and Clash Royale (2019)

still have to be cognizant of the literary interactions that occur when their students use them. Digital texts like video games and mixed reality applications can provide researchers with a unique window into how students immerse themselves in digital narratives and virtual spaces. For example, Sir Arthur Conan Doyle's beloved Sherlock Holmes has been rendered into video games over the years since 2002 with the latest being created in 2016 with episodic mysteries to play and solve, see figure 1. Students are now capable of acting as Sherlock Holmes instead of hearing the adventure from Dr. Watson's account. This gives students an immersive experience into the detective experiences of Sherlock Holmes, his mysteries, ways of being, and greatest of all, a sense of empathy than can be unmatched with traditional print-based approaches to literature study.

Mobile-based games like *Clash Royale, Clash of Clans,* and *Minecraft: Pocket Edition,* are considered current education-friendly favorites within the scene of mobile-based gamers today. These games have come a long way since mobile games began to appear on phones in the late 1990's. Schilling (2011) reminds us it was *Tetris* that first appeared as a mobile game in 1994 on the Hagenuk MT-2000. Soon after, *Snake* appeared on Nokia's 6110 in 1997. Since *Snake*, mobile-based games have evolved in their complexity into games like *Clash Royale,* which came out in 2016, and expects its players to understand the use of ninety-three different characters' attributes and limitations during gameplay, whereas Nokia's *Snake* required its users to learn one character's attributes and limitations during gameplay, see figure 2. For example, millennials who grew playing mobile games first evolved from basic mobile gaming literacy to advanced gaming literacy where players have to account for more than simple moving images and interactions to complex symbolic interpretations, and quick, in-game decisions.

The latest virtual reality and augmented reality devices have proven themselves to be major players in the repertoire of innovative literacies available for teachers. These devices provide teachers and students with the opportunity to approach a wide range of curricular experiences from different perspectives. New technologies like the *Microsoft Hololens 2*, set to come out in 2019, will provide innovative spaces

Figure 3. Rumii virtual reality lecture hall with students and a lecturer

Figure 4. An example of Nier: Automata asking the player to think about their in-game decision

and experiences for students to learn. Researchers can use this new technology to learn more about how students interact within mixed reality contexts. The *Oculus Quest* virtual reality headset, released in 2019, provides its users with thousands of applications and resources for players to play, research, experience, and collaborate. For example, Rumii, a collaborative application for virtual reality devices allows users to meet in virtual environments that foster collaboration without a classroom, see figure 3.

These devices, used as learning tools, are capable of propelling teachers' and students' understanding of digital texts and storytelling into new realms (Anderson & Jiang, 2018). Brown (2008) says,

"If videogames, like literature would transform consciousness and enthrall both critical and popular audiences, its creators must be artists as well as artisans, trained in the craft of writing, as well as the use of the complex tools necessary to tell stories in this new medium" (p.19).

Players get the chance to *become* a character in the video game, and this new stance of what it means to play and read may change what it means to empathize within narrative spaces and texts. Researchers like Murray (1997) believed that video games could serve a greater role in developing interactive narratives, and indeed they have over the years with video games like *Mass Effect* series, *Nier: Automata,* and *Detroit Become Human,* see figure 4.

Figure 5. A group of students attacking a Behemoth in Dauntless on classroom computers

Personal computer gaming, or better known as (PC gaming) has taken rise and is currently favored among many experienced and not-so experienced gamers around the world (Harvey, 2018). Using computing power via laptop, tablet, or desktop computer, players can access digital games like *Dauntless*, *Fortnite*, *Minecraft*, and thousands more, see figure 5. With the recent rise in *Chromebook* usage in school classrooms (Schaffhauser, 2015), educators are interested in how they can leverage web-based games and software to build digital reading and writing skills for the 21st Century student.

TRENDS IN NEW LITERACIES IN THE CLASSROOM

In recent years, there has been a refreshing amount of research on new literacies in the classroom. The authors of this chapter have seen the changes first-hand as public educators, and now as pre-service educators, who hear and see the changes when we visit classrooms. Technology has crept its way into the classroom and educators at all levels are beginning to take a closer look at how digital texts might play a larger role in their curricular goals. As the evolution of literacy continues to provide new learning affordances for classrooms, educators must attempt to stay up to date on the latest modalities for reaching their students. For example, the rising popularity of virtual reality and augmented reality devices has led to an increase in their understanding and use in schools and other fields as tools for experiencing, creating, and collaborating on content in new ways. Educators must understand the importance of using the latest technologies or they will eventually be doing their students a disservice by not preparing them with contemporary, multimodal resources. Educators must seek to understand and implement the literacies they grew up learning alongside, the literacies they use as adults, and the future literacies their students will use as trends in technology continue to evolve in the classroom.

The transactional relationship between digital texts and print literacy may shed light on the evolving nature of literacy studies. Human activities and relationships are seen as transactions in which the individual, and the social, cultural, and natural elements interfuse. Although both literacies share many theoretical commonalities, the field of literacy studies seems to be scaffolding itself for more complexity as technological advances push the boundaries of what it means to be literate in the 21st Century. The interactivity of new media-based literacies may challenge the meaning of what it means to empathize with digital spaces and characters with the advent of user-friendly, high-quality virtual reality capabilities. DGBL has been explored recently as a powerful avenue for employing conventions of literacy learning as digital play.

CONCLUSION

At a time when literary platforms are shifting in education, it is important to recognize similarities and differences between print and digital texts. If the aim of educators is to make their students more literate, in any discipline, the literature found in this review recommends they incorporate a mix of both print and digital texts into their curricula. Educators are also recommended to take an inventory of the literacies their students use or do not use in and out of school. The literature suggests that giving students the opportunity to use both print and digital texts in school will better prepare them to make meaning in the future as society becomes more digitized. The skills required to be literate in the 21st Century have grown, and it demands that educators adopt a wider scope of what it means to use digital texts for learning. Much of the literature found in this review discusses the ideological concepts of literacy in relation to education; however, more research is needed from classroom practitioners to fill gaps surrounding the field. What does good literacy learning look like across disciplines in the K-12 classroom? What can we learn about the evolution of literacy and learning by using both print and digital texts with students? These are questions for educational researchers and classroom practitioners. The field needs detailed, qualitative examples of students' interactions with both print and digital texts in a variety of disciplines in K-12 classrooms to better understand what skills and literacies are needed to best serve their needs.

DISCUSSION QUESTIONS

- How has our notion of what it means to read and write changed over the last 30 years?
- How can we leverage new literacies for new results in education?
- How can pedagogical strategies keep up with new literacies and literary affordances?
- How does an educator know when to use print-based literacies instead of digital texts?
- What is the right amount of print and digital texts needed to best educate students in the 21st century?
- Should educators focus their attention to digital texts over literacies like printed magazines, hardback books, and foldable maps?

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Chapter 9
Contemporary Archival Description as Required Digital Competence of Today's Archivists

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ABSTRACT

This chapter examines the significance of knowing archival description standards, metadata models, and serializations for archivists who work in archival institutions and organizations of record creators. The author starts with international standards and one Croatian organization, which generates archival descriptions automatically by the archives management tool it uses. This software functionality was to become possible because the organization had professional knowledge of required standards. Also, the author explains university and professional education programs in Croatia, which build the digital competence of today's Croatian archivists. Moreover, the chapter outlines the global practice with archival description and production of finding aids in ways which are adequate today. Finally, the author uses the described case study, the analysis of finding aids practice in Croatia, the analysis of educational programs in Croatia, and the analysis of the global state of archival description to offer conclusions about the importance of this professional competence.

INTRODUCTION

This chapter was inspired by the journal article about computer-generated description as the required digital competence in the archival profession, published in the *International Journal of Digital Literacy and Digital Competence* (Rajh & Pavetic, 2017). The article detected that the production of computer-generated finding aids is a very sophisticated digital competence of today's archivists, and the usage of this competence becomes increasingly frequent. The practices with contemporary archival description,

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in general, are using computer technologies to produce up-to-date finding aids, so they are correspondingly considered to be digital competence.

The archival description is a process of gaining control over the archival materials and facilitating their usage and interpretation by producing their descriptions. Finding aids are the products of archival description in completed forms of inventories, guides, lists, registries, and so forth. Finding aids and metadata descriptions of archival materials can be formatted as books, or they can be prepared as computer files - structured and serialized in many different ways.[1] Metadata is data about archival materials in this sense. Those professionals who describe archival materials or records as potential archival materials are archivists and records managers. Professionals in charge of records work in two kinds of environments; in those where records are being created, on records creators' archival collections, and in those where records are being preserved, i.e., in archival institutions. Archivists are experts in charge of archival processing (accession of materials into archives, archival arrangement, description, preservation), and additionally, from a current perspective, they are deeply involved in records management, information governance, and even the design of information systems which manage all information assets of organizations. The border between current record and the archival record, predominantly established with the rise of the modern state administration and strongly marked in the 20th century, as Theo H. P. M. Thomassen stated, has weakened in the digital age of the facilitated re-usage of the recyclable and quickly disseminated information (Thomassen, 1999). While the responsibilities of archivists and records managers may vary, as Thomassen also stated, the same profession includes archival and records management, so all these practitioners should share the same theoretical foundation, methodology, and conventional and digital competences.

There are numerous international and national standards for archival description, finding aids, metadata structures, and serializations today, and archivists must acquaint themselves with these standards. The role of university and professional education providers in the learning of these professional standards is quintessential. The standards that archivists use have been maintained by professional bodies such as the International Council on Archives (ICA), the Library of Congress, the Preservation Metadata Implementation Strategies (PREMIS) working group, the World Wide Web Consortium, and so forth.

INTERNATIONAL STANDARDS AND NATIONAL LAWS AS FOUNDATION FOR DESCRIPTIVE PRACTICE

Professionals who handle current and historical or archival information and records consult various standards in their everyday work. Standards related to the archival domain deal with processes such as the appraisal of material, their disposition, transfer and destruction, digitization, microfilming, and so forth. Besides that, they deal with the quality of material, packaging and storage conditions, and physical or digital repositories. Moreover, they cover the issue of management of records and collections. Also, there are risk management standards in this domain. In addition, there are ways to standardize particular properties of records, for instance, digital signature and their long-term preservation. In comparison, there are standards that seek to preserve records' authenticity not by preserving their digital signatures but by other means such as blockchain technology. In this universe of standards, there are some standards that facilitate the description and visibility of information or records. These standards focus on metadata. Among all of these standards used in the archival domain, this chapter pays close attention to the next three types of standards. At first, there are descriptive standards used by both "traditional" and "digital" archivists (1). Then, there are standards for (meta)data models (2), and there are also serializations standards (3) that extend descriptive standards and require new (digital) competence.

- **Descriptive standards:** descriptive standards used on a global scale are the following – "General International Standard Archival Description" or ISAD(G) for describing archival materials, "International Standard Archival Authority Record for Corporate Bodies, Persons and Families" or ISAAR(CPF) for describing records creators, "International Standard for Describing Functions" (ISDF), and "International Standard for Describing Institutions with Archival Holdings" (ISDIAH). Records creators are institutions that create (potential) archival materials, and their description provides context for these materials. Institutions with archival holdings are usually, but not exclusively, archives. The International Council on Archives maintains these standards. There are various national descriptive standards, which conform to the stated international standards, such as "Describing Archives: A Content Standard" (DACS), accepted by the Society of American Archivists. All these standards provide conventions that ask archivists to use specific metadata when they describe archival entities. Those entities are archival materials, records creators, their functions, other agents, institutions with archival holdings, activities, and so forth, depending on the standard. As Susan E. Davis stated, the early development of descriptive standards in archival practice can be traced back to the seventies and eighties, ISAD(G) and ISAAR(CPF) were adopted in the nineties, and ISDF and ISDIAH had their first release in the noughties (Davies, 2003). In 2016 the consultation draft of the conceptual model for archival description called Records in Contexts (RiC) emerged (International Council of Archives, 2016). The next draft version of its conceptual model was planned for 2019 (Clavaud, 2018). RiC will also include specific ontology (Gruber, 1993; Borst, 1997; Studer, Benjamins, & Fensel, 1998; Guarino, Oberle, & Staab, 2009).[2] Archival description based on ISAD(G), ISAAR(CPF), ISDF and ISDIAH uses records creator and its context to comprehend archival materials so RiC could become the 'one standard to rule them all' with the change of the notion of provenance and the shift from record creator's context to the plurality of possible contexts. Description of archival materials is usually completed in an electronic (computerized) form of some finding aid. For instance, an inventory and description of all archival entities are nowadays usually maintained by an archival management system/archival data management system. For this, the archivists require additional metadata standards.
- **Metadata standards:** The archivists should use the conventions related to the structures of previously defined finding aids and metadata. Inventory created in compliance with ISAD(G) could be prepared in the Encoded Archival Description (EAD) format for the exchange of descriptions among numerous archival institutions and their archival management systems. Similarly, as ISAD(G) metadata are implemented using the EAD metadata model, ISAAR(CPF) can be implemented as Encoded Archival Context (EAC) and ISDIAH as an Encoded Archival Guide (EAG) for sharing descriptions of records creators and institutions with archival holdings. Other standards related to metadata structures are Metadata Encoding and Transmission Standard (METS), PREMIS, Dublin Core (DC), and so forth. METS is an XML document that contains descriptive, administrative, and structural metadata about digital objects in digital repositories (Library of Congress, 2019b). METS includes the header element, descriptive metadata section, administrative metadata section, file section, structural map, structural links, and behaviors with the described item. PREMIS is the model of semantic units which represent properties of entities related to the preservation of digital objects. These entities are the object, activity, agent, and

rights connected with the object. The object encoded in the PREMIS standard is an intellectual entity hierarchically divided into its various representations, files, and bitstreams. The PREMIS data dictionary specifies the semantic units of each entity (https://www.loc.gov/standards/premis/v3/premis-3-0-final.pdf). DC is used to describe various resources by using fifteen core metadata terms for their description, such as the title of the resource, its creator, identifier, subject, description, publisher, contributor, date, type, format, source, language, relation, coverage, and rights. DC became an ISO standard in 2009 (the last revision – ISO 15836-1:2017).

- **Serializations:** Various serializations express various metadata models – to increase the drama in the archival plot. Serializations are the ways to present and interpret a metadata model. METS is serialized in XML serialization. Data models can even be combined, for example, PREMIS can be combined with METS, which serves in that case as the container, and then it then can be serialized in XML format. Lately, PREMIS is serialized through the use of turtle (https://github.com/PREMIS-OWL-Revision-Team/revise-premis-owl/tree/master/examples). METS standard the with ISO standard for Open Archival Information System (OAIS), a standard that deals with digital repositories and their stored information packages. In that use case, METS is used as an XML file that brings metadata of OAIS information packages. PREMIS also relates to ISO OAIS standard in the same sense as METS documents do. Various serializations of PREMIS are used today, as Thomas Habing noticed, due to systems' and networks' capacities, processing of metadata, the targeted agent of the interpretation of metadata (human/software), storage, indexing and retrieval of metadata, and the characteristics of metadata structures themselves (Habing, 2016). The situation is more or less applicable to other metadata models also.

Besides the standards, national archival laws are essential for descriptive practice too. It would be an endless task to comment on various national laws regarding archives and archival practices, so the author will focus only on Croatian archival legislation. Croatian archival practice with finding aids and archival description has many similarities with archival practices in the neighboring countries with which Croatia shared the administrative and archival domain history in Austro-Hungary and Yugoslavia. The case study mentioned in Rajh's and Pavetic's article described archival legislation in Croatia in 2017 and the practice with finding aids (Rajh & Pavetic, 2017). In July 2018, the new umbrella archival law entered in to force in Croatia (Law on Archival Materials and Archives, Official Gazette, 61/18). The law requires the production of bylaws or supportive ordinances in one year, so the majority of the new bylaws came into effect in late summer and autumn 2019.

Before the new bylaws came in, the situation was the following: records creators prepared lists of metadata about their archival materials, and archival institutions produced several types of finding aids. The descriptive practice of institutions in the Croatian National Archives (CNA) network and the creation of archival finding aids were prescribed in the special Ordinance on Registers (Official Gazette 90/2002 and 106/2007 – this ordinance was still valid in the period of writing this chapter). Finding aids prepared by archival institutions were founded on ISAD(G) international standard, but without leaning on international standards on metadata structures and serializations. The ordinance (Official Gazette, 90/2002, 106/2007) prescribes the Registry of archival fonds and collections of the Republic of Croatia, dossiers of fonds or collections, summary guides, and summary and analytical inventories. The ordinance is obligatory for institutions from the archival network of Croatia and institutions enrolled in the register of archival institutions, but not for records creators from the public sphere. Regarding the metadata structures, progress has been made with archival description good practice examples provided by the Croatian archival society. Examples of finding aids can be found on the National Archival Information System (NAIS) webpages (NAIS, n.d.). NAIS serves as the repository of archival descriptions and digitized archival materials, which originate from various archival institutions and records creators (http://arhinet.arhiv.hr/default.aspx).

Records creators *usually* do not create finding aids but lists with metadata about their holdings which they prepare in XML serialization and export to NAIS, with some exceptions, like the case of Croatian Agency for Medicinal Products and Medical Devices, described by Rajh and Pavetic (Rajh & Pavetic, 2017). Records creators prepared their XMLs according to NAIS' schemas. The bylaw (ordinance) for administrative institutions which create public records (public records creators) prescribes the creation of metadata by records creators according to the schemes and the submission of metadata to CNA (Ordinance on the Protection and Preservation of Current and Archival Records Outside the Archives, Official Gazette 63/2004 and 106/2007). This bylaw is expected to be replaced in late 2019 or early 2020. The author is a member of the working group which aims to produce this bylaw. Metadata provided by records creators should be transmitted to CNA, and eventually used in their finding aids. The bylaw will define the required set of entities, properties, and relations, or classes and data and object properties. There are advantages in opting for one of the globally recognized metadata structures. However, although the bylaw is in its draft stage, it is apparent that the legislature will opt for the set appropriate for the Croatian national administrative domain. Of course, this legislative decision carries a consequence. The implementation of the bylaw, for the interoperability reasons, would require metadata mapping to common metadata structures and serializations – or the development of the specific ontology for this domain and preparation of metadata files according to one or more of the selected serializations. For normal operations, the update of records creators' databases should be sufficient. Another working group of experts is in charge of producing the package of bylaws for the archival institutions, but the work of these two groups are coordinated, so it is expected that Croatian records creators and archives will have harmonized practice. The new bylaw for the production of finding aids in archival institutions, i.e., Ordinance on Registers, was also in the pipeline at the time of writing this chapter.

Competence in Archival Description

This digital galaxy of descriptive, data-modeling, and syntactic (serialization-related) standards, to stay just on the descriptive part of archival practice, is very wide and complicated, so archivists should be taught and well trained in order to use them. The author uses the case of the Agency for Medicinal Products and Medical Devices in Croatia, described in the work of Rajh and Pavetic (2017), to show the set of competence areas required for the production of contemporary finding aids.

Computer-Generated Archival Description in the Agency for Medicinal Products and Medical Devices

In 2017, the computer-generated archival description function was designed by the IT solutions vendor Omega-Software from Zagreb (Croatia) and the Agency for Medicinal Products and Medical Devices. This software functionality was applied to the commercial archival management system produced by Omega-Software in 2012 while working on the use cases of the Agency for Medicinal Products. T. Pavetić and A. Rajh and were both involved in the development of the archival management system and the development of the computer-generated description functionality, as vendor's expert and the subject-matter expert of the client. The Agency for Medicinal Products and Medical Devices is the national drug regulatory authority and a record creator. The archival management system installed in the Agency serves the Agency to manage and control its current and archival material. The system is connected with the Agency's digital archives, case management/letter office application, and its business applications. The Agency regularly submits XML files with metadata about its archival holdings to NAIS. The goal of the implementation of this new function was to enable automatic production of the summary inventory of the Agency's holdings. The functionality was designed to create inventory in human-readable and in machine-readable form. The human-readable form was designed according to good practice examples on the Croatian archival society's webpages (CAS, 2019), and computer-readable form was prepared according to EAD3 finding aid structure standard (Library of Congress, 2019a). During the development of the new functionality, Rajh and Pavic analyzed the literature and standards and conducted metadata analysis to plan the work on Omega's archival management system installed in the Agency, as stated in their article. Standards that were included in the analysis were ISAD(G) and ISAAR(CPF), and the literature was related to their implementation. The development started with the implementation of metadata of entities associated with the creation of archival material, consistent with the ISAAR(CPF). It was followed by creating links between these entities and descriptions of archival materials prepared according to the ISAD(G) standard. The last step of the development was related to the generating of the summary inventory in two forms – as EAD XML file and as Microsoft Word file. The EAD XML summary inventory file declares the method of its production and then lists the standards which have been used for the description of the Agency's archival holdings:

```
    <maintenancestatus value="derived" />
    <maintenanceagency>
      <agencyname>Agencija za lijekove i medicinske proizvode</agencyname>
    </maintenanceagency>
  (…)
    <conventiondeclaration>
      <abbr>ISAD(G)</abbr>
<citation>ISAD(G): General International Standard Archival Description, second
edition, Ottawa 2000</citation>
    </conventiondeclaration>
    <conventiondeclaration>
      <abbr>ISAAR(CPF)</abbr>
<citation>ISAAR(CPF): International Standard Archival Authority Record for
Corporate Bodies, Persons and Families, second edition, Canberra 2003</cita-
tion>
    </conventiondeclaration>
(…)
```

Competence Related to the Archival Description

The previous section of this chapter indicated the competence required for the production of finding aids. This section provides the list of standards used in the case of in the Agency for Medicinal Products and Medical Devices (HALMED, 2019), during the development of its computer-generated archival description functionality, as well as the standards that would be useful for the production of archival descriptions in any present-day organization.

- **General process-based or function-based, and technical standards literacy:** these standards refer to archival processes and broader processes used by the archivists in their work
  - Knowledge of standards used in archival processes
    - In the case of the Agency for Medicinal Products and Medical Devices, the collection management standard was consulted (ISO/TR 19814:2017). Risk assessment was conducted for the description process as well as for other archival processes in the Agency (ISO/TR 18128:2014).
    - In general, the ISO standard related to Open Archival Information Systems (ISO 14721:2012), and the transfer of content (ISO 20104:2015, ISO 20652:2006, ISO 13527:2010) would be useful because those descriptions could be used alongside the content, when this content is being transferred from one archival environment to some other archival environment. ISO 14721:2012 was not used in the development of computer-generated archival description function because it was already applied to construct the Agency's digital archives.
- **Descriptive, metadata, and serialization standards literacy:** these standards refer to archival description, the structuring of descriptions, and their interpretation potential.
  - Descriptive standards of the International Council on Archives
    - In the example of the Agency, metadata about its current and archival materials, as well as about its units and the organization itself as the records creator was prepared according to standards ISAD(G) and ISAAR(CPF).
    - In general, standards of the International Council on Archives such as ISAD(G), ISAAR(CPF), ISDF, and ISDIAH, or RIC, should be the foundation of archival description functionalities.
  - Other standards related to the description of resources
    - In the example of the Agency, ISO metadata standards were consulted during the design of metadata processing and for the estimation of efficacy of metadata handling (ISO 23081-1 to 3, in their earlier versions). The Agency used EAD in its version 1.0.0 from 2015 as the metadata structure standard. It also used the W3C XML standard for the serialization of its finding aid in computer-readable form. For the human-readable form of the summary inventory, the Agency used Open XML standard (ISO 29500).
    - In general, other useful standards include metadata structure standards, serialization standards, and linked data standards, web-ontology language guidance documents for specific metadata structures, W3C standards, and standards related to thesauri and vocabularies for retrieval.

Besides knowing the standards which are required or convenient for the process of describing archival materials, related competence includes knowing the metadata analysis and metadata mapping techniques. How can a person who works with archival materials gain such knowledge and skills? A person can acquire archival competence and become a professional archivist in Croatia by graduating the archival science program from the Study of information sciences or by graduating from any other 5-year university study and by taking the professional archival exam after at least one year of practice in an archive. The Study of information science, offered by the Department of Information and Communication Sciences, Faculty of Humanities and Social Sciences at the University of Zagreb, includes the following courses at the BA level: "Introduction to Archival Theory and Practice," "Records Management, Archival Arrangement and Description," "Archival Appraisal," and "Protection of Archival and Library Materials." The MA level comprises of the following courses: "Digitization and Migration of Documents," Information Sources and Systems in Archives," "Metadata for the Management of Materials," "History of Institutions," "Digital Archives," "Digital Preservation," "Planning and Designing of Archival Management Systems," and "Management of Archival Institutions." At the University of Zagreb, students study information science as a single or double major. They are required to gain 180 European Credit Transfer and Accumulation System points (ECTS credits) at the BA level and 120 ECTS credits at the MA level. After graduating the MA level study, students in Zagreb acquire the title of Master of information sciences and gain the archival science competence in their diploma. The Department of Information and Communication Sciences (in Zagreb) is currently working on the new archival science MA program - with the proposed courses: "Archival Theory," "Archival Processing and Description," "Records Management," "Digitization," "Records and Archival Management Systems," "Archival Policies and Practices," "Digital Preservation," "Archives and Society," "Advanced Technologies in the Archives," "Metadata and Linked Open Data," "Legal Context of Records and Access Management," "Archival Pedagogy," and "Project Management." The last two courses should be elective. However, this is still in the early planning phase.

The study of Informatology organized by the Department of Information Sciences at the University of Osijek offers several courses related to archival science such as "Metadata and Identifiers," and "Management of Institutions in the Information Domain" at the BA level, and "Digital Data Preservation," "Paper Materials Preservation," and "Collection Management" at the MA level. Similarly, the Department of Information Sciences at the University of Zadar offers several archival courses as well: "Organization of Records in Information Institutions," "Motion Picture Heritage," and "Introduction to Digital Archives" at the BA level. At the MA level, they offer "Archival Theory and Practice," "Modelling and Building of Digital Collections and Services," "Archival Appraisal," "Preservation of Archival Materials," "Management of the Preservation of Materials in the Archives," "Libraries and Museums," "Systems for Archival Descriptions and Access to Archival Materials," and "Processing of Digital Materials." The Catholic University of Croatia offers one archival course as part of the Study of History – "Introduction to Archival Science." The Polytechnic in Pozega offers a professional study of administration, with courses related to archival practice such as "Office operations" and "Archiving." However, this is not an archival study; students are awarded the title of "Bachelor of public administration." Archiving is a required course in the third year, credited with 3 ECTS. It contains fifteen lessons about archival legislation, the mandate of archives, archival materials, terminology, appraisal, transfer, arrangement, access and use, repositories, ICT in archives, and so forth (https://www.vup.hr/_Data/Files/1202011184154.pdf). The lessons about archival description and ICT in archives need to include more content about metadata, structures, and serializations. Students in Osijek do not acquire the archival science competence in their diploma. The University of Zadar does not produce Master's graduates with the archival competence in their qualifications neither; the information science program is offered as a single major, but the students have a relatively small number of required archival courses at the BA and MA level. The last time the course "Systems for Archival Descriptions and Access to Archival Materials" was held was in the academic year 2016/2017, and the emphasis of the information science program in Zadar is not on the archival science.

The most relevant archival existing courses from the perspective of archival description, structuring of metadata, and their serializations from above-mentioned university-level studies are the following:

- The Study of Information Science at the University of Zagreb
    - Archival Arrangement and Description (a required course in the second year at the BA level study, http://theta.ffzg.hr/ECTS/Predmet/Index/5934)
        - This course contains fourteen lessons; eight lessons refer to archival description, metadata, metadata structures, and serializations. Archival description standards taught to the students are the International Council of Archives standards, so metadata structures related lessons are focused on EAD and EAC. Students should become conversant with the descriptive standards in archives and records creators' organizations, international standards for the description, Croatian descriptive practice, and the most significant metadata models and their serializations.
        - The course comprises thirty hours of theory and thirty hours of practice. Students earn 6 ECTS credits for attending this course.
    - Metadata for the Management of Materials (a required course in the second year, or an elective course in the first or second year at the MA level, http://theta.ffzg.hr/ECTS/Predmet/Index/3179)
        - This course contains fourteen lessons, and at least ten lessons refer to archival description, metadata, metadata structures, and serializations. The course focuses on EAD, METS, Dublin Core, and PREMIS standards. According to the course plan, the last lesson is focused on the interoperability of metadata and standards.
        - The course comprises fifteen hours of theory and fifteen hours of practice. Students earn 3 ECTS credits for attending this course.
- **The Study of Informatology at the University of Osijek**
    - Metadata and Identifiers (a required course in the third year at the BA level, https://sokrat.ffos.hr/ff-info/kolegiji.php?action=show&id=294)
        - According to the course webpage, this course is more focused on librarianship then archival science, but it contains lessons that refer to METS and Dublin Core metadata, XML, and RDF metadata serializations, and the interoperability issues.
        - The course comprises thirty hours of theory and thirty hours of practice. Students earn 5 ECTS credits for attending this course.
- **The Department of Information Sciences at the University of Zadar**
    - Systems for Archival Descriptions and Access to Archival Materials (an elective course in the first or second year of the MA program, http://www.unizd.hr/Portals/70/docs_stari_web/Diplomski_revidirani_program_informacijske_znanosti_2015-16_HRV.pdf)
        - The course covers description and access issues – it explains the character and scope of archival metadata, the descriptive standards of the International Council on Archives,

EAD and other metadata structures, RDF, XML serialization, the relationships to other heritage institutions' standards, the future of description. The majority of content units of the course are connected to the archival description-metadata models-serializations nexus.

- Students earn 4 ECTS credits for attending this course.

Regarding the professional archival exam, although Croatia is in the period of changing the related ordinance, the conditions and methods of acquiring the professional titles are similar to previously prescribed conditions and methods (e-Counseling, 2019).[3] The titles in the archival profession in Croatia are the following – archival technician, senior archival technician, archival technician-specialist, senior archival technician-specialist, archivist, senior archivist, and archival advisor. For instance, the exam for the archivist title, as the most recognizable professional title, comprises several general and specific subjects. General subjects are related to the outline of the civil and legal system in Croatia, legislation in the domain of culture, the preservation of archival material, and informatics. The specific part of the exam includes subjects such as "Archival science," "History of institutions in Croatia," and "Records management." An archivist can have a supplementary specialty or expertize such as "film archivist," "conservator," "old records specialist," and "modern records specialist."

The Croatian Council on Archives (Ministry of Culture of the Republic of Croatia, 2019) prescribes the content of the subjects and the literature for the exam. The exam reading list includes the descriptive standards of the International Council on Archives, several texts on the arrangement and description processes, guidelines on best practices for using electronic information, and ISO 23018 metadata standard "Metadata for records."[4] However, the list includes no literature dedicated to metadata models, serializations, visualization, ontologies, semantic web, and linked data of any kind. There are two commissions further involved in this process, one is in charge of taking exams, and the other is responsible for awarding archival practitioners with senior professional titles (senior archival technician, senior archival technician-specialist, senior archivists, archival advisor). Before the new ordinance, the conditions of acquiring the professional titles were open to the interpretation by members of the commission in charge of this matter in various periods. Some archivists who did not work in the national archival network but in records creators' institutions or other types of archives were allowed to take the professional exam in one period, and the others who were in the same situation were not allowed to do the same later. In the first case, the commission interpreted the archival practice as the practice with archival materials. The same was interpreted in the second case as something which happens only at the archives of the state. The regulation was the same, but some commission members were adamantly against the idea of sharing professional titles with archivists who work in records creators' milieu. The conditions in the new respective ordinance will allow archival professionals to take professional exams no matter where they are employed as long as they work with archival materials. This corresponds to the present-day global archival practice and makes a strong case – it would be in everyone's interest that the educated experts work with archival materials.

RECOMMENDATIONS

After looking into the legislation and archival education in Croatia, the recommendations are put forward and systematically presented in Table 1. The first one aims to widen the practice of archival description to all archival professionals, no matter where their work, as long as they work with present and future archival materials. It is important to take issue with the opinion that archivists describe materials in archives only, not in records creators' organizations – as their original place of creation. In Croatia, the digital archival holdings are being preserved in the original environment for a maximum of ten years before their transfer to archives (Law on Archival Materials and Archives, Official Gazette, 61/18). Moreover, this period is even longer for conventional materials – it is thirty years. It looks like a waste of time to avoid describing archival materials while they lie on records managers' shelves or servers. It would be better to teach the records managers about describing their materials and to allow them to do so. Describing records in the moment of their creation or shortly after that is essential for their protection as it would enable proactive preservation activities. Also, backlogs are being created when the archival profession avoids describing records for which it is known according to retention plans that they will become archival materials. The practice of archival description should be extended towards future archival materials. Thence the first recommendation is to extend the archival description practice to archivists who work in records creators' environments and to attune its quality. Regarding the extension of the descriptive practice, the ordinance related to the practitioners in records creator and those related to practitioners in archives should be harmonized in parts where they prescribe the description of holdings. Attuning the quality of the finding aids requires harmonizing the production of various finding aids, so they become more typical. Finding aids in Croatia have almost the features of the work of art. This situation implies that they are incompatible to a large extent. In other words, the archival description practice should be harmonized and extended to all professionals who work with potential archival materials.

The second recommendation is to harmonize the collection of metadata from the creation of records in administrative institutions to their preservation in archival environments – during the entire records continuum. The new ordinance related to records creators prescribes gathering records management and potential archival metadata from the very beginning of the records lifecycle. Harmonizing the bylaw for records creators with those for archives in this matter would maximize the efficiency of metadata management. Archival legislation usually prescribes collecting metadata in one of the well-established metadata structures. Using a standardized structure simplifies migrations of metadata to different commercial IT solutions for archival management. The upcoming bylaw for records creators is introducing the data dictionary of its own because it is being produced in the period when ISAD(G)-related standards are still dominant, and RiC is still in its initial stage of acceptance and implementation. The additional reason concerns the distinctiveness of record management practice in Croatia. Though many metadata structures exist in the wider archival domain, there is no structure that contains all that was predicted to be in the Croatian administrative domain. For the stated reasons, it was hard to decide on a particular metadata structure in this lawmaking process.

Archivists are creative while they work on their finding aids and descriptions, even with the existence and restrictions of descriptive standards. Also, there are many metadata structures for usage, many different ways to serialize the chosen structure, and many ways to store it into the repository. However, there are rules, validation procedures, and best practices. There are more and less effective methods to produce, maintain, and transfer an archival description. Some finding aids are being produced in a maladroit way. The archival description could be articulated and communicated in many ways. Future records managers and archivists who will be employed by records creators' organizations or archives should be conversant with the variety of ways of describing archival materials. They should attend the courses which explore the subject and putt this knowledge into practice. From the point of view of the author of this chapter, which takes into account the analysis of archival courses, there are not enough courses related to subjects

Table 1. Recommendations related to archival description training in Croatia

	Recommended measures	Who should implement these measures?
1	To widen archival description practice to include more archivists in records creators' environments and to attune the quality of descriptions.	Universities Croatian Council on Archives Croatian Archival Society (as the professional association)
2	To harmonize bylaws to support more economical production and transfer of metadata.	Ministry of Culture of the Republic of Croatia
3	To transfer current archival description trends into the university and professional programs.	Providers of the education and educational materials – universities and the Croatian Council on Archives

of archival description, archival metadata, and serializations for information science students in Croatia. The third recommendation is, therefore, to monitor current trends in archival description, anticipate the future of archival description, and help information science students to prepare for practical tasks. It is important to teach future professionals to create archival descriptions compatible with new standards and global developments in the field. In this way, Croatian archivists, who are proficient in the creation of content of finding aids, could become more competitive on the global market, participate more in global archival projects, and contribute more to the present-day archival practice.

EMERGING TRENDS IN ARCHIVAL EDUCATION AND PROFESSION RELATED TO ARCHIVAL DESCRIPTION

The topics related to archival description should be more represented in the formal education of archivists in Croatia today. While a three-year BA program of information science at the University of Zagreb has 180 ECTS credits, and a two-year MA program has 120 ECTS credits, a minimal number of ECTS credits comes from the courses related to the archival description, metadata structures, and serializations, so a small number of ECTS credits is appointed to this matter. In the end, a small share of students' time and effort is spent to gain archival description related competence. The new, proposed archival science MA program of the Department of Information and Communication Science in Zagreb promises progress in this sense. However, it is still in the early planning phase. The author of this chapter is involved in the development of the new program. The future and emerging trends in this field are connected to the usability of descriptions, the portability of metadata, and the interoperability of systems that contain metadata. Content analysis is traditionally also in focus of the education and training of future archivists. Some of the most critical skills related to the archival description include the following:

- **Traditional competence related to content analysis**
    - analysis of the records creator and its history
    - analysis of the history of the archival material
    - analysis of sources related to the archival material being described
    - analysis and implementation of standards
        - descriptive standards

- **New competence which considers the usability of descriptions, portability of metadata, and interoperability of archival management systems**
    - analysis of existing and anticipated users
    - analysis and implementation of standards
        - metadata structures
        - serializations
        - other contemporary subjects such as the implementation of linked data paradigm, visualization of archival materials and other
    - preparation and implementation of various serializations as final outputs
    - metadata mapping from and to multiple structures and serializations
    - migration of metadata
    - efficient and sustainable metadata management

Regarding the professional development of archivists in Croatia, their professional titles, and their specialties, it is quite possible that more specialties will appear in Croatia gradually. The primary division of specialties to "old records specialty" and "modern records specialty" simplifies the archival profession too much and does not correspond to the new professional tasks in an appropriate manner. It is possible to implement methods for visualization of older archival records that have been digitized and show them to the audience in a new way. It is also possible to deal with digital records and to describe them traditionally. This disrupts the difference stated in the ordinance related to professional titles as it makes this difference irrelevant. Regarding the film archivists, it is evident that their specialty covers just a few of the content and media types of archival materials. Similarly, as having the conservation specialty defined in the ordinance, the methods and processes related to the stabilization and retroactive repairs of digital records could also be specified. In other words, the list of specialties should be updated. However, this should be done in a monotonous and systematic manner, applying the same or similar criteria. The specialties in the archival profession should be respectively uniform, meaningful to the professionals, and relatively stable, and at the same time, they should reflect the archival concerns of the present-day. This is a difficult task for the future.

CONCLUSION

Archival practitioners implement arrangement plans and describe archival materials. In the description phase, which is inseparably linked to the arrangement and usually starts amid the arrangement, they need to analyze the material and its creator and produce the description or particular finding aid. Before and during the production of the finding aid, the archivist needs to analyze the designated community of users of the finding aid and material and make decisions related to metadata and descriptive standards, metadata structure, serialization of these metadata, visualization and presentation issues, and so forth. When archivists use archival management systems, they do not have to handle the serialization of finding aids themselves, but they need to understand the serialization process, its results, and their effects. This is important because maintaining archival metadata and finding aids goes beyond the lifespan of particular projects and archival management IT tools.

Table 2. Comparison of the past and the present situation, and a plausible future related to archival description practice in Croatia

	Professional who works in records creator's organization in Croatia	Professional who works in an archival institution in Croatia
Past situation	− Archival description did not exist. − Descriptions were not based on descriptive standards. − Finding aids and descriptions were not prepared by standardized metadata models. − Metadata sets were not prepared in standardized serializations. − Metadata sets were not prepared for re-use, and archival holdings were not visible to the public.	+ Archival descriptions existed. + Descriptions were based on descriptive standards. − Finding aids and descriptions were not prepared by standardized metadata models (EAD, METS, and so forth). − Metadata sets were not prepared in standardized serializations. o Limited visibility of archival holdings.
Current situation	o Rare cases of archival descriptions exist. o Rare cases of descriptions that lean on descriptive standards exist. o Rare cases of finding aids prepared by standardized metadata models exist. o Rare cases of metadata prepared in standardized serializations exist. o Linked data projects with metadata about records creators, creators' administrative cases, and records are in their infancy stages.	+ Archival descriptions exist. + Descriptions lean on descriptive standards. o Rare cases of finding aids prepared by standardized metadata models exist. − Metadata are not prepared in standardized serializations or prepared for usage, transfer, and interpretation according to other current requirements. o The visibility of archival holdings is minimal.
Plausible future	+ The archival description exists as the upgrade of records management evidence. + Descriptions lean on standards, or the national practice is built upon standards. + Finding aids are prepared by records creators according to standardized metadata models, or the metadata created by creators can be used by archival institutions for the production of finding aids. + Metadata are prepared in standardized serializations, + …or ready for transfer, further usage, and new interpretations by generating metadata consistently.	+ Archival descriptions exist. + Descriptions lean on standards. + Finding aids are prepared by standardized metadata models. + Metadata are prepared in standardized serializations, + …or ready for transfer, further usage, and new interpretations by generating metadata consistently.

+ = predominant practice, ¡ = rare cases, – = non-existent practice

By implementing the stated three recommendations, a plausible future of practice with archival materials in Croatia should look as indicated in Table 2. The first recommendation aims to take the practice with a proper archival description in archival institutions and to use it in records creators' organizations too. As long as archivists describe materials that are considered archival, as stated in organizations' retention plans, regardless of the place where they handle these materials, they should use appropriate archival description techniques. The implementation of the first recommendation should enable proactive preservation measures and prevent backlogs. The second recommendation is linked to the new bylaws and asks for additional harmonization of these bylaws to support more economical production and transfer of metadata. The implementation of the second recommendation should ensure efficient metadata management and spare time required for archival processing. The third recommendation suggests the integration of archival description trends into university and professional programs. Standards should be added to courses related to archival legislation. Metadata structures, metadata mapping, serialization topics, ontologies-related topics, liked data, and semantic web topics could be covered by metadata-related or similar courses. The implementation of the third recommendation should ensure the necessary competence and skills in describing archival material and increase the visibility of records creators, archives, and their heritage.

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KEY TERMS AND DEFINITIONS

Archival Legislation: Legislation in the domain of the archival profession. Archival legislation in Croatia consists of the highest law on archives and bylaws which regulate particular issues of archival practice.

Archives: 1) The accumulation of archival materials of a records creator for the preservation purpose. 2) A physical or virtual environment where archival materials are accumulated and preserved. 3) An institution with the mandate to preserve archival materials. 4) An organizational unit entrusted with the task to preserve organizational archival materials.

Archivist: A professional who carries out archival processes of on archival materials in an environment that contains such materials.

Descriptive Standard: Standards used by archivists for describing archival materials and related archival entities. A descriptive standard defines which metadata should be used. Archival descriptive standards are ISAD(G), ISAAR(CPF), ISDF, ISDIAH, RiC.

Finding Aid: A product of the archival description process that contains metadata about archival material in an arbitrary form or according to selected metadata model. Finding aids are produced to manage and interpret archival materials. Finding aids examples are guides, inventories, lists, and so forth.

Metadata Model: A structure of metadata which facilitates transmission, use, and interpretation of metadata between various human and software agents. Metadata models used by archivists are METS, PREMIS, DC, and so forth. A metadata model defines the structure for metadata set defined by descriptive standard (in case of EAD) or introduces a new set of metadata (in the case of METS, DC, or PREMIS).

Serialization: An expression of the structure of metadata which presents the structure and thus facilitates the transmission, use, and interpretation of metadata between various mostly software agents. Serializations used by archivists are XML, RDF, JSON, Turtle, and so forth.

ENDNOTES

1 "Serialization typically describes how a data structure or data model is converted into formatted bits that can be stored in some physical medium, such as disk, tape, or computer memory, or transmitted across a network. The goal is to be able to recreate a semantically equivalent data structure or data model by reading the serialized, formatted bits from the storage media or from the network." Habing T. (2016). Serialization of PREMIS. In A. Dappert, R. Guenther R., S. Peyrard (Eds.) Digital Preservation Metadata for Practitioners. Switzerland, Cham: Springer, p. 161.

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Section 3

Teacher Perspectives While Integrating New Technologies in Education

Chapter 10
Use of Smartphones for Self-Regulated Foreign Language Learning Activities

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ABSTRACT

Smartphones can significantly affect the development of foreign languages in two distinct ways. Firstly, online informal learning of languages may result in naturalistic foreign language acquisition while mobile assisted language learning implies the use of smartphones following a conscious decision to engage in language learning activities that would result in the improvement of one's language competence. Based on quantitative and qualitative methodology applied on a sample of undergraduate students in Slovenia, the main objective of this chapter is to explore the use of smartphones for self-regulated English language learning activities beyond the language classroom.

INTRODUCTION

The device that young adults are most likely to use to access internet content is their smartphone or "mobile supercomputer" (Abdous, Facer, & Yen, 2012; Leis, Tohei, & Cooke, 2015). In fact, already in 2012 more young people used the internet every day than computers, which indicates online access through mobile devices (Eurostat, 2016). Within just a few years, smartphones have developed from niche items into the primary devices used to access online resources. However, the fact that younger generations daily use smartphones to access internet content to meet their personal needs does not necessarily imply that they will willingly embrace mobile resources for learning (Stockwell, 2008; Lyrigkou, 2018).

Smartphone activities involving language use fall under the umbrella of two concepts. The first is online informal learning of languages, in particular of English as one of the predominant languages of the online world. Online informal learning of English was defined by Sockett and Toffoli (2012) as the result of activities that users of English perform online and that involve exposure to language input as

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well as language production and interaction in a variety of authentic communicative events. In this chapter language development that results from engagement in online informal learning of languages where learning the language is not the primary focus of the activity will be referred to as language acquisition (Krashen, 1982), seen as emulating the process of acquisition of one's mother tongue. The attention of the language user is placed on the meaning rather than linguistic form, and takes place during authentic language reception, production, or interaction activities in the physical or virtual environment. In fact, this type of learning is similar to language development in naturalistic settings (Kusyk, 2017; Sockett & Kusyk, 2015). Learning the language in this case is not the primary focus of users that access online content with other professionally or personally relevant objectives in mind (for example, to watch YouTube clips for entertainment purposes). Nevertheless, some studies show that experienced language users will engage in online informal activities with a primary or secondary aim to learn the language (Jurkovič, 2019; Trinder, 2017).

The main focus of this chapter is the second relevant concept when discussing the use of smartphones for activities involving language use. This is mobile assisted language learning or "the use of mobile technologies in language learning, especially in situations where device portability offers specific advantages" (Kukulska-Hulme, 2013, p. 3701). The use of smartphones with a primary intention of improving one's language competence will be referred to as language learning (Krashen, 1982), seen as that part of the process of language development that is conscious in nature, places attention on the language form and not only meaning, and usually takes place in classroom settings or regulated by others, for instance teachers. In the case of self-regulated language learning through smartphones, the main objective of the smartphone user is to access resources that will support conscious language learning and enable them to place the learning focus on the language form, for example using smartphone apps, visiting websites with language learning exercises and tasks, or accessing online dictionaries.

The three most frequently addressed research topics in mobile assisted language learning studies so far have been teaching vocabulary, the usability of mobile assisted language learning systems, and (existing and potential) user stances toward mobile assisted language learning (Duman, Orhon, and Gedik, 2015). In most studies made into the effects of mobile assisted language learning on language development (recently, for example, Çakmak and Erçetin, 2018; Cho, Lee, Joo, and Becker, 2018; Seibert, Hanson, and Brown, 2019), the learning was teacher- or researcher-regulated. This means that these studies do not reflect the language learning activities that smartphone users engage in when their learning is not dictated by others, i.e., when it is self-regulated.

From a theoretical standpoint, this chapter can be understood within the framework of the theory of agency, especially given that language learner agency is essential to language learning development (McLoughlin, 2016) in the language classroom and beyond (Lai, 2015; Paiva, 2011). As defined by Duff (2012), agency refers to an individual's ability to make choices, take control of their own actions, self-regulate their learning activities, and pursue their individually set goals. In addition, agency can be related to leaner autonomy, motivation, and self-efficacy (Sade, 2011).

Within the theory of agency, language learners are viewed as active participants in their own personal language learning process (Kukulska-Hulme, 2016). In turn, self-regulation is understood as the degree of active participation of the language learners in their own learning (Zimmerman & Risemberg, 1997). From the perspective of the complex dynamic systems theory, agency can be understood as a system that is relational or always linked to the affordances provided by the context in which learning takes place, emergent or characterised by the possibility to develop, spatially and temporally situated, achievable by means of the learning environment, changeable through iteration and co-adaptation, multidimensional, and heterarchical (Larsen-Freeman, 2019). In an environment that examines language learning and acquisition through the use of smartphones, agency allows the language learners to exploit to their benefit (or not) all the affordances provided by smartphone technologies (Lai & Zheng, 2018) and enhanced accessibility.

Therefore, in this chapter self-regulated learning is understood as the learning of metacognitively, motivationally, and behaviourally engaged learners whose efforts to learn are not regulated by external agents, such as teachers, parents, or others (Zimmerman, 1989). This means that the learners themselves decide when and how they will engage in language learning and which resources they will use for this purpose.

The main objective of this chapter is to present a study into the use of smartphones for self-regulated language learning activities, and the reasons underlying smartphone users' choices when language learning activities are involved. In this way, the chapter will contribute to the still under-researched field on the use of mobile devices for learning outside the language classroom (Stockwell, 2013). In the pursuit of this goal, the literature review section will first examine the literature on mobile assisted language learning, with emphasis placed on meta-analyses of language learning apps and of mobile assisted language learning projects. With a comparative objective in mind, the main findings of the most recent studies on online informal learning of English and other languages will then be summarised. The two research questions set for the study are presented next, followed by a description of the adopted research methodology. The results are then presented in relation to each research question. In the discussion, the results are interpreted and placed into the broader international context of research studies in this field. In the conclusion, the findings are summarised, the ideas for future research drawn, and the limitations of this study acknowledged.

Literature Review

Kim and Kwon (2012) analysed an inventory of 87 language learning smartphone apps in terms of their content/design, procedure and approach, and technological features. The main findings indicate that the majority of the analysed apps only include short language data (e.g., wordlists or dialogues) and aim at the development of vocabulary. Only few support collaborative learning or socially interactive learning. Instead, they are based on form-focused instruction following audio-lingual and task- and test-based methodology but do include sounds, music, or videos. Most are designed as a study reference and not full instruction courses. The authors conclude that smartphone apps have the potential to develop the productive skills of writing and speaking but they usually do not.

In a meta-analysis of implementation studies in mobile assisted language learning over twenty years, Burston (2015) found that most studies were teacher-centred, and focused on English as a foreign language for adults, with the development of English vocabulary as the main objective. 90% of them were designed for individual voluntary extracurricular and out-of-class use. Given their focus on structuralist grammar and vocabulary drills, they did not introduce any pedagogical innovation to foreign language teaching. In most cases, mobile assisted language learning was not integrated into the curriculum and hence remained at the level of pilot testing with a limited number of students.

Importantly for this chapter, several studies into mobile assisted language learning have also shown a significant drop in the use of mobile devices for learning after the completion of the experiment, so the users did not continue to independently use mobile devices for language learning after the end of the teacher- or researcher-led experiment (Kondo et al., 2012) nor used digital devices for language learning although they had been instructed on their benefits and uses (Jarvis, 2014). In addition, research data suggest that computers are the preferred tools for conscious language learning activities if compared to mobile devices (Jarvis & Achilleos, 2013).

Viberg and Grönlund (2013) divided the limitations of mobile assisted language learning into technical, psychological, and pedagogical limitations. The technical limitations include, for instance, the small screens that smartphones and tablets have compared to the screens of laptop or desktop computers (Gikas & Grant, 2013). Moreover, too much technical knowledge that is required from teachers in terms of (even simple) materials design is a serious hindrance (Kukulska-Hulme, 2016; Viberg & Grönlund, 2013). The most important psychological limitation to mobile assisted language learning seems to be that learners might perceive their smartphones as devices that they only use in their private lives for personal needs related to entertainment and social purposes rather than educational purposes and thus learning (Abdous, Facer, & Yen, 2012; Khabiri & Bagher Khatibi, 2013; Kukulska-Hulme, 2009; Lai & Zheng, 2017). Nevertheless, this attitude seems to have slightly shifted in the recent years (Stockwell & Liu, 2015). Finally, mobile assisted language learning has several pedagogical limitations. Burston (2014, p. 115) claims that if only content delivery is used, as has been the case in most studies, mobile assisted language learning will not be in line with "the constructivist, learner-centred methodologies which have dominated foreign language teaching for the past 20 years." Thus, mobile assisted language learning would need to enable language practice in authentic task-related contexts in accordance with contemporary second language development theory, so learning is contextualised and collaborative rather than form-based and isolated (Tai, 2012).

In their study of self-directed use of mobile devices for language learning beyond the classroom, Lai and Zheng (2017) explored the dimensions of learners' self-initiated and self-directed language learning with mobile devices outside the language classroom, and how the learners used the digital tools at their disposal to construct their own self-directed mobile learning experiences outside the language classroom. This mixed-methodology study, conducted among 256 undergraduate Chinese students, showed an active involvement of the students in learning though mobile devices out of class. Their main language learning activity was using mobile devices to enhance their vocabulary knowledge. Among personalisation, authenticity, and connectivity as three potential benefits of the use of mobile technologies, the respondents expressed a higher frequency of the use of mobile devices for personalised learning. In relation to limitations of mobile phones for learning, the respondents mentioned small screens and slow connections, the association of mobile phones with daily life rather than learning, and different concentration levels required by short and simple tasks compared to complex ones done using computers. A significant implication for pedagogical practice put forward by the authors is that if educators wish to enhance learning through mobile devices, educational mediation and interventions will be needed.

In the field of learning languages for specific purposes (LSP), an overview of smartphone apps for English, German, and Italian that would be designed for specific LSP learner groups was made by Jurkovič (2017). The analysis revealed five apps designed for the learning of Academic English, eleven for Business English, and one for Medical/Nursing English. No apps were found for the learning of English related to the disciplines of chemistry, logistics, maritime studies, public administration, science and technology, tourism, and political sciences. In terms of the German language, only one app was found for Business German, whereas no app that would correspond to the set selection criteria seems to exist for LSP learners of Italian. These findings indicate an almost exclusive focus on Business and Academic English while neglecting the other languages and disciplines of study. The absence of smartphone apps for the learning of languages other than English and for specific disciplines of study can be seen as another pedagogical limitation of smartphones for language learning purposes.

In comparison, the field of online informal learning of languages, or language acquisition through exposure to online content and engagement in social online activities, shows that most smartphone and other devices' users engage in a variety of online activities which can in turn have a positive effect on their language competence.

Arndt & Woore (2018) compared the rate of incidental vocabulary learning through video blogs and written posts, and the differences in terms of elements of vocabulary knowledge learned through these two modes. Differently from other studies that relied on researchers' students as the study participants, in this study the participants were elicited through the Nerdfighter website. The findings show that textual and video input have similar effect rates on incidental vocabulary learning. However, it seems that orthographic knowledge is better acquired through reading, but also that video input allows for greater variance in the depth of processing and the resulting greater variation in vocabulary scores. The authors also tentatively suggest that video input has a greater effect on the recall of target word grammatical functions and meanings.

The main research objective of Lee and Dressman (2018) was to explore the significance of the quality or diversity of online informal language learning activities for learning outcomes. The results of their study conducted among 94 undergraduate South Korean students indicate that the diversity of online language acquisition activities significantly affects the learning outcomes in speaking, productive vocabulary use, and willingness to communicate online. English speaking proficiency was particularly affected by a combination of diverse activities that involved form- and meaning-focused engagement (i.e., language learning and acquisition). The conclusion is that the quantity of online language use is not the only determining factor for the rate of language acquisition.

Lyrigkou (2018) relied on qualitative and quantitative methodology to study the frequency of exposure of Greek adolescents to English outside the classroom setting, the effort that is associated with exposure to English, and the relationship between invested effort and quality of speaking performance. The findings indicate that only few activities were practised very frequently. These were using different smartphone apps (not specifically designed for language learning but for other purposes, for instance gaming), watching short online clips, and listening to English songs. Most participants in the study did not invest any effort into form-focused understanding when they encountered new vocabulary in English. This indicates a lack of agency of the young participants in this study and reliance on external sources (teachers, parents, and peers) for the regulation of their own learning. The participants viewed the use of online resources more as a form of entertainment than an opportunity that could lead to language learning. In terms of spoken production, the study showed that frequent online users displayed a greater awareness of spoken conventions in English, and used more natural fillers and discourse elements.

Peters (2018) explored the differences between Flemish secondary school and undergraduate students in terms of out-of-class exposure to English language media, the relationship between this exposure and vocabulary knowledge, and other factors that affect vocabulary knowledge. The most frequent out-of-class receptive activities among Flemish English language users and learners are listening to music, and watching films and television series with or without subtitles. The participants' vocabulary knowledge was shown to be slightly but positively correlated with exposure to English through unsubtitled video content, reading books and magazines, and online surfing. Importantly, out-of-class exposure to English had a greater effect on vocabulary knowledge than the length of language learning through formal instruction.

The study conducted by Jurkovič (2019) among undergraduate students in Slovenia on their online engagement through smartphones, the predominant language for online use, and the effect of smartphone activities in English on perceived language competence in English corroborated some findings of previous studies in other contexts. These are that the nature of online participation in English as a foreign language most frequently is receptive rather than productive or interactive. These receptive activities mostly involve exposure to English language popular culture content. A comparison between users that prefer their mother tongue for online activities through smartphones and the users that prefer choosing English shows a positive correlation between the use of English and English language competence.

Research Questions

The research questions for this study are:

RQ1: What is the frequency of smartphone uses for self-regulated language learning activities compared to the frequency of smartphone uses for language acquisition activities among undergraduate students in Slovenia?

RQ2: Which factors influence the frequency of engagement in language learning activities through smartphones among undergraduate students in Slovenia?

METHOD

Instruments and Data Dollection

Three instruments were used for the collection of data in the present study. Quantitative data on the frequency of smartphone activities involving language use were collected by means of an online survey, the global self-assessment scale of the Common European Framework of Reference for Languages (CEFRL; Council of Europe, 2001) was used to collect data on the self-perceived English language competence levels among the participants, and finally, qualitative data on the use of smartphones for language learning were collected by means of semi-structured interviews.

First, the students at three Slovene public universities were asked by their LSP teachers to use their smartphones to complete the online survey. This means that convenience sampling was used. However, by asking the participants to complete the survey in class, a high response rate was obtained. The online survey, available from December 2016 through March 2017, yielded quantitative data on the participants' age, gender, discipline of study, and use of smartphones for language learning and language acquisition activities. The initial inventory of language learning and acquisition activities that can be performed using smartphones was collected from a group of students. Then, colleagues' suggestions were used to validate and complete the list. Another group of students was then asked to pre-test the survey so that potentially confusing statements could be paraphrased or removed. The statements describing smartphone uses for language learning or acquisition activities were then randomly ordered in Microsoft Excel and transferred into the online survey.

Second, the online survey contained the CEFRL global self-assessment scale (Council of Europe, 2001). Using this scale, the participants were asked to self-assess their language competence in English as one of the predominant languages of the online world.

Third, this chapter will highlight that section of semi-structured interviews that aimed to explore the reasons for (not) using smartphones for language learning activities. Skype was used for the interviews with geographically distant interviewees while face-to-face meetings were organised with the participants from the same local area as the researcher's. All interviews were conducted in Slovene as the mother tongue of the participants and the researcher.

Participants

The online survey was completed by 905 full-time first-cycle degree students from the Slovene public universities of Ljubljana, Maribor, and Primorska. 626 (69%) participants were female and 275 (31%) participants were male. Their mean age was 20.5 years (modus: 19). One participant was excluded from the analysis because he stated that he did not own a smartphone. If divided by discipline of study by the Frascati classification, 102 (11%) participants came from the biotechnical sciences, 115 (13%) from the technical sciences, 506 (56%) from the social sciences, and 181 (20%) from the humanities.

The final inventory of participants for the semi-structured interviews consisted of a self-selected sample of 16 interviewees that had provided their email contact information in the online survey. Ten participants were female and six were male. Two were students of the technical sciences, two of the biotechnical sciences, seven of the social sciences, and five of the humanities. The interviews took place in April and May, 2017.

Data Analysis

In the online survey, the participants rated the frequency of performing the listed smartphone activities involving language use on a 1-5 scale (1 - never or almost never, 2 - several times a month, 3 – several times a week, 4 - once a day, 5 - several times a day). Ordinal variables reflecting the frequency of use of smartphones for specific activities involving language use were thus generated. For a discussion on the treatment of ordinal scales as interval scales, see Knapp (1990).

Quantitative data were analysed with IBM SPSS Statistics 23.0 using the following statistical methods: the Pearson coefficient of correlation as the most common coefficient used to test the association between categorical variables (in this chapter the (Language) Learning factor and age, and the (Language) Learning factor and the self-assessed level of language competence in English); the independent samples t-test, used when we want to compare two groups using the mean value of the variable that we would like to explore (in this chapter the (Language) Learning factor and gender); and One-Way ANOVA, used to compare two or more matched groups (in this chapter the (Language) Learning factor and discipline of study) (Singh, 2007).

In addition to quantitative data, qualitative data were collected following the principles of the mixed-methods approach. The triangulation engendered by combining different quantitative and qualitative methods generates a more comprehensive picture of the phenomenon that we are investigating (Stickler & Hampel, 2015). Hence, semi-structured interviews were used to gain an insight into the interviewees' experience and their reflections upon relevant details addressed by this study (Seidman, 2006).

The main method used for the analysis of interview transcripts was two-stage content analysis. After transcribing the interviews, data were read multiple times so that the researcher got familiar with the relevant aspects related to the use of smartphones for language learning activities. Then, common themes and concepts were coded and grouped. In the Results section, the participants' comments are marked as follows: M - male, F - female, age (numerical value), and field of studies according to the Frascati classification (TS – technical sciences, BTS – biotechnical sciences, SS – social sciences, HUM – humanities).

Results

In the following section, the results will be presented by examining each of the two research questions separately.

Frequency of smartphone uses for self-regulated language learning activities compared to the frequency of smartphone uses for language acquisition activities

The descriptive statistics for the online activities that the participants perform using their smartphones are shown in Table 1. The data are presented in descending order by mean frequency of use. The (LA) or language acquisition label indicates activities that may affect language development mainly through language acquisition, while the (LL) or language learning label indicates activities that are directly related to language learning.

The data presented in Table 1 show that the participants mostly use their smartphones for activities that do not belong under the umbrella of language learning. Among the activities whose mean value exceeds 3, which means that they are performed on average at least several times a week, we can find sending short text messages (4.55) as the only language production activity. This is followed by several language reception activities: listening to music (4.04), reading social media comments (3.89), and reading emails (3.86). The participants communicate with their classmates with an average frequency of 3.78, then look for general information (3.65) and study-related information (3.49). Two more language reception activities that are performed through smartphones at least several times a week are watching YouTube videos (3.26) and reading the daily news (3.23). Finally, another productive activity with a mean value higher than 3 is writing emails (3.11). For a thorough discussion of smartphone activities in terms of language reception and production in the participants' mother tongue and English in Slovenia, see Jurkovič (2018) and Jurkovič (2019).

On the other hand, none among the language learning activities performed through smartphones exceeds the value of 3, which means that all are performed less often than several times a week. The only language learning activity whose value is close to 3 is using smartphones for accessing online dictionaries (2.68). The mean values of all other activities in this category are lower than 2, which means that they are performed on average less often than several times a month. These activities are using smartphones for writing down new words in a foreign language (1.70), accessing language learning websites (1.70), playing language games (1.58), using language learning apps (1.58), and participating in social media groups on language learning (1.50).

Factors that Influence the Frequency of Language Learning Activities through Smartphones

In order to reduce the number of variables into interpretable factors that allowed further analysis and to confirm that all language learning indicators load on a single factor, principal components analysis with Direct Oblimin rotation was performed to investigate the underlying dimensions of smartphone use among the participants. Non-normal distribution variables with skewness or kurtosis coefficients

Table 1. Frequency of smartphone uses for language learning and acquisition activities

	Mean	Std. dev.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
(LA) I send short text messages.	4.55	.812	-2.079	.082	4.530	.163
(LA) I listen to music.	4.04	1.123	-1.120	.082	.527	.164
(LA) I read social media comments.	3.89	1.233	-1.019	.082	.100	.163
(LA) I read emails.	3.86	.892	-.485	.082	-.193	.165
(LA) I communicate with my classmates.	3.78	.965	-.489	.082	-.078	.165
(LA) I look for general information.	3.65	1.104	-.493	.082	-.464	.164
(LA) I look for study-related information.	3.49	1.063	-.295	.082	-.511	.164
(LA) I watch YouTube videos.	3.26	1.149	-.106	.082	-.732	.163
(LA) I read the daily news.	3.23	1.165	-.266	.082	-.680	.164
(LA) I write emails.	3.11	.986	.224	.082	-.365	.164
(LL) I access online dictionaries.	2.68	1.121	.402	.082	-.487	.164
(LA) I read long texts.	2.67	1.081	.250	.082	-.520	.164
(LA) I post social media comments.	2.43	1.195	.585	.082	-.484	.163
(LA) I watch foreign films or series without subtitles.	2.39	1.321	.485	.082	-.948	.164
(LA) I watch foreign films or series subtitled in English or another foreign language.	2.33	1.337	.563	.083	-.898	.165
(LA) I communicate with my teachers.	2.30	.958	.550	.082	.119	.164
(LA) I watch foreign films or series subtitled in my mother tongue.	2.12	1.252	.794	.082	-.504	.165
(LA) I watch television shows.	1.98	1.154	.845	.082	-.415	.163
(LA) I listen to radio shows.	1.72	.989	1.172	.082	.389	.163
(LL) I write down new words in a foreign language.	1.70	.998	1.367	.082	1.150	.164
(LL) I access language learning websites.	1.70	.963	1.473	.082	1.926	.164
(LA) I play games that have written instructions.	1.62	1.032	1.682	.082	2.044	.164
(LA) I read e-books.	1.62	.954	1.713	.082	2.527	.164
(LL) I play language games, such as crosswords.	1.58	.818	1.406	.082	1.654	.164
(LL) I use language learning apps.	1.58	.927	1.773	.082	2.950	.164
(LL) I participate in social media groups on language learning.	1.50	1.029	2.149	.082	3.726	.164
(LA) I listen to podcasts.	1.40	.759	2.171	.082	4.982	.164
(LA) I leave voice messages.	1.39	.857	2.431	.082	5.627	.163
(LA) I listen to recorded lectures.	1.37	.773	2.326	.082	5.224	.163
(LA) I play games that involve written interaction.	1.33	.855	2.892	.082	7.932	.164
(LA) I play games that involve spoken interaction.	1.26	.756	3.374	.082	11.411	.164
(LA) I listen to audio books.	1.17	.538	4.236	.082	21.880	.164
(LA) I keep a blog.	1.08	.360	5.766	.082	39.276	.164
(LA) I keep an audio blog.	1.03	.264	10.441	.082	120.571	.164

greater than +/- 2 (see Table 1) were eliminated from this analysis. The eliminated variables are related to two statements on language learning activities through smartphones: using language learning apps downloaded onto smartphones, and participating in social media groups that talk about language learning. The high kurtosis value of these two variables indicates a fat tail on the left side or, in other words, that the majority of the participants very rarely or never perform these activities.

Principal components analysis showed high loadings of at least two indicators on seven smartphone use factors that together explain 65% of total variance of smartphone use. These factors are Films, Series and Music; Reading; Social Media; Gaming; Radio and Television; (Email) Communication; and finally (Language) Learning (for a full description of these factors, see Appendix 1).

The next sections will explore the association between age, gender, discipline of study, and level of English language competence on one hand, and the (Language) Learning factor on the other. As has been shown, the latter integrates the language learning activities performed through smartphones. These results will allow a better understanding of what may influence the (non) use of smartphones for language learning activities.

First, the Pearson coefficient of correlation was used to test the association between two scale variables: the (Language) Learning factor and age. The results show a slight statistically significant negative correlation between these two variables ($r=-0.124$, $p=0.000$). This means that with age the frequency of smartphone uses for language learning activities decreases. Thus, younger participants in the study tend to use their smartphones for language learning activities more often than their older peers.

Second, the association between the (Language) Learning factor and gender was tested using the independent samples t-test. Value 1 was assigned to the male gender and value 2 to the female gender. At $p=0.000$ ($t=-3.853$), the test revealed a statistically significant association between the female gender and the (Language) Learning factor. In other words, female participants tend to use their smartphones for language learning activities more frequently than their male counterparts.

Next, One-Way ANOVA (Post-Hoc Bonferroni) was employed to test the association between the (Language) Learning factor and the participants' discipline of study. At the significance level of $p=0.000$, the results indicate that the participants from the humanities use their smartphones for language learning activities statistically significantly more often than their peers from other disciplines, and vice versa. The same holds true for the participants from the social sciences if compared against their peers from the technical sciences, and vice versa (see Table 2 in Appendix 2).

Finally, Pearson's coefficient of correlation was employed again to explore the association between the (Language) Learning factor and self-assessed language competence in English. The test did not show any statistically significant correlation between these two variables ($r=-0.020$, $p=0.573$). This means that the participants at different levels of language competence in English did not display any differences in the frequency of use of smartphones for language learning activities.

The analysis of quantitative data revealed several relevant findings. With the exception of accessing online dictionaries, other language learning activities are seldom engaged in through the participants' smartphones. These activities would be most frequent among younger female smartphone users that are enrolled in studies in the social sciences or humanities. Put differently, older male participants from the fields of technical or biotechnical studies are least likely to use their smartphones for language learning activities.

The following section presents the results of the content analysis of qualitative data that will shed some light onto the reasons for the low frequency of use of smartphones for language learning activities among the participants.

Instead of performing language learning activities, some participants mentioned engaging in language acquisition activities but with conscious language learning in mind as a secondary aim. Here focus is not only placed on the meaning of the input but also on the form of the target language: "*I like visiting a website called 9gag, the main purpose of which is to entertain through funny videos or pictures with ironic text. All text and comments are in English. With that website it is easy to learn new vocabulary, especially the urban-type that is commonly used within the teen-age category and I like that*." (M, 20, TS) Among the participants that have in fact been using or have used language learning apps or websites, this use seems to be very sporadic and done for fun rather than focused learning: "*I use Duolingo (I have an Android phone). My sister told me about it. I only use it occasionally and more like a challenge to revise the French that I learnt in elementary school*." (F, 23, SS)

In general, the findings of the qualitative analysis corroborate three categories of reasons for the low frequency of use of smartphones for language learning among the participants, previously identified as limitations of the use of mobile devices by Viberg and Grönlund (2013): psychological, pedagogical, and technical.

Among the psychological reasons why smartphones are only seldom used for language learning, the opinion was prevalent that smartphones are personal devices that are mostly used for entertainment and communication rather than learning: "*I think that smartphones are primarily used for fun*." (M, 22, SS) Another reason seems to be that for learning also young generations prefer face-to-face communication with a teacher if compared against computer or mobile assisted learning: "*I actually do not like learning through devices. I still prefer having a live person that explains things, helps you if necessary, provides feedback. I think that learning through devices is too impersonal*." (F, 20, SS) Personal relevance or perceived usefulness is another factor: "*I would use an app or would consult sites if they were related to my field of studies. Our teacher prepared some tasks for us and that was good, revising vocabulary lying in my bed. But I do not think there are apps like this out there and what she did was limited*." (M, 20, TS) Finally, the participants seem not to be willing to spend financial resources on the purchase of smartphone apps for language learning, which can be seen as a psychological or an economic factor. A typical statement is: "*I do not know if the commercial apps are better than the free ones. I have not tried any and probably never will although they might only cost what you would spend on a cup of coffee*." (F, 20, HUM)

The first pedagogical reason for the low use of smartphones for language learning activities is that, in the opinion of the participants, smartphone apps are usually designed for beginner levels of language competence, so only simple phraseology and vocabulary can be learnt: "*I doubt that I will ever try to learn a foreign language through my smartphone. My English is excellent, I have a good background in Spanish, French, and Arabic. If the need to learn a new language should arise (for job purposes), I would probably opt for a language course. But if I travelled to a foreign country I might choose an app that teaches you the basic language skills or some phrases for everyday use*." (F, 23, SS) Secondly, foreign language teachers do not seem to encourage their students to use smartphones for language learning but they do recommend using them for language acquisition: "*The teachers never have recommended the use of language learning apps. They only suggested we should listen to online radio and watch many films and series in the original language*." (F, 20, SS) The design of the apps that the participants have tried is also detrimental and the participants would like the apps to emulate informal online uses: "*Maybe, if the app tried to teach you the language in an entertaining way. We learn foreign languages through films, music, games … without being aware that we are learning them. I think that I would try to learn a foreign language if the app was equally entert*aining." (F, 20, SS) Finally, even though using online dictionaries is the most frequent language learning activity, the interviewed students reported using them mostly when they need them for their academic studies in teacher-designed tasks, which means that their learning neither in this case is entirely self-regulated: "*I only use dictionaries for my studies, when I am translating articles or other literature; otherwise I do not use any online dictionaries*." (F, 20, HUM).

Finally, the technical reasons for not using smartphones for language learning activities include the limitations of the screen size, if compared against that of computers, and website design: "*Most older websites are still not adjusted for smartphone use and you cannot see what's on the far right part of the screen and the 'send' button might be hidden somewhere at the bottom, so, so, I never do grammar exercises using my smartphone but I have done some on the computer*." (F, 23, SS) Another limitation is the difficulty of performing complex and productive language activities and the resulting better suitability for the learning of vocabulary: "*Small screen, writing, only drag and drop and click, but only vocabulary that is easy to use. Reading, the screen is too small. Listening is ok but the related tasks again are simple. I think it is good when teachers upload into the VLE the videos that we watched during class so we can watch them at home again if we want to, also using our smartphones. So it really depends on what you want to do, certainly not writing. And I would do it occasionally, but otherwise I would prefer a computer or face-to-face communication with the teacher*." (F, 20, HUM) The last mentioned reason was the inability to multitask or perform several activities at the same time, which the laptop or desktop computer enables, in this case using a dictionary while watching a video that was professionally relevant to the participant: "*I was listening to an explanation about maths and I did not understand everything so I wanted to check the unknown words in a dictionary but on the smartphone you cannot simply have several tabs open like on the computer so I got frustrated. I did it on my computer later on in the evening because that was important for my test*." (M, 20, TS)

Discussion

The main objective of this chapter was to explore the frequency of smartphone uses for language learning activities among undergraduate students in Slovenia, and the factors that influence the (low) frequency of use of smartphones for language learning activities.

First of all, the results of the present study corroborate the findings of other studies that explored the online activities involving language use among foreign language learners (but, in most cases, did not place any focus on the device used for these purposes). Thus, receptive language acquisition activities prevail while the most frequent activities conducted in English involve the consumption of English media culture (Jarvis, 2014; Jurkovič, 2019; Lyrigkou, 2018). For some online users, language acquisition activities involve a degree of focus on the language form and not only meaning, which corroborates the findings of the study conducted by Trinder (2017) and shows that often it is impossible to draw a clear distinction line between foreign language learning and acquisition that might be taking place as two parallel processes or an integrated one.

On the other hand, language learning activities are performed with much lower frequency, including the use of online dictionaries, which is the language learning activity with the highest frequency but still mostly done when externally regulated. This study explored self-regulated language learning activities through smartphones, which means that the language learning should not be not regulated by external agents. However, also other studies have shown that, even when instructed on the use of mobile devices for language learning, students rarely engage in these activities after the completion of the experiment

(Jarvis, 2014), which indicates a lack of agency and self-regulation, and reliance on external sources, as shown by Lyrigkou (2018). In the words of Golovatch and Vanderplank (2007, 144), this can be described as “teacher overdependence”.

The analysis of quantitative and qualitative data has shown some factors that are associated with the frequency of use of language learning activities through smartphones among Slovene undergraduate students. The frequency of use of smartphones for language learning activities is associated with age. In fact, with age the frequency of use of smartphones for language learning decreases. Secondly, female participants seem to use their smartphones for language learning more often than their male peers. The same is true for students of the social sciences and humanities compared against students of the technical and biotechnical sciences. It has to be noted, however, that the social sciences and humanities traditionally attract more female students than technical and biotechnical sciences, and vice versa. Interestingly, the level of language competence was not shown to be associated with the frequency of use of smartphones for language learning although we might expect that the participants at lower levels of language competence would tend to use them more often for vocabulary learning or grammar revision, which is what most language learning apps and websites are designed for (Burston, 2014; Kim & Kwon, 2012).

The reasons why smartphones are not used more often for language learning activities among this group of participants can be divided into psychological, pedagogical, and technical, as suggested by Viberg and Grönlund (2013).

First, it seems that smartphones are still viewed as devices designed for communication and entertainment rather than learning (Jurkovič, 2019; Lyrigkou, 2018; Stockwell, 2008). Thus, smartphone users will engage in a number of activities involving language use but these will rarely have the self-regulated educational purpose of improving one’s language. Second, a psychological limitation of learning through smartphones is that also younger generations prefer live contact with a teacher and peers to learning through technological devices. Another factor that is here classified among psychological factors but could be listed in a specific category of financial or economic factors is the unwillingness of the participants to invest into an app that would meet their specific personal and professional language learning needs.

There are a number of pedagogical limitations to the use of smartphones for language learning. Although the results presented in this chapter have shown that the level of language competence is not associated with the frequency of use of smartphones for language learning, it is important to emphasise that most language learning websites and smartphone apps are dedicated to learners at the beginning levels of language proficiency (Kim & Kwon, 2012). This means that proficient learners, whose individual needs are even more specific than the needs of beginners, will hardly find adequate online resources dedicated to language learning. In addition, the vast majority of participants came from disciplines other than linguistics. This means that most of their language learning needs are highly specific (Dudley-Evans & St.John, 1998). The qualitative data indicate that the participants would be more willing to use smartphones for language learning if the online content or apps met their specific learning needs. However, the analysis conducted by Jurkovič (2017) showed a relative absence of language learning apps for purposes other than Business or Academic English. In this respect, the available learning apps fail to meet the criteria of personalised learning that would take into account the specific needs of these learners (Kukulska-Hulme, 2016). The results of this study also corroborate the findings of other studies that smartphone app design is pedagogically not such to attract learners. The participants agree that the apps that they have tried are based on simple form-focused vocabulary practice (Burston, 2015; Kim & Kwon, 2012; Tai, 2012). Instead, what would be required is constructivist and learner-centred methodologies in line with learners’ needs (Burston, 2015). Thus, mobile assisted language learning would need to enable language practice in authentic task-related contexts in accordance with contemporary second language development theory, so learning is contextualised and collaborative rather than form-based and isolated (Tai, 2012).

The third group of reasons for the low use of smartphones for language learning is technical. Despite the increasing sizes of smartphones and touchscreens and most recently, foldable smartphones, they still do not enable easy multitasking across different tabs and monitors, which computers do. Secondly, smartphone apps and interactive social learning-oriented websites that would be suitable for smartphone use are still difficult to design for language teachers despite the widely available website templates. For these reasons it seems that for now technology assisted language learning will largely remain within the domain of (laptop) computers (Jarvis, 2014; Lai & Zheng, 2017).

Engagement in diverse online activities (meaning- as well as form-focused, seems to be an essential factor for the development of the English speaking skill (Lee and Dressman, 2018). However, the present study has shown that language learners will only seldom take advantage of the opportunities provided by mobile assisted language learning, which opens pedagogical intervention opportunities for the teachers. In fact, it seems that some language learners need guidance in the ways in which they can exploit the affordances of the unprecedented access to the vast online resources providing a myriad of foreign language learning opportunities (Lyrikgou, 2018). Therefore, education mediation and pedagogical interventions might be needed if language learning through smartphones and other mobile devices is to be enhanced (Lai & Zheng, 2017) and for personalised learning, foregrounding the role of the teacher as the regulator of activities, to extend into personal learning, in which the roles of the language learners and their agency are seen as paramount (Kukulska-Hulme, 2016).

CONCLUSION

The results presented in this chapter have shown that smartphone activities involving language use are mostly limited to language acquisition activities and that the low frequency of use of smartphones for language learning activities can be attributed to a variety of demographic, psychological, pedagogical, and technological factors.

Nevertheless, dedicated websites or smartphone apps have the potential to bridge the gap between self-regulated language learning, online informal language learning, and formal language instruction in a classroom setting. Online resources could provide the form-focused instruction that language acquisition lacks and that significantly contributes to language development (Lee & Dressman, 2018). The findings that both textual and video input may have similar effect rates on incidental vocabulary learning (Arndt & Woore, 2018) are also significant because of smartphones' suitability for exposure to video content.

This study has provided some indications on the design of smartphone apps or websites that would be better suited to the needs of modern smartphone users: emulation of informal learning through popular culture media, consideration of specific learner needs, free availability, enabled multitasking, and mobile-friendly websites. In addition, these resources would have to meet the criteria for personalised as well as personal learning through customisation and provision of software able to supply intelligent assistance to the learner (Kukulska-Hulme, 2016). A technology acceptance model (Davis, 1989) can be used to identify whether these and other conditions would encourage smartphone users to consider their smartphone devices not only as an entertainment and communication tool but also educational technological resource.

The limitations of this study may provide the springboard for further research. First of all, this study was conducted in the local context in Slovenia among undergraduate students who are a specific demographic group in terms of age and level of education. It could be expected, somehow contrarily to the results of this study, that this is the cohort that would be most open to the use of smartphones for learning because of their young age and enrolment in education. Therefore, more research is necessary in other contexts and among participants from different age groups.

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APPENDIX 1

Smartphone use factors:

- Films, Series, and Music (initial eigenvalue: 5.663, variance explained: 24%, Cronbach's alpha: 0.79) with the following four indicators: I watch foreign films or series without subtitles. (0.833), I watch foreign films or series subtitled in English or another foreign language. (0.800), I watch foreign films or series subtitled in my mother tongue. (0.616), and I listen to music. (0.505);
- Reading (initial eigenvalue: 2.369, variance explained: 10%, Cronbach's alpha: 0.61) with the following four indicators: I read the daily news. (0.734), I read long texts. (0.669), I look for general information (0.417), and I read e-books. (0.414);
- Social Media (initial eigenvalue: 1.703, variance explained: 7%, Cronbach's alpha: 0.58) with the following two indicators: I read social media comments. (0.785) and I post social media comments. (0.731);
- Gaming (initial eigenvalue: 1.489, variance explained: 6%, Cronbach's alpha: 0.88) with the following two indicators: I play games that involve written interaction. (0.941), and I play games that involve spoken interaction. (0.938);
- Radio and Television (initial eigenvalue: 1.183, variance explained: 5%, Cronbach's alpha: 0.59) with the following two indicators: I listen to radio shows. (0.785), and I watch television shows. (0.748);
- (Email) Communication (initial eigenvalue: 1.127, variance explained: 5%, Cronbach's alpha: 0.73) with the following four indicators: I read emails. (0.804), I write emails. (0.766), I communicate with my teachers. (0.652), and I communicate with my classmates. (0.560); and
- (Language) Learning (initial eigenvalue: 1.090, variance explained: 5%, Cronbach's alpha: 0.73) with the following four indicators: I access online dictionaries. (0.788), I write down new words in a foreign language. (0.728), I access language learning websites. (0.707), and I look for study-related information (0.524).

APPENDIX 2

Table 2. Association between (Language) Learning and discipline of study

Discipline of study	Discipline of study	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Technical sciences	Biotechnical sc.	-.12983437	.13282963	1.000	-.4811153	.2214465
	Social sciences	-.41212547*	.09941835	.000	-.6750470	-.1492040
	Humanities	-1.17525300*	.11541064	.000	-1.4804677	-.8700383
Biotechnical sciences	Technical sc.	.12983437	.13282963	1.000	-.2214465	.4811153
	Social sciences	-.28229109	.10680150	.050	-.5647381	.0001559
	Humanities	-1.04541863*	.12182844	.000	-1.3676058	-.7232315
Social sciences	Technical sc.	.41212547*	.09941835	.000	.1492040	.6750470
	Biotechnical sc.	.28229109	.10680150	.050	-.0001559	.5647381
	Humanities	-.76312753*	.08415738	.000	-.9856899	-.5405651
Humanities	Technical sc.	1.17525300*	.11541064	.000	.8700383	1.4804677
	Biotechnical sc.	1.04541863*	.12182844	.000	.7232315	1.3676058
	Social sc.	.76312753*	.08415738	.000	.5405651	.9856899

Chapter 11
CLIL Approach and Educational Technologies:
ClassLabs, Teachers' Digital Literacy, and High School Students' Opportunities

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ABSTRACT

CLIL (content and language integrated learning) is an educational approach in which a foreign language is used for the teaching and learning of content and language. The Council of Europe has fostered it as an innovative methodology for promoting plurilingualism and raising the quality of school curricula. Furthermore, in European Commission's reports, the use of educational technologies in CLIL approach has been recommended for improving the effectiveness of language learning. In this work, a study on the integration of different activities in CLIL settings as ClassLabs is presented, underlining the significant link between CLIL and information communication technologies in the Italian context. In particular, in the promoted technology-enhanced environments, the combination of videos, online exercises, and the production of multimedia artifacts is proposed in order to make enjoyable the acquisition of cross skills. CLIL teacher profile is also introduced, specifying the different skills and competences a teacher must develop in order to be fully qualified in a CLIL ClassLab.

INTRODUCTION

CLIL (Content and Language Integrated Learning) is an educational approach foreseeing both curricular content taught through the medium of a foreign language, and a classroom providing the only site for learners' interaction in the target language (Dalton-Puffer, 2011; Genesee & Hamayan, 2016). The term CLIL was created in the mid Nineties on the not completely new idea to designate practices in content-based language learning. In fact, in Sixties, in Canadian and USA schools, a prototype of CLIL

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methodology was carried on by means of immersion programs under a different label: Content-based language teaching or Content-Based Instruction (Arribas, 2016).

CLIL giving equal attention to language and content provides the definition of a "dual-focused approach" (Mehisto, Marsh, & Frigols, 2008) with a practice that is "content-oriented but language sensitive" (Wolff, 2007). It regards a content-based instruction and immersion education, even if only less than 50% of the curriculum is usually taught in the target language. In particular, in CLIL approach the following elements can be detected (Arribas, 2016): language is used as an instrument to learn the content of a subject present in the school curricula: language and subject learning converge (Coyle, Hood, & Marsh, 2010); the focus is on content and not on the grammar; language is learnt in a natural way in the classroom setting, relating it to the real world; learners' exposure to the target language increases; CLIL prepares students to a multilingual and global society. Regarding learning strategies, CLIL foresees a shift from a traditional teacher-centered practice to a motivating student-centered model, where collaborative groups work and exchange information. In this view, CLIL becomes a significant communicative medium in contrast to a focus on individual thinking processes, and teachers create as many opportunities as possible for interaction, ideating and using proper tasks to promote them. Furthermore, considering Information and Communication Technologies (ICT) as a substantial added value to enhance these teaching practices, CLIL and technologies for learning are strictly linked, as recommended by the European Commission. In fact, in recent years, in order to "free" learning from the chains of the traditional means and contents, schools have understood the importance of carrying on activities linked to sophisticated educational technologies, and have reserved specific curriculum activities and physical spaces (with laboratories) to the use of technology (Bertacchini, Gabriele, Tavernise, 2013). In these laboratories, CLIL allows the bridging of educational experiences based on advanced technologies with traditional forms of schooling: in their daily life, students experience a world full of digital codes, accessing, searching and manipulating information, and in CLIL contexts, they apply their skills thanks to an appealing and engaging setting. In this work, towards the goal of detecting all the elements that can contribute to the development of a CLIL approach in a technology-enhanced educational setting, an effective integration of different kinds of computer-based activities in a ClassLab is proposed, also discussing the role of the fundamental actors of the educational process: teachers and students. In particular, fundamental questions are the following: is there a grounded theoretical approach regarding the proposed methodology? How is possible to combine tasks and technologies in a CLIL course in a class curriculum? Are traditional technology devices (the ones typically used at school) sufficient for the suggested practice? What do teachers think about the possibilities offered by the CLIL approach and are there limitations? What are the challenges and the opportunities of the technological approach? Is it important continue to discuss on an approach born in the Nineties? The Italian context is also explored.

BACKGROUND

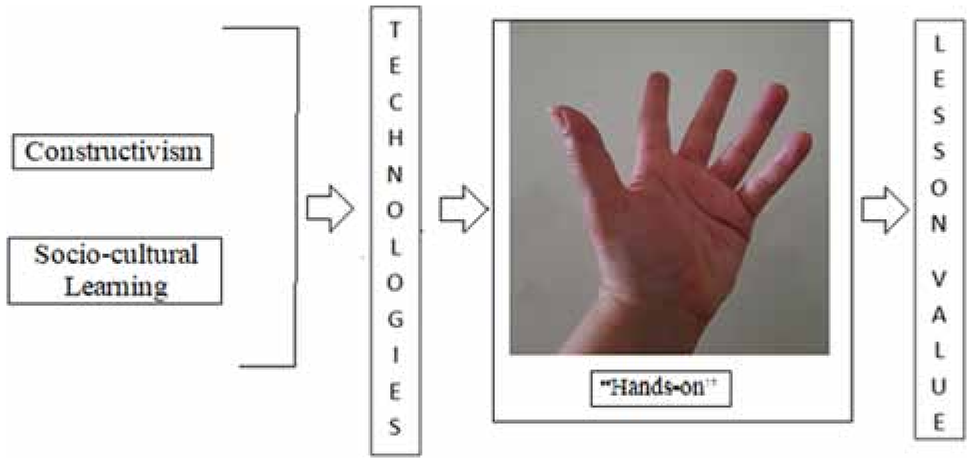
In last decades, the constructivist approach has emphasized learning as the outcome of a process of attainment and construction of knowledge through the observation of the effects of actions in the world (Papert, 1980, 1986; Papert & Harel, 1991). According to this theory of reference, knowledge is built through action, and cognitive activity can be investigated considering the artifacts that mediate it (Kafai & Resnick, 1996; Bertacchini, Bilotta, Pantano, Tavernise, 2012; Gabriele et al., 2019): manipulating materials, thinking and building an artifact enable students to develop advanced cognitive skills in problem solving, in thinking strategies and in the acquisition of new concepts. In particular, it has been demonstrated that multimedia technologies, in combination with instructional techniques, enhance learners' performance in multifaceted problem solving situations (Patil & Kudte, 2017; Remus et al., 2008; Bilotta, Pantano, Tavernise, 2010) and laboratory investigations (Bertacchini, Gabriele, Tavernise, 2013), improving the development of language expression, logical thinking, and originality (Fridin, 2014; Tavernise, 2012). In fact, positive results of various researches demonstrate that students' perception of lessons is highly positive when didactic technologies are involved: topics seems more interesting, learners are motivated and feel that technologies provide them an advantage over students in traditional settings. Hence, classroom teaching practice has introduced specific software or many kinds of technologies in order to become cognitive amplifiers and support the study of different school subjects (Bertacchini, Bilotta, Gabriele, Pantano, & Tavernise, 2015; Bertacchini, Gabriele, Tavernise, 2011) as for example 3D virtual worlds (Cinganotto, 2019; Tavernise & Bertacchini, 2015, 2016, 2017). In this context, language of programming can also be used (Vaca Cárdenas et al., 2016) and class become laboratories or "Fablab" (Blikstein, 2013), where students are the producers and the consumers of their educational artifacts, the "prosumers" (Bertacchini & Tavernise, 2014; Bertacchini, Feraco, Pantano, Reitano, Tavernise, 2008). Thus, learners can also "produce" materials, becoming main actors of their learning process, and classrooms are transformed in laboratories (ClassLabs) where students carry on a hands-on approach, manipulating real or virtual didactic materials. In fact, thanks to advanced learning environments, the possibility to virtually "manipulate" significant 3D objects can be provided, as well as a range of different tools can be integrated via a single user interface (i.e. texts, images, audios, videos, pictures, and animations) (Giglio et al., 2015). Manipulation and exploration of virtual contents provide the great opportunity to carry on personalized experiences through experiences starting from learners' interests. The educational environment also improves cooperation, collaboration, and communication: from a theoretical point of view, socio-cultural learning (Vygotsky, 1978) is located and co-regulated in a social context where language itself becomes a process socially constructed (Lantolf & Thorne, 2006). The instructor must be a facilitator promoting peer-to-peer interaction, with clear educational objectives to carry on during all the activities and, in order to increase intrinsic motivation, presenting didactic material through an appealing and entertaining modality (Tavernise, Bertacchini, Pantano, Bilotta, 2015). On the other side, students participate in the knowledge practices of a group, supported by other members, having the opportunity to learn various disciplines as physics (Austin, 2009) or foreign languages (Dlaska, 2002).

Regarding CLIL, European Union recommends it for both general education and VET (Vocational Education and Training) as a teaching strategy particularly effective in enhancing workers' mobility and employability. It is part of the Strategic Framework for European Cooperation in Education and Training (ET 2020), and present in a series of European Commission reports (1995, 2003, 2008) with the language-learning goals to educate citizens to multilingualism. In the report "Improving the effectiveness of language learning: CLIL and computer assisted language learning" (European Commission, 2014), the relationship between CLIL and technologies it is stressed through the association of the twenty-first century skills to language learning in CLIL. In general, regarding the integrated learning, the approach enhances the increasing of specific linguistic and subject skills working on more levels (Cognition, Content, Culture, and Communication), and not only of grammar structures. In other words, CLIL functions on the basis of a 4Cs framework embedded in a relevant context or enriched framework (Agolli, 2017):

- **Content:** in CLIL, it refers to the subject learning students are expected to acquire. Teachers think it in terms of skills, in order to predispose instructional conditions proper to their acquisition.
- **Communication**: students study by using the language instead of learning it in terms of linguistic structures. They are usually members of groups and are involved in situations of common interaction.
- **Cognition**: learners are usually involved in activities that allow them to construct new understandings by using higher thinking. They usually develop their cognitive processes and acquire knowledge at the same time (content and language integration) (Mariño, 2014).
- **Culture**: students experience activities supporting the understanding of different contexts/cultures towards a multicultural knowledge and by using "authentic didactic materials".

The acquisition of Lower and Higher Order Thinking Skills is promoted. Regarding Lower Order Thinking Skills, competences related to the definition of objectives, information order, monitoring and revision, are increased. With regard to Higher Order Thinking Skills, problem solving, thinking strategies, critical thinking, and planning/research skills are developed. In CLIL using ICT, Computational Thinking is also improved: as a basic knowledge skill of the 21st century, it comprises problem formulation, logical organization and data analysis, data representation through abstractions, creation of computational automatic solutions, and problem generalization, as well as cross skills as the application of solutions to other contexts (Gabriele et al., 2019). Hence, current advances in Information and Communication Technologies and the opportunity to use pioneering media at school provide novel strategies for the learning of educational contents in an entertaining way (Bertacchini, Tavernise, Gabriele, 2017; Okan, 2003; Bilotta, Gabriele, Servidio, Tavernise, 2009). This new kind of learning is called "Edutainment", thanks to the mixture of the two terms "education" and "entertainment" (Tavernise, 2012) and refers to the fact that, in hands-on ClassLab, students' active role in an enjoyable learning by doing environment implies positive emotional effects. As many studies confirm, a significant effect on both mental effort investment and level of satisfaction is demonstrated (Um, Plass, Hayward, & Homer, 2011). In this view, the design of advanced educational settings should take into account that learners are motivated and actively engaged in the process of skills development, when technologies are involved (Bertacchini, Gabriele, & Tavernise, 2011). Although data show motivation as a key factor in educational courses and, in the "society of knowledge", different kinds of motivation for learning are increasingly demanded, it is often neglected (Lancioni & Chandran, 2009). Motivation is also a direct determinant of a second language learning and, from Nineties onwards, research on motivation has undertaken a move towards a dynamic construct grounded in the context where education takes place. Thus, motivation has been analyzed with regards to the characteristics of the language-learning process strictly connected to the classroom (Vandergrift, 2005). Different studies carried out in many different contexts have confirmed that there is a clear correlation between motivation and language achievement. However, researchers might run the risk of becoming current Argonauts on a mission for the golden fleece (the 'theory of motivation'), as the search for a universally valid theory of motivation (Lasagabaster, 2011). Many factors interact and they seem to play diverse roles across ages and in different contexts, but the use of technologies, the following of personal interests, and teamwork are resulted as highly motivating and engaging.

Figure 1. The ClassLab model(© 2019. Tavernise Assunta)



TECHNOLOGY-ENHANCED SETTINGS

CLIL strategy forces schools to rethink their pedagogy, and involving all the protagonists of the educational process as the major prerequisite to the success (Di Martino & Di Sabato, 2012; Bertacchini, Gabriele, Tavernise, 2011): teachers, students, parents need to be part of a reflection on the CLIL state of the art as part of the new advanced setting and means of change. However, the starting point to consider should be the Class-Lab, the heart of the educational design, where all the activities are carried out.

ClassLabs

Over the past decade, as previously underlined, instructional activities have been designed using ICT in order to arise students' motivation, increasing understanding and student-centered strategies (Tavernise, Bertacchini, Pantano, Bilotta, 2015). In this context, many opportunities have been offered to students, thanks to the use of technological devices as touch-screen tools and personal computers, or to the integration of a variety of multimedia teaching tools. It has also been become common and suitable the use of Internet in class, thanks to the following convincing factors: reduced costs; flexibility in the access to educational needs (in terms of time, place and duration); a huge opportunity of knowledge; access to interactive systems enabling a human-centric classroom-like learning environment (Corvello, Pantano, Tavernise, 2011). Hence, classes have been transformed in laboratories or, better, ClassLabs. In these advanced environments, the use of didactic technologies has been associated to a "hands-on" perspective (Figure 1).

If the construction of knowledge happens when learners design, co-build, and share materials, the traditional model of education becomes reversed, because students are active in their process of learning and they do not passively listen to the teacher (Blikstein, 2013). They build a personalized knowledge rather than accumulate notions. In this setting, technologies can be used for the fruition of the contents provided by the teacher, for the realization of tasks, and for the realization of products. Regarding the fruition and the tasks, used materials should be easy to approach and understand: using too difficult materials involves the risk of increasing students' uncertainty, discouraging them and undermining their self-esteem to the point of complete refusal. Furthermore, some students might experience CLIL course as an extra and useless weight. The only way to overcome this problem is the emphasising of CLIL importance involving all the participants in the CLIL process (all the teachers, but also the students and their families). Regarding the realization of products, the designing and producing of educational objects makes students free to invent their products or artifacts, that can be videos, PowerPoint presentations, online researches, and audiovisual exercises. Devices to use can be multimedia platforms and web tools, strategies could include flipped classroom or BYOD/BYOT (Bring Your Own Device/Tool, that refers to students' bringing of their own technology like smartphones, tablets, and laptops for educational use at school) (Cinganotto, 2016). Furthermore, additional opportunities are provided by Techno-CLIL, a free online education possibility promoted by EVO (Electronic Village Online), a community realized by teachers all over the world, keen on English Teaching, gloctodidactic practices and learning environments (Cinganotto & Cuccurullo, 2019; Langé & Cinganotto, 2015).

The products realized by students, as result of learners' great effort, could be enormous in terms of construction of a new knowledge because, during the realization, learners can explore/identify different elements, learn about/evaluate on the basis of their competences and acquiring new ones, follow specific provided paths of learning designed by the facilitator, ideate artifacts on their own interests. Regarding content in CLIL, it has to be flexible and should be implemented in different ways: artifacts can be theme-based activities, units or projects, cross-curricular studies (fundamental for their involving different contents of the school curriculum). In this view, teachers do not propose a translation of materials or to translate materials, but "real" ones. For example, students can read articles or realize a journal, they can watch videos selected and downloaded by the teacher, or ideate a video. Moreover, for the realization of the product, the teacher/facilitator can propose a path of learning (an artifact, more artifacts by different groups, or artifacts that can be connected each other, as for example various pages to gather in a journal). Following this technology-enhanced strategy based on "real" materials, CLIL lacks of pseudo-realistic aspects, which learners may potentially face in a traditional foreign language learning locus (Ting, 2018). In this view, teachers' presentation of translated materials using the visual support of Powerpoint slides cannot be considered a correct use of ICT resources and, regarding content, a mistake referring to Chesterman's "principle of perceived similarity" (1998). In fact, according to this principle, translators tend first to consider those resources that are perceived as being similar to the mother tongue.

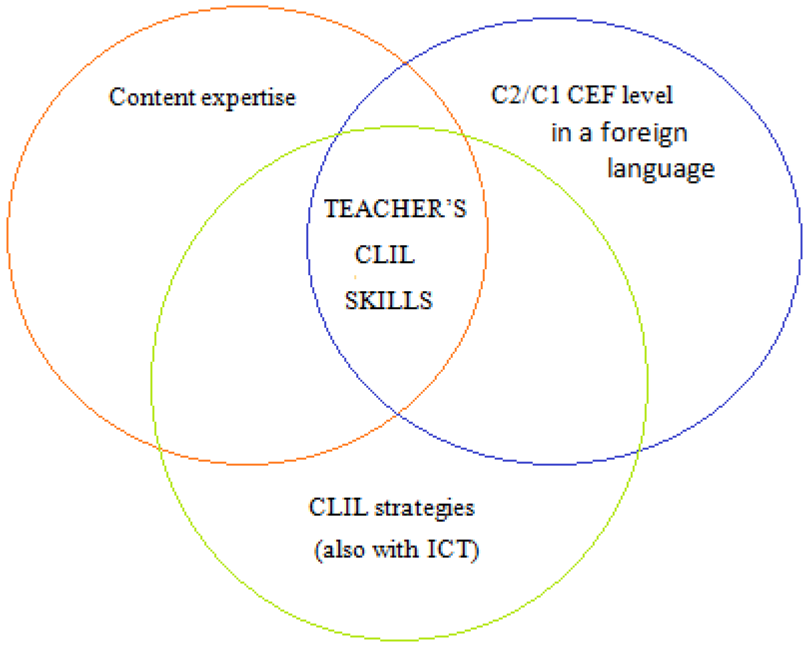
In Europe, CLIL is characterised by a great diversity in its implementation: experiences vary among different countries and among regions within the same country (Eurydice report, 2006). This situation could be connected to the autonomy given to countries, regions, communities, and schools but, above all, to the lack of shared European guidelines. In Italy, CLIL has been introduced by the ex-Minister for Education Gelmini (D.M. 68 del 30/07/2010, MIUR - Ministero dell'Istruzione, dell'Università e della Ricerca). Furthermore, the link between CLIL and ICT has been clearly reported in the National Digital School Plan (PNSD) issued in 2015, underlining the technological innovation in teaching practices and in the school system in general, in the view of a re-launch of the digital in the school with the Law 107. However, the theoretically well-planned Italian CLIL has irremediably shown some serious weaknesses when has faced the reality of schools and, in particular, with in specific areas of the country. In fact, in Southern Italy, many schools do not have technological laboratories or devices and, in all the country, teachers have not the proper training, and the lack of a discussion about pedagogy and the co-design of CLIL work involving teachers, students, and families has not been considered as fundamental.

Teachers/Facilitators

In the traditional school context, during a grammar lesson of a foreign language, the teacher asks questions and the pupils provide short answers which makes the teacher input abundant and the learner's output minimal (Swain, 1988). Swain affirms that not many tenses and grammatical structures are used and, therefore, little practise of more complex language structures can be observed. However, if teachers adopt certain didactic strategies (e.g. role-playing, debate, 'real-life' discussions, etc.) in an immersion classroom, the pupils seem to feel comfortable using more complex structures of language and show a great motivation to contribute to elaborate the lesson. Classes where teachers stimulate pair-work or team-work, opportunities for students to practise the language in a stimulating and not intimidating environment are increased. In CLIL context, as in the social-constructivist educational tradition, the teacher is a facilitator, he/she does not transmit information or skills to the learner, but rather focuses on supporting /facilitating students' learning. However, in Europe, diversity in CLIL implementation foresees different teachers' linguistic competence and teachers' training (Eurydice report, 2006). In the majority of the cases, CLIL teachers are usually experts in either subject areas or language learning, but rarely both (Di Martino & Di Sabato, 2012), CLIL involves non-native speakers as teachers and classroom content is not taken from everyday life or target language culture, but from school disciplines (Dalton-Puffer, 2011). In Italy, the involved teachers are mostly those who are already part of the school system on a permanent basis, and the reform does not include foreign language teachers: all the responsibility for CLIL implementation is on non-language teachers who must possess a second language competence of C2/C1 CEFR (Common European Framework of Reference for languages) level (in some case B1-B2). In particular, Ministry of Education established the characteristics of the CLIL teacher profile through a specific decree (D.D. 6, 16 April 2012, MIUR), specifying the different competences a CLIL teacher must develop in order to be fully qualified: language competences, subject competences, teaching competences, ICT competences (Figure 2). It consists in a new professional figure (not only a teacher, a facilitator, or a technician) whose role is to assist and support the CLIL educational process. Hence, different formative levels are arranged in mandatory MIUR courses, overcoming the problem of schools financial difficulties in subsidizing courses for teachers.

The lack of well-qualified teachers preclude the enhancement of CLIL: teacher's competences, his/her knowledge of ICT ("digital literacy"), methodology and techniques (including classroom management skills), and the lack of effective language competence invalidate the whole CLIL innovation. Language knowledge is CLIL defining feature and its constitutive backbone; the teacher has to make output comprehensible, be able to adjust it to the students' language level, check their comprehension, sum up and reformulate the message. These tasks require a sophisticated language knowledge, in addition to strategic awareness and skills (Di Martino & Di Sabato, 2012). Moreover, regarding ICT, a teacher cannot be a facilitator if he/she does not know the device to utilize for a successful learning. In an advanced technology-enhanced environment, the teacher/facilitator must have ICT-related skills, and he/she has to involve, motivate, and ensure learning. The work profile is quite complex and demanding, if the different specific skills to be developed are taken into account. As facilitator, the teacher is the exclusive authority in the class and its manager. For this reason, his/her technological knowledge must be improved and continuously trained. On the other side, numerous researches have showed that pre-service and in-service school teachers have a general low level of technological knowledge. Moreover, this level of knowledge is firmly related to the perception of self-efficacy in teaching, that is the teacher's assessment to obtain students' results of engagement and learning, even among the students

Figure 2. Teacher's CLIL Skills (© 2019. Tavernise Assunta)



with difficulties (Savran Gencera & Cakiroglub, 2007; Pavón Vázquez & Ellison, 2013; Wolff, 2012). An approach including educational tools into earning process in classroom could help teachers to focus on students' engagement and entertainment. In particular, research confirmed that an active training as well as the possibility to redesign learning through the incorporation of instructional technologies in teaching, lead to very positive results education; finally, teachers must be the main motivators for learners. In particular, teachers have many roles, because they must: 1) facilitate learning in collaborative and technological environments, 2) design lessons; 3) select digital materials ; 4) build new materials; 5) support the building of products by learners, motivating them. Moreover, in CLIL contexts, teachers design on the basis of the students' foreign language level and, above all, on their needs, personal expectations, and individual interests. The starting point is that the CLIL model is flexible and accordingly it can be adapted to every kind of context (Coyle, Hood, Marsh, 2010; Coyle, 2007, 2008). Furthermore, teachers evaluate CLIL in the classroom, and they use the gathered data to plan future units. However, the structure of CLIL assessment is still in progress: shared tools for evaluation are not be considered in literature. In conclusion, teachers' planning of CLIL programs could be shared with professional learning communities.

Learners

Students are the focus of the structural and functional organization of the educational process, but rarely they are asked about the process itself. The participation in a CLIL course usually comes presupposing an insufficient knowledge of the foreign language on the part of the learners, but no existing researches assess the different level of language knowledge in the class at the beginning of the CLIL course. In France, Poland, and Hungary, CLIL students are selected on the basis of their initial assessment at the entrance exams both on the target language and on subject knowledge. On the contrary, in Spain, Germany, Finland and Sweden, CLIL is normally opened to all students. Moreover, European learners can have access to the educational tools in the setting (the "ClassLab") but in current approach protocols, digital literacy is not measured and no information are present as prerequisites. One of the most important dimensions in CLIL courses, as previously discussed, is the collaboration through peer learning. If the production of a multimedia product is foreseen, the free creation of contents following personal interests should be taken into account as a fundamental motivating and attractive characteristic. The moving of students' consideration "from the what" to the "how" could be very difficult in a CLIL course: learners could pay more attention to the learning of the content than to the innovative features of the technology-advanced setting. This reminds that it is certainly not just innovation in itself that change the current school reality, but rather the way such novelties are perceived, absorbed and adjusted to each and every single teacher's personal teaching path (Di Sabato & Di Martino, 2012).

In Italy, the focus for discussion on the relationship between educational technologies and learning in classroom is chiefly on the presence at school and the related access to technological tools. In last years, technological devices have been acquired by schools as fundamental part of education, but the situation is very different in the various regions, cities and towns of the country. On one side, this matter seems related to the lack of funds of certain schools for the buying of technological devices or to the funds provided by the European Commission for regions with financial difficulties for learning implementation. While the current use of technology in school classroom is irregular, in some High School subjects, the use of ICT in CLIL is mandatory (e.g. at the Computer Science course in Scientific High School, specialization in Applied Science). Moreover, the habit restriction of a "traditional" perspective can affect especially students that are not ready for the challenges of CLIL, and/or students with weaknesses in school grades in second language and curriculum discipline. Learning experience can also be influenced by the infrastructure, the quality of content and assessment, the quality of learner support systems, the assumptions made by learners and facilitators about the learning experience itself, peer support networks for learners and facilitators, and the educational design (Macnish & Trinidad, 2005). However, methodological structure based on educational technologies and edutainment, the learning-by-doing principles, and the advantages of task-based instruction, which are at the basis of this teaching modality, can support the proposed approach and succeed in motivating weaker or perplexed students. New CLIL research could also involve students with specific disabilities and show their needs, also foreseeing the realization of advanced tools and settings for each defined necessity. With this aim, schools should analyse the data obtained in recent researches and consider the enormous possibilities of the future, reflecting on the kind of "educational philosophy" they want carry out in CLIL evolutionary scenario, also defining the new objectives to pursue.

DISCUSSION: CONNECTION TO THE INITIAL ISSUES AND CONTROVERSIES

Fathoming the elements that can contribute to the development of an integrated content-language approach to different technologies for a computer-based CLIL setting, referring to the study questions present in the Introduction, the solid theoretical approach regarding the proposed methodology refers to constructivism and socio-cultural learning. In particular, this work refers to the hands-on approach of constructivism and to the use of ICT for designing and constructing entertaining CLIL contents. In fact, in ClassLabs, teachers with expertise can teach using didactic technologies not only to explain contents and assign exercises, but to promote didactic technologies for ideating and realizing instructional artifacts. In this view, it is possible to combine tasks and technologies in a CLIL course working on the levels of Cognition, Content, Culture, and Communication, integrating skills on specific linguistic and subject skills, and not only of grammar structures. Also two additional dimensions are followed: the freedom of creating contents linked to the topics of the subject according to personal interests, and the peer learning. Taking this approach into account, the technologies to integrate for an advanced laboratorial course can comprehend storytelling through the realization of videos or the virtual manipulation of different digital learning elements (also through touch-screen devices). Technologies can be used for the fruition of the contents provided by the teacher, for the realization of tasks, and for the realization of products. It is preferable to use open source applications, already used for the promotion of digital literacy all over the world. In these ClassLabs, interactive whiteboard, computers, iPads, and mobile devices are available.

On the other side, many teachers (especially in certain grade of school) refuse educational technologies. General resistance is due to the potential negative impact of massive technology on learners minds, because culture still seems strictly linked to the use of books and entertainment to technologies: if some materials are entertaining, they seems far from education. Data of various researches confirm that teachers judge CLIL approach as stimulating, but that they do not have sufficient foreign language knowledge or the competences requested by Italian Ministry appears as many and rigid. The CLIL model based on technologies can potentially be appealing and pleasant, but teachers' main concern regards the perception of self-efficacy in a classroom with digital natives daily immersed in advanced technology. In fact, the age of permanent teachers is usually high, and they are not formed for using technology in class. However, using ICT at school, the construction "in the head" can happen "in the world" through the construction of a product (Papert, 1980), and the artifact can be shown, discussed, examined, probed, and admired. This is the most important challenge and opportunity of the technological approach for learners.

FUTURE RESEARCH DIRECTIONS

Regarding challenges of future developments, the CLIL approach should foresee shared guidelines throughout Europe, and preliminary requisites should include a basic knowledge of technology issues because different results could be obtained with groups of naive users. Moreover, as in some European countries, initial tests should be administrated in order to have a fully knowledge of the class with regard to second language level, content awareness, familiarity with technologies, predisposition towards a CLIL course. Results should support CLIL teacher in the designing of the educational intervention, and the assessment should be correlated to a quantitative measurement for valid findings and rigorous procedures. CLIL assessment should be accurately investigated.

Benefits of CLIL have been clearly explained by current research, and are related to context, content, language, learning, and culture. In relation to context, CLIL prepares students to globalization, it may help in gaining international certification and increase school grades. With regard to content, CLIL offers a different point of view on many school subjects, preparing students to academic studies or future jobs (Coyle, Hood, Marsh, 2010). Starting from the already obtained positive results of CLIL courses, future studies could potentially be interesting, and new areas could be investigated. Moreover, some CLIL features in technology-enhanced settings can be considered as crucial by those teachers who want to ensure full development, enhance involvement, and improve the motivation of their students. Furthermore, a strong impact could be a broad productive possibility of CLIL "prosumers" (producers who are also consumers) for the cultural industry, that could link the requests of different educational environments at a digital/global level in different countries (a first level could be considered the community EVO realized by CLIL teachers at a world level).

Regarding CLIL situation in Italy, laboratorial courses for pre-service teachers, based on the integration of different technologies, could be promoted at a University level. These courses should let pre-service teachers familiarize not only with the most used technologies at school (as for example whiteboards), but with the potential tools capable of realizing higher quality educational processes also for CLIL. In courses for permanent teachers, they should change the vision of the use of technological devices in classroom, perceiving themselves as competent and effective facilitators. All the elements that contribute to CLIL teachers' participation in a technology-based setting and its development, should be detected, analyzed, and considered as fundamental for promoting teachers' digital literacy.

CONCLUSION

CLIL approach constitutes a revolution in methodology and at school level. However, in recent years, discussion on some problems has been interrupted and specific questions are still open, as for example assessment, shared guidelines for the implementation of a good CLIL, and the correct use of technology in ClassLabs. Regarding the latter, this theoretical study has presented the contribution of technologies to a successful CLIL methodology, based on activities student-centered, open educational resources, and innovative learning environments. In these technology-enhanced settings, students develop Lower and Higher Order Thinking skills, and pay higher attention when the facilitator use multimedia teaching tools. Thanks to educational ICTs, lessons are judged as more interesting and information more "real".

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KEY TERMS AND DEFINITIONS

ClassLab: Classroom where students can "make" as in a laboratory.

CLIL (Content and Language-Integrated Learning): An educational approach that foresees the integration of content and language.

Digital Literacy: Individual's ability to find, evaluate, and compose clear information through digital materials, processing diverse data sources and understanding macro relevance and micro application of seemingly disparate ideas.

Educational Technologies: Physical hardware and software used to facilitate learning and improving instructional performance by creating, using, and managing appropriate technological processes and resources.

Higher Order Thinking Skills: Known as HOTS, include synthesizing, analyzing, reasoning, comprehending, application, and evaluation.

Information Communication Technologies: The integration of telecommunications (telephone lines and wireless signals) and computers, as well as necessary software, storage, and audiovisual systems, that enable users to access, store, transmit, and manipulate information.

Lower Order Thinking Skills: Known as LOTS, they include remembering, understanding, and applying. In order to reach the higher level of thinking skills, the lower order of thinking skills must be achieved first.

Chapter 12
Integration of Information and Communication Technology in Teaching Processes

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ABSTRACT

Digital technologies have drastically changed the mindset of communities and compelled them to function smartly. It is a must for everyone to keep updated and acquire the technical know-how for sustenance. Information and communication technology (ICT) and its capability to impact teaching-learning processes have enforced the educational institutions to apply it in pre-primary education to higher education and research. Such technologies have been explored as beneficial in variety of situations. Government is also investing a smart amount of funds to support institutions for creating appropriate ICT environment. The present study attempts to explore the factors responsible for successful integration of information and communication technology in teaching-learning process. Keeping in view the explored factors emerged from the study, it suggests to the government and policymakers how to design and develop the training programs in the area of ICT incorporation in the teaching-learning process.

INTRODUCTION

Today, Information and communication technology has become an important part of most of the enterprises (Zhang et al., 2007, Bamrara, A., 2012). Computers began to be placed in schools in the early 1980s, and several researchers suggest that ICT will also be an important part of education for the following generations (Bransford et al., 2000; Grimus, 2000; Yelland, 2001). Modern technology offers many means to improve teaching and learning in the classroom (Lefebvre et al., 2006). Dawes (2001) believes that new technologies have the potential to support education across the curriculum and provide opportunities for effective communication between teachers and students which was not possible in past. Uttarakhand is a developing State and most of its population relies on Government Schools for educating their kids. ICT tools play a critical role in teaching-learning process as it has been observed very effective in the

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Classrooms to dispense the knowledge. ICT in education has the potential to be influential in improving teaching processes. However, this potential can not be easily achieved. Given the importance of ICT in society and possibly in the future of education, the discovery of possible obstacles to the inclusion of these technologies in schools would represent an important step to improve the quality of teaching and learning. Balanskat et al. (2006) pointed out that problems will be continued to be encountered, although teachers adopt the power of digital technology and apply it too. Keeping in view the usability and applicability of digital tools, School Education department of Uttarakhand has also implemented various projects to encourage the digital awareness among teaching fraternity.

Review of Literature

Several studies studied the applications of novel technologies in the classroom and explored it as indispensable to provide opportunities for students to learn to work in an information age (Buabeng-Andoh, C. et al., 2012; Al-Alwani, 2005; Gomes, 2005; Osborne et al., 2003; Ozden, 2007, Tondeur et al., 2012). It is evident, as Yelland (2001) argued that traditional educational environments do not seem to be suitable for preparing learners to function or be productive in the workplaces of today's society. She claimed that organizations that do not incorporate the use of new technologies in schools cannot seriously claim to prepare their students for next generations. This fact is supported by Grimus (2000), who pointed out that "by teaching ICT skills in primary schools the pupils are prepared to face future developments based on proper understanding". Similarly, Bransford et al. (2000) reported the use of technologies at "what is now known about learning provides important guidelines for uses of technology by teachers for 21st Century. A primary barrier to teachers' readiness and confidence in using ICT, despite general enthusiasm and belief in benefits for learners, is their lack of relevant preparation, either initially or in-service. Training opportunities have remained limited in accessibility and contradictory in quality (Hennessy et al., 2010).

ICT can play various roles in learning and teaching processes. Bransford et al. (2000) concluded that it has great potential to enhance student achievement and teacher learning. Wong et al. (2006) pointed out that technology can play a part in supporting face-to-face teaching and learning in the classroom. A pool of researchers identified that such technologies are helpful in inclusive education, reducing teachers' work load, helpful in teaching to students with special needs and develops a conducive environment for teaching-learning (Iding et al., 2002; Shamatha et al., 2004; Romeo, 2006). While new technologies can help teachers enhance their pedagogical practice, they can also assist students in their learning. According to Grabe et al. (2007), technologies can play a role in developing learner skills, enthusiasm, and understanding. Becta (2003) opined that five factors influence the likelihood that good ICT learning opportunities will develop in schools: ICT resourcing, ICT leadership, ICT teaching, school leadership, and general teaching. He indicated that the success of ICT inclusion of new technology into education varies in various spectrums in which it has been used. Osborne et al. (2003) emphasized that along with the modifications in perception on the nature of science and the role of science education, the integration of ICT tools will pose a new challenge in Science Teaching. Numerous classifications have been done by researchers and practitioners to categorize the barriers to use of ICT tools during teaching-learning process. Few classified it in two categories, i.e., extrinsic and intrinsic barriers. In one study, Ertmer (1999) referred to extrinsic barriers as first-order and claimed it as access, time, support, resources and training, whereas extrinsic barriers as second order and cited it as attitudes, resistance, beliefs; whereas

Bingimlas, K. A. (2009) claimed extrinsic barriers as pertaining to organizations rather than individuals and intrinsic barriers as pertaining to teachers, administrators and individuals.

Another classification found in the literature is with respect to teacher level and organization level. Becta (2004) grouped the barriers according to whether they relate to individual such as lack of time, lack of confidence and resistance to change and to the organization such as lack of effective training in solving technical problems and lack of access to resources (Carver, 2016). Similarly, Balaskat et al. (2006) divided them into micro-level barriers including those related to teachers' attitudes and approach to ICT and meso level barriers including those related to the institutional context. Another perspective presents the obstacles as pertaining to two kinds of conditions – material and non-material (Pelgrum, 2001). Several researchers indicate that one barrier that prevents teachers from using ICT in their teaching is lack of confidence. Dawes (2001) sees this as contextual factor which can act as a barrier. Sang et al. (2010) pointed out that that prospective ICT integration significantly correlates with all teacher related variables, except for gender.

Beggs (2000) asserted that teachers' fear of failure caused a lack of confidence. On the other hand Balanskat et al. (2006) found the limitations in teachers' ICT familiarity makes them feel anxious about applying ICT tools in the classroom and thus not confident to use it in teaching. Lack of confidence and experience with technology sway teachers' motivation to use ICT in the classroom (Cox et al., 1999; Osborne et al., 2003; Wastiau, P. et al., 2013; Ghavifekr et al., 2016). Newhouse (2002) explored that many teachers lacked the confidence as well as skills to apply computers and were not enthusiastic about the changes and integration of supplementary learning associated with bringing computers into their teaching-learning practices.

In the developing countries, research reported that teachers' lack of technological competence is a chief barrier to their acceptance and adoption of ICT (Pelgrum, 2001; Al-Oteawi, 2002). In Syria, teachers' lack of technological competence has been carried out as the main barrier (Albirini, 2006). Empirica (2006) produced a report on the use of ICT in European schools which showed that teachers who don't use computers in the classrooms claim that 'lack of skills' are a constraining factor preventing teachers from using ICT for teaching. Pelgrum (2001) conducted a worldwide survey and found that teachers' lack of knowledge (Gebremedhin et al., 2015) and skills is a serious obstacle in using ICT in primary and secondary schools. In Silica's study (2005), teachers complained about how difficult it was to always have access to computers. Drent et al. (2008) pointed out that teacher as important for the integration of ICT in teacher education. School level factors turn out to be of limited importance for innovative use of ICT.

Korte et al. (2007) found infrastructure barriers such as broadband access not yet being available. Toprakci (2006) found that low number of computers, oldness or slowness of ICT systems and scarcity of educational software in the school were barriers to the successful implementation of ICT into Science education in Turkish Schools. Similarly, Al-Alwani (2005) found that having no access to the internet during the school day and lack of hardware were impeding technology integration in Saudi schools. Gomes (2005) found a lack of appropriate infrastructure and lack of appropriate material resources to the barriers. On the basis of various studies, I pointed out the major barriers as lack of confidence, lack of competence and lack of access to resources.

Table 1 Summary of results for Hypothesis 1

SN	Proposed Relationship	Karl Pearson's Coefficient of Correlation	Chi Square Estimates	
			Value	df
1	Experience - Computer Skill Level (Confidence)	-0.010	13.68	9
2	Experience - Computing (Confidence)	0.118	17.60	9
3	Experience – Use of Keyboard (Confidence)	0.044	26.59	9
4	Experience – Use of Mouse/ Touchpad (Confidence)	0.003	25.12	9
5	Experience – Task Performance (Confidence)	0.059	37.32	9
6	Experience – Using MS Word (Confidence)	0.043	25.69	9
7	Experience – Using MS Paint (Confidence)	0.050	25.34	9
8	Experience – Using MS PowerPoint (Confidence)	0.065	37.94	9
9	Experience – Using MS Excel (Confidence)	0.047	26.91	9
10	Experience – Using MS Access (Confidence)	0.067	21.55	9
11	Experience – Using Internet (Confidence)	0.027	28.69	9
12	Experience – Using E-Mail (Confidence)	0.047	37.65	9

Objectives

- To study the teachers' *Confidence* to apply the ICT tools in teaching-learning process
- To analyze the status of teachers' *Access* to ICT resources
- To study the teachers' *Competence* to apply the ICT tools in teaching-learning process

Research Methodology

The present study analyzes the barriers which obstruct the path of applying ICT tools in a classroom. For the purpose, a representative sample of 570 (Out of which, 519 Responded) Primary School teachers has been interviewed using a questionnaire in ninety-five blocks of Uttarakhand (*using Systematic Random Sampling*) to rate their views on various dimensions of ICT usage in a classroom. The collected data has been analyzed using SPSS to calculate correlation coefficients and χ^2 statistic. What emerged from the review of literature was individual's *Confidence, Competence, and Access* to ICT resources has a significant impact on ICT usage in the classroom. The occurrence of all components enhances the probability of exceptional integration of ICT tools in learning and teaching opportunities.

Analysis and Discussion

Hypothesis 1 H_0: Teachers' Confidence to Apply the ICT Tools in Teaching-Learning Process does not Differ Significantly

To study the teachers' *Confidence* to apply the ICT tools in teaching learning process, a set of questions have been developed using UNESCO ICT Competency Framework for Teachers. The *Confidence* has

Table 2 Summary of results for Hypothesis 2

SN	Proposed Relationship	Karl Pearson's Coefficient of Correlation	Chi Square Estimates	
			Value	df
1	Experience – Applying ICT Tools (Competence)	0.017	25.21	12
2	Experience – Use of Computers in TLP (Competence)	0.012	29.23	12
3	Experience – Use of Smart Phones in TLP (Competence)	-0.049	19.72	12
4	Experience – Use of Mobile Apps in TLP (Competence)	-0.005	31.32	12
5	Experience – Evaluation Using ICT Tools (Competence)	0.060	50.90	12
6	Experience – Use of MS Word (Competence)	0.005	37.49	12
7	Experience – Use of MS PowerPoint (Competence)	-0.122	55.39	12
8	Experience – Use of MS Excel (Competence)	0.226	80.23	12
9	Experience – Use of Internet (Competence)	-0.055	22.09	12

been rated with 12 variables which include computer skill level, computing, use of keyboard, Use of mouse, task performance, Use of - MS Word, Paint, Power-point, Excel, Access, Internet and E-Mail.

It has been observed that computer skill level is negatively correlated to experience of the teachers, whereas rest of the variables has a positive correlation. The calculated values of χ^2 at 95% confidence level are 13.68 and 17.60 which are less than the tabulated value (χ^2_{cal} = 16.92) for nine degrees of freedom and it shows that there is no significant relation between computing and computer skill level with the experience of teachers. Further, the calculated values of χ^2 at 95% confidence level are 26.59, 25.12, 37.32, 25.69, 25.34, 37.94, 26.91, 21.55, 28.69 and 37.65, which are greater than the tabulated value (χ^2_{cal} = 16.92) for nine degrees of freedom and which show that null hypothesis is rejected. Hence, Teachers' *Confidence* to apply the ICT tools in teaching-learning process differs significantly.

Hypothesis 2 H_0: Teachers' Competence to Apply the ICT Tools in Teaching-Learning Process does not Differ Significantly.

To study the teachers' *Competence* to apply the ICT tools in teaching learning process, a set of questions have been developed using UNESCO ICT Competency Framework for Teachers. The *Competence* has been rated with 9 variables which include applying ICT tools, Use of Computers in TLP, Use of Smart Phones in TLP, Use of Mobile Apps in TLP, Evaluation Using ICT Tools, use of - MS Word, MS Power-point, MS Excel and Internet.

It has been observed that Use of MS Power-point, Internet, Smart Phones and Mobile Apps in TLP are negatively correlated with experience of teachers; whereas rest of the variables is positively correlated. The calculated values of χ^2 at 95% confidence level is 19.72 which is less than the tabulated value (χ^2_{cal} = 21.03) for twelve degrees of freedom and it shows that there is no significant relation between use of Smart Phones in Teaching Learning Process with the experience of teachers. Further, the calculated values of χ^2 at 95% confidence level are 25.21, 29.23, 31.32, 50.90, 37.49, 55.39, 80.23 and 22.09, which are greater than the tabulated value (χ^2_{cal} = 21.03) for twelve degrees of freedom and which show that null hypothesis is rejected. Hence, Teachers' *Competence* to apply the ICT tools in teaching-learning process differs significantly.

Table 3 Summary of results for Hypothesis 3

SN	Proposed Relationship	Karl Pearson's Coefficient of Correlation	Chi Square Estimates	
			Value	df
1	Experience - Computer Ownership (Access)	-0.039	17.12	6
2	Experience - Use of Computers (Access)	-0.024	25.69	6
3	Experience - Computer Ownership by School (Access)	0.043	27.25	6
4	Experience - MS Word for TLP (Access)	-0.017	24.02	6
5	Experience - MS PowerPoint for TLP (Access)	0.004	13.02	6
6	Experience - MS Excel for TLP (Access)	-0.173	19.57	6
7	Experience - MS Access for TLP (Access)	0.120	21.09	6
8	Experience - MS Paint for TLP (Access)	-0.014	28.88	6
9	Experience - Internet for TLP (Access)	0.058	35.98	6
10	Experience - Use of internet on smart phone (Access)	0.007	21.01	6
11	Experience - Helping Others (Access)	-0.052	24.10	6

Hypothesis 3 H_0: Teachers' Access to ICT Resources does not Vary Significantly

To study the teachers' *Access* to ICT resources and apply it in teaching learning process, a set of questions have been developed using UNESCO ICT Competency Framework for Teachers. The *Access* has been rated with 11 variables which include Computer Ownership, Use of Computers, computer ownership by School, use of MS Word, MS Excel, MS Access, MS Paint, Internet for TLP, use of internet on smart phone and helping others to use ICT.

It has been observed that Computer Ownership, Use of Computers, MS Word, MS Excel, MS Paint and Helping others to use ICT resources are negatively correlated with experience of teachers; whereas rest of the variables is positively correlated. The calculated values of χ^2 at 95% confidence level is 13.02 which is less than the tabulated value (χ^2_{cal} = 16.92) for six degrees of freedom and it shows that there is no significant relation between use of MS PowerPoint for Teaching Learning Process with the experience of teachers. Further, the calculated values of χ^2 at 95% confidence level are 17.12, 25.69, 27.25, 24.02, 19.57, 21.09, 28.88, 35.98,21.01 and 24.10 which are greater than the tabulated value (χ^2_{cal} = 16.92) for six degrees of freedom and which show that null hypothesis is rejected. Hence, Teachers' *Access* to apply the ICT tools in teaching-learning process differs significantly.

CONCLUSION AND SUGGESTIONS

Since Confidence, Competence and Access have been found to be critical components for technology integration in schools, ICT resources including software and hardware, effective professional development, sufficient time and technical support need to be provided for teachers. No one component in itself is sufficient to produce good teaching. However, the presence of all components increases the likelihood of excellent integration of ICT in learning and teaching opportunities.

Table 4 SWOT Analysis

STRENGTHS	WEAKNESSES	OPPORTUNITIS	THREATS
Smart Phones' Availability among Teachers	Non- Availability of Computers in Schools	Effective Digital environment of the Nation	Poor Infrastructure
Internet Usage on Smart Phones	Lack of Confidence and Competence among teachers to apply computers/ ICT Tools	Interest among teachers to apply A/V learning material for TLP	Financial Barriers
Availability of Easy-to-use apps for TLP	Lack of access to ICT Resources (Computers/ Online Tools)	Internet access on Smart Phones	Cyber Threats
	Lack of Appropriate Training Facilities	Power of Digital Learning over Traditional Methods	Lack of technical support

Further, effective digital environment of the country, interest among teaching fraternity to apply Audio-Visual media for teaching learning processes, internet penetration and its usability and power of digital learning over traditional methods are the areas where Government and Educational agencies need to focus and catalyze the digital culture in education. School Education Department must work in sync with State and Central Governments along with the Non Government Organizations to ensure the access of computers and ICT resources in Schools and strengthen the capability of teachers to develop their confidence and competence to use ICT Tools in teaching learning process.

FUTURE RESEARCH POSSIBILITIES

The present study has been conducted over 519 Government Primary School Teachers of Uttarakhand, whereas the future studies can focus on larger samples including the Government Secondary and other Private Schools operating in the State. Experience of the teachers has been considered as a factor to correlate Competency, Confidence and Accessibility to ICT resources, whereas other factors, i.e., age, gender, mental aptitude and technical aptitude can also highlight more relevant issues associated to challenges incorporated in Use of ICT tools for TLP.

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Chapter 13
The Processes of Appropriation of Technological Tools in the Classroom:
Teachers' Perspective

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ABSTRACT

This chapter aims to investigate how teachers perceive the usefulness of introducing technological tools (namely, iPad) for the learning/teaching process in a professional secondary school. More specifically, the authors intend to understand how the process of iPad appropriation is identified by the teachers as a learning tool. Through the analysis of focus groups involving different teachers belonging to the same school, the authors intend to detect teachers' self-efficacy and beliefs concerning the appropriation of the use of the iPad in the classroom along a school year. The findings of the study highlight diverse facilitating and hindering elements in the process of teachers' appropriation of such technological tool. The study opens further spaces to examine teachers' and students' perceptions in mastering new technological tools and in building new processes of teaching/learning.

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INTRODUCTION

In the last decades, teachers are confronted with the emergence of different pervasive technological tools during their pedagogical activities. Among various devices that are currently used in the classroom (i.e., netbooks, mobile phones, computers, and mp3 players), increasing attention in the field of technology of education is paid to the tablet, such as the iPad. This focus of interest concerns different learning levels, from preschool to tertiary education (Falloon, 2013; Kucirkova, Messer, Sheehy, & Panadero, 2014; Manches, 2011). These studies have the merit of opening spaces for reflecting about the use of different technological tools in the classroom. However, what is still lacking is a qualitative investigation of how the use of iPads is perceived in relation to the process of users' appropriation in the classroom. This allows to analyze the teachers' perceptions of iPad appropriation as supporting tool for their didactic activities. The authors' goal is to conduct an analysis of what teachers think about these technological tools, and how they declare to use these technologies as resources for their teaching activities. This work should enhance the understanding of how to support teachers' beliefs, in order to facilitate the integration of iPads in their professional settings. By exploring the perceptions connected to this process of appropriation, the authors also intend to improve the awareness of the aspects that facilitate and hinder the effective use of the iPad in the classroom. This may assist teachers to overcome barriers and to became successful "technology adopters" (Bingimlas, 2009).

THE USE OF IPADs AND SUBJECTIVE AND INTERACTIVE COMPONENTS OF TEACHERS' APPROPRIATION

Different reasons are recognized as key factors in pushing people towards the use of digital and mobile technologies in educational settings (Cochrane, Narayan, & Oldfield, 2013). Firstly, technologies improve the access to course materials and allow to align with broader institutional and business goals (Kukulska-Hulme, 2005). Secondly, technological tools play a role in fostering learning about complex topics (Jacobson & Archodidou, 2000). Finally, they have the merit to provide learners with dynamic and nonlinear access to a wide range of information (i.e., text, graphic, audio, and video). In this vein, technological tools such as iPads are considered "post-PC" devices implying a "mobile complexity" (Murphy, 2011). In addition to the above-mentioned benefits, it is important to recognize some challenges that can emerge with respect to the traditional teaching and learning processes: Students' distraction can increase; the management of the classroom can result more complex; difficulties in planning and managing the students' work can emerge; a lack of knowledge and available resources can impact the possibility to develop new systems of education.

The introduction of the iPad as a learning tool has been promoted with great emphasis by several studies questioning the added value that this technological device entails in education. Research highlighted the benefits with respect to the emerging efforts in terms of adaptation and promotion of qualitative changes in the school community (Jones & Issroff, 2007). Different studies have documented various forms of teachers' rejection or low-level use of new technological tools, despite the availability of devices in the classroom. Most of the traditional training courses for preservice (and in-service) teachers do not provide specific learning skills to manage an effective appropriation of new technologies (Llorens, Salanova, & Grau, 2002). In the authors' view, many critical factors in the appropriation of the use of iPads in the classroom should be questioned and require a critical analysis. In fact, aspects such as the pedagogical appropriation of a technological tool into a course, the possibility to have a model for a pedagogical use, as well as the presence of a supportive learning community are essential in modelling new ways of leading learning/teaching processes.

For these reasons, in this chapter the authors intend to take into account teachers' perspectives in their experiences of appropriation of iPads in their use in the classroom. In the authors' view, an exploration of the narratives about these processes can be relevant to conceive more effective pedagogical designs, based on the of technological tools in the classroom. In order to sustain this perspective, a crucial element concerns teachers' self-efficacy and beliefs on new technologies. In fact, different subjective dimensions could affect the processes of appropriation of the iPad. Although these elements are often considered as second-order barriers, defined as the intrinsic factors that hinder and interfere with technology appropriation, different studies showed the relevance of teachers' self-efficacy in this process. The authors refer to self-efficacy as the teachers' ability to organize and implement a course of actions that are necessary to properly manage a particular context and to achieve a goal (Bandura, 1997). As teachers with high self-efficacy have a greater tendency to innovation processes (Boéchat-Heer, 2018a, 2018b; Deaudelin, Dussault, & Brodeur, 2002), self-efficacy can concern the belief in abilities and skills which are necessary to successfully perform a technologically sophisticated new task. Carugati and Tomasetto (2002) showed how the perception of teachers' own performances against the use of computers has an impact on practices of appropriation of new technology. Another aspect to be considered is the subjective dimension of the process of appropriation of technology. This is also connected to the teachers' beliefs and has impacts on decisions about learning and teaching processes (Kagan, 1992). In fact, beliefs influence the organization of the classroom (Churchill, Fox, & King, 2012; Sendan & Roberts, 1998), as well as the teaching practices (Pajares, 1992) and the teachers' use of a new technological tool.

The two above-mentioned dimensions (i.e., the teachers' self-efficacy and the teachers' beliefs) are the main variables that are considered as crucial in the exploration of teachers' subjective appropriation of new technological tools. For this reason, the authors intend to focus on the process of appropriation in terms of an interactive phase in which teachers are called to manage various strategies of acceptance, rejection, and use of a device in educational contexts.

The adoption of a new technology is typically performed through different replacements and transformations. On the contrary, transformation occurs when a process or a resource is completely changed, by a process of rebuilding the learning methods. Some studies on the introduction of technologies in the classroom have emphasized the importance of developing learner-centered teaching/learning methods that promote participation and empowerment (Niemi, Kynäslahti, & Vahtivuori-Hänninen, 2012). Different studies showed how the role of teachers and students changes in this sense. For instance, students become "investigators, co-operators, sometimes experts, clarifiers, and strategic users of available resources" (Tardif, 1998, p. 70). At the same time, the teacher becomes a guide, a coach, a facilitator or a tutor. In this sense, the technological tool is an artifact that pushes teachers and students to interact. More specifically, Beguin and Rabardel (2005) consider an instrument as a mixed entity, consisting of the artifact and its usage. Rabardel (1995) already distinguished three levels: 1) A scheme of the use of the artifact, which concerns the actions and the activities that are directly connected to the artifact; 2) A scheme of action which is mediated by the instrument and connected to the activity, and which aims at achieving the users' purposes through the use of the artifact; 3) A scheme of collective activity which is mediated by the instrument and is associated to collective activities and purposes that are achievable through the use of the artifact. According to this approach, "the instrument contains, in a specific form, the set of relationships that the subject can maintain with the reality on and in which it allows to act with himself and the others" (Rabardel, 1995, p. 262). The introduction of an artifact within a given situation does not mean that it is immediately used as a tool, because people need to appropriate the instrument and create (or discover) the possible ways of use. The above-mentioned schemes act, then, as organizers for the various actions involving the artifacts, and, at the same time, contribute to its implementation.

The authors are interested in this instrumental teacher-student interaction. The notion of appropriation is thus employed when the user begins to employ the artifact in his/her environment. Jones and Issroff (2007) defined appropriation as the process by which a technology or a particular technological artifact is adopted and shaped in use. The process also includes aspects concerning the mutual influence between the technology and the users (Overdijk & van Diggelen, 2008). This process of mutual shaping between the tool and the subject recalls the instrumental approach (Rabardel, 1995) based on the distinction between the artifact and the instrument: An artifact is an object of the human activity that is designed for specific activities. The user builds and develops some cognitive structures (i.e., the schemes) using the artifact to carry out a task; an instrument is a mixed entity, consisting of a part of the artifact that is mobilized by an individual during its use and another component that is psychological.

These perspectives open a space for a reflection about the relevance of how users in educational contexts appropriate new technological tools. For this reason, in this chapter the authors intend to focus on teachers' subjective components that could impact the process of iPad appropriation in the classroom. The authors will consider self-efficacy and the beliefs, as well as the material and contextual aspects, that play a role in this endeavor.

METHOD

Goal of the Study

The authors aim to examine teachers' perceptions about the process of iPad appropriation. The research questions the authors address are the following: How the processes of teachers' appropriation of iPads emerge and evolve during the school year? Which are the factors that facilitate or hinder the process of teachers' appropriation? To what extent does the role of teachers and students evolve?

Context and Participants

This study is part of a project in collaboration with the organization for information technology in schools, as part of the services for compulsory education in the Swiss canton of Neuchâtel (Boéchat-Heer, Impedovo, & Arcidiacono, 2015). At the beginning of the project, iPads were available to a group of nine teachers of a secondary school (leading classrooms of pupils from 13 years old, on average). Teachers have on average 17.5 years of teaching (from 4 to 35 years) representing all disciplines (i.e., German, English, French, History, Geography, Art, Sport, Science and Nature, and Computer Science). The level of teachers' familiarity with technological devices was very heterogeneous: The majority of the teachers declared that they never used iPads at school. The data were collected along a school year through different methods: Focus groups, diaries, and questionnaires (Arcidiacono & Boéchat-Heer, 2013; Boéchat-Heer & Arcidiacono, 2014).

Table 1. Emerging categories related to iPads appropriation

Dimensions	Indicators
Management of technical features.	Reference to iPad's features and constrains.
Management of sociorelational aspects.	Reference to the role of the colleagues and the technical staff.
Management of didactic and pedagogical beliefs.	Reference to didactical and educative values.
Management of subjective strategies.	Reference to personal choices and actions.

In this chapter, the authors exclusively refer to the data they gathered through focus groups. In particular, they analyze two focus groups about the teachers' subjective experiences of iPads appropriation. The first focus group was conducted at the beginning of the research project, when the iPads were just given to the participant teachers for an initial use in the classroom. The second focus group was realized six month later. The focus groups were carried out at the teachers' school. Each focus group lasted about one hour. They were led by a researcher, playing the role of facilitator and using the mirroring technique (Rogers, 1967). During each focus group, the facilitator was in charge of supporting the participants' talk, by appreciating their emotions and, when necessary, by asking for supplementary explanations, but always without any judgments or evaluations. Focus groups were audio-recorded and fully transcribed.

Analytical Procedures

Considering the discursive nature of their corpus, the authors adopted a qualitative approach (Arcidiacono, Baucal, & Buđevac 2011) to categorize in an inductive way the dimensions (related to the perceptions of the process of iPads appropriation) that emerged from the participants' discourses. Through a process of tuning, namely a progressive comparison between the theoretical aspects and the data analysis, the authors identified the indicators and systematized them until a high level of consent among researchers was reached (agreement rate = 80%). As result of this first analytical step, they condensed the data into four dimensions (Table 1).

RESULTS

This section reports the results in two subsections: In the first part, the authors explore the different dimensions of teachers' appropriation of iPads by a comparison between the two focus groups; in the second part, they discuss the changes in the teachers' appropriation. In presenting the results, the researchers refer to quotations of the participants' interventions during the focus groups, completed by elements of description and interpretation.

A Comparison between Focus Groups

During the first focus group, four teachers (E1, E2, E3, and E4) expressed their need to be "quickly" familiarized to the use of the iPad. They declared a wish to have the new technological device in the "hand," to have the opportunity to try and discover the basic features of the iPad. Although all the participants expressed this need, different constraints emerged. In particular, the management of technical features was at the core of their exchanges. E1 mentioned some constrains about the fact that iPads were not available to everybody at the beginning of the project: "As long as the tablets are not there, it is a little blind." E2 indicated the prohibition of taking the tablet out of the school. This problem was mainly related to the impossibility to test it and to discover the basic features of the iPad: "Considering the fact that we have no right to take the iPad at home, it will be quite complicated. It means that, if we want to try a stuff, we have to stay here, so at school." During the course of the second focus group, these aspects were deeply problematized, as in the excerpt concerning teacher E3:

So, in my mind, if used regularly, the iPad that we provide should already be configured with useful applications for Math, English, and Gym, in order to use it like using a book and, worse, we also have to choose which method to use with it. So, quite simply, I prefer to show them by myself than losing a week downloading applications. And also, these apps cost 120 Swiss francs. In addition, I have no wi-fi in my gym room, so it cuts every video I cannot work with, it would have been interesting. So, finally, there is not much, there is not much. And for the experiment I have conducted with the video, yeah, it's funny, but not essential.

E3 condensed different technical problems that emerged during the first focus group. In particular, the issues were related to the following elements: The use of the right application and the possibility to configure the iPad; the necessity to find a different teaching approach; the costs of the application. A main problem was related to the "affordances" between the iPad and some contextual aspects (e.g., the absence of wi-fi in the gym). The teacher revealed a form of disappointment concerning the balance between the technical constrains and the traditional teaching modalities ("it's funny, but not essential"). In this sense, the advantages of the iPad were minimized by the material and technical affordances the participant perceived as barriers to the use of the new device.

Another aspect concerned the management of sociorelational aspects. In fact, the social and relational aspects of the processes of iPad appropriation were related to the contacts with other colleagues, as well as the relationships with the technical and management staff. In the first focus group, the teachers declared to be strongly supported by their technical staff, who was available for any requests and information. E1 highlighted the emergence of a positive relationship with the staff. This aspect is particularly important, considering the novelty of the device in the school's practice: "It is true that (technical staff member) always said she was available, she also offered to give us the equipment she had for. to get used to iPads since I do not know anything about it. So it's really new." E2 highlighted the introduction of the iPad and the position of the managerial staff: "So this is really new. I think the direction is also in the backstage, in the background, so they will be there to support us, if necessary." Considering their colleagues, the teachers expressed the need to share information to make possible, easier, and more effective the process of familiarization to the new technological resources that were available.

E3 suggested the need to create an efficient network and to share competences and resources: "I think it would be interesting to have a lot of cohesion between all the colleagues who will use this material in the classroom, instead of staying in our own corners." E3 expressed this sociorelational aspect as an urgent need to "manage" the novelty of the iPad's introduction: "So, it's really important to communicate among us on what is working, what is not working, etc."

In the second focus group, the teachers announced a better familiarization to the technical use of the iPad. However, they declared they had excessively delegated the resolution of some technical and managerial problems to other staff members.

The strategy of delegating was expressed by E4, who claimed for a full availability of the technological staff ("a person who make only this… always available"). The teacher invokes the need of a continuous support ("and when something is not working, we need to call someone"), but without suggesting any alternative solutions:

There should be a person who makes only this, and he/she should be always available, because (technical staff member) had to spend school's hours outside… and, as [another teacher] *said before, a presentation of the main applications that everyone would like to use has to be made, to us… and when something is not working, we need to call someone.*

Immediately after, by saying "I feel a bit in a boat", E5 expresses a feeling of frustration for not being somehow "guided" in solving issues raised by the users' experience with iPads: "But otherwise, in relation to the management, I feel a bit in a boat. They do not really master, I mean the direction."

Considering the management of didactical and pedagogical beliefs, during the first focus group, the teachers evoked an expectation of changes connected to the process of iPads appropriation. However, they were not able to prepare themselves to anticipate possible negative consequences and unexpected effects.

E1 uses a metaphor in order to express the idea that iPads are an opportunity to change: "I see the iPad like a huge kick in the anthill where we change the way we teach." This idea is also suggested by E2, in relation to an "unfocused" perception: "I really find it hard to imagine what it will change. I think it will change a lot in the students' motivation, but then I really do not know what." The same idea is highlighted by E3, who shows a lack of didactical and pedagogical knowledge about the introduction of the new technology in teaching and learning processes: "We do not know how these things will happen. So it is an experiment." The teacher feels that the introduction of the iPad in the classroom may determine some changes in triggering the processes of innovation in teaching. According to the teacher, it will provide opportunities for a new pedagogy, both for the students and the teachers.

E4 expresses an expectation of taking the new opportunities that iPads give ("to try what I wanted to do before, by using just a computer"). However, the didactical and pedagogical teachers' views could be too general and not clear for the students ("they do not see the relation between tablets and crafts"):

So, personally, I think this is an opportunity to try what I wanted to do before, by using just a computer. Well, my students, they ask some questions, because they do not see the relation between tablets and crafts. There is one who told me, "but are we going to cut wood with a tablet?" Certainly not (laughter). So, I said, "First start working and after everything should be stored." We cannot let the iPad alongside established.

In turn, E5 talks about a possible general application of the iPad in the field of arts, and makes connections between his expectations and some complex pedagogical goals ("this device will help them to open their eyes and their horizons"):

I expect from my students that this device will help them to open their eyes and their horizons. So, it is limited to the little thing they already know… Indeed, the application in the field of arts is huge. Let's see if they will enjoy it.

Then, this "faith" in technology to reach students' autonomy is expressed by E6:

And then, I have a secret dream, is that, really, it makes them much more independent. I mean the students… if they need something, they will stop to go to the teacher saying "Miss, I need this"… But they will be familiarized to say "oh well, I see." So, I really hope to develop some students' autonomy and freedom now that these resources are available.

In the second focus group, there is a contrast between the teachers' experience in using iPads during the first semester of the school year and the teachers' initial expectations. Indeed, participants did not recognize the device as a resource for the learning processes, and considered it more as a ludic tool.

E7 expressed the students' feeling of the iPad as "more a toy than a tool", without any didactical and pedagogical value:

I feel that for them it is more a toy than a tool. It is as if something is done in the digital way instead of paper, "I can do the same exercise on paper." They feel that it's really fun when it is done in the laboratory, even though the exercise is the same.

E8 also reiterated the nonrecognition of the iPad as a teaching tool: "But this is the same approach, it is another tool, but the approach remains the same, and this is a limitation." Both teachers expressed few critical considerations on how to use the new technology in didactic processes. However, the lack of advantages in the use of the iPad in the classroom and the encountered difficulties led the teachers to "accommodate" themselves to a negative position and, consequently, to reject the use of the iPad.

E9 labeled the shared mood connected to the lack of efficiency of the instrument during the lesson, compared to traditional methods:

It is true that, well, just to bounce off the frustration… the little frustration is the time we spent to prepare the video, a production with a text tool and everything. And then there is nothing working, and the lesson was difficult. It was a bit painful, so, suddenly. It's true, it happened several times, unfortunately, and, suddenly, I saw some things down. I have a little bit reduced, I prepared a written text, to better manage it.

E10 expressed the same attitude, coming back to the use of traditional supports:

Then, the experience would be complete again, if we could send homework to students and then circle. While there, at some point, we arrange iPads in the shelf and then it stops. So, we must necessarily return to the paper, to the type of exercise, I know, imposed by the State.

E11 focused on the relationship between the iPad and the subject he taught: for some subject, such as foreign languages, the use of the iPad was more useful than for other subjects:

I teach English and History. Concerning English, uh, I quite use the processing software, I invite them [the students] *to do something by using the Internet for researching a theme X or Y* [...]. *Concerning History, the applications are fairly expensive. So, I opted to buy them for me* [....]. *So, it is often necessary to refocus the topic, but when something is produced, it is sometimes very, very nice. That's it.*

Teachers were not perceiving the expected didactical and pedagogical changes due to the introduction of iPads. E12 clearly states this:

The big advantage is to be able to illustrate the lessons, to add all you need, links, videos. That's a huge advantage. Now, drawbacks. Our technical problems that have a little bloated, then… I see too. Is it something changing during a lesson with the iPad? No, not at all. I agree with you, yeah. unfortunately. Unfortunately, because there would be good things to do. I have not noticed any changes. I sometimes feel more like you said, as a coach behind the students when they work with their tablets, from time to time. But, otherwise, I do not feel that there are any changes.

In the first focus group, teachers felt to be part of an "innovative trend" that can lead forms of transformation during didactic practices. In fact, faced to iPads, teachers examined both the possibilities and the constraints of the tool with respect to other didactic practices. As they highlighted, the digital devices obliged them to change their practical and pedagogical behavior, and to accommodate it to the use of the tool. However, teachers expressed some resistances during this process, highlighting elements of frustration connected to the situations in which the device does not work or does not add a real value, compared to traditional methods. It appears that technologies are presented as threats (Pegrum, Oakley, & Faulkner, 2013), needing a more complex knowledge and skills in relation to pedagogy and contents of teaching.

The participant teachers also discussed the management of subjective strategies. As the authors already observed in the first focus group, the teachers expressed an initial enthusiasm and motivation about their involvement in the project. Almost all the participants highlighted the importance of being part of such process and of having opportunities for thinking about their technological appropriation, through a shared involvement with colleagues. E1 stated: "As I'm very curious, I said yes [to participate in the process]. Finally, there is plenty to discover through it. I think it's great, because I wanted to use computers [to teach]; it is a possibility."

E2 added: "So it's true that it's good, because we feel we engaged in a new thing, there is the motivation from the teachers' perspective, and also from the students' side. There are questions, and we can offer an answer." E3 shared:

I have no iPad at home. I was able to buy one last week and then I've started to be familiar with the tool, navigating the Internet, trying to find some sites and things like that, and then I was doing it all the time.

E4 reported: "I have a Mac at home. As it is like the iPad, I am not worrying too much, I think it will go fast enough. And, yeah, I see myself as a self-taught person, in this matter." E5 concluded: "I just did [yesterday afternoon] some research online and then I saw that there are sites offering educational applications, and then I put it in my favorites, but that's all I made, for now."

As the contributes above show, the teachers showed an initial form of active participation and engagement. In fact, they looked for personal solutions, in order to facilitate the process of appropriation of iPads and their use (E3: "trying to find some sites and things like that"). In this sense, they evoked dimensions of self-efficacy (E4: "I see myself as a self-taught person in this matter") and forms of self-initiatives (E5: "I saw that there are sites…I put it in my favorites"). During the second focus group, a teacher's disappointment emerges, despite some attempts to overcome the technical difficulties. E6 said: "So, now I take my precautions and I charge [the battery] at home, just in case, and that's the time, but it is a precaution, because, for one or two times, I did not manage." E7 affirmed:

I bought a lot of applications for testing it during the summer holidays. These are rather collaborative or similar to work spaces, and then, well, it was time-consuming to prepare, already. At the beginning the limitations made me more or less thinking to leave the project, as a possibility. So, these are my limitations.

The teachers tried to find new ways to introduce the iPad in their activity. Sometimes, they provided solutions (E6: "I take my precautions and I charge the battery at home"; E7: "I bought a lot of applications for testing it during the summer holidays"), confirming the limitations they already expressed and the possible consequences (E7: "thinking to leave the project"). Teachers mainly expressed positive attitudes to use the iPad in the classroom, although moving from a general enthusiasm for their involvement in the project to some forms of disappointment and frustration, especially considering the risk of the failure in matching some of the expectations. In fact, the initial element of curiosity and novelty that the iPad had introduced was strongly reduced by the material components of the tool. Sometimes, this aspect represented a form of resistance to the innovative processes they experienced.

Supporting Teachers' Changes in the Appropriation of the iPad

This section considers the four dimensions to which the authors referred in the sections above in terms of elements that can support and facilitate the process of iPads appropriation. As to the change from managing the technical features to a social shape of the use of iPads, the authors observed that technical problems strongly affected the teachers' use of that tool. However, the use was not static. On the contrary, it was continuously shaped by the teachers' choices. The participants were not considering iPad as an artifact with characteristics that are independent from the practical use: Learners can construct these characteristics while they work with it. This process of social shaping of the technology emerged through the participants' interventions during focus groups: The use and effects of the tool continuously change during this process of appropriation.

The management of sociorelational aspects highlighted a change from individual to a collective appropriation. The teachers appropriated the new technology by "adapting" it to goal-directed activities. Sharing information and knowledge with colleagues facilitate this process. Indeed, the teachers negotiated meanings for the appropriation of the new technology, by building together common resources for their community of practices. The teachers built a shared understanding of constraints and resources, and found common strategies to use the tool and to achieve some educational goals. This collective sense-making attribution improved the appropriation process and encouraged creative solutions to solve problems.

As to the management of didactic and pedagogic aspects, in line with the outcomes of Pegrum et al. (2013), the results showed that the iPads are not fundamentally designed to be used as learning and teaching tools. In order to transform the technological tool into an effective instrument for learning activities, the technology needs to be integrated into the social practices the participants enact. This leads to the process of customizing the use of technology, calling in a way for the interaction between the tool and the didactic/educational needs of the community. Supporting the idea that "it is the teacher, rather than the technology, that influences the effectiveness of digital technology use in schools" (Starkey, 2011, p. 24), teachers can act as intermediary players using iPads in educational activities. In this way, the technology can become transformative and can improve the creativity of the community.

Finally, different elements fostering subjective strategies emerged and highlighted a process going from the teachers' resistance to their engagement. In fact, teachers have to find the sense and appropriate the properties of the iPad. They have to explore the constrains, by accommodating it to their educational routines. The authors observed how the teachers were sometimes resistant to use the iPad: Their experiences of appropriation can be considered as learning processes that have value for their professional development. The researchers consider that the four dimensions they identified are useful elements to structure future teachers' trainings, in order to support the process of iPad appropriation (Table 2). The training should be oriented to foster the sense of self-efficacy, helping teachers to be more resilient and able to adopt innovative teaching processes. The possibility to recognize the educational value of technological devices both for students and teachers could become a meaningful aspect of learning in formal and informal settings, in which teachers can play a role of mediators.

Table 2. Evolution of the four dimensions throughout the appropriation process

	Dimensions	Initial phase	Final phase
I	Management of technical features.	Technical features.	Social shape of the use.
II	Management of sociorelational aspects.	Individual perspective.	Collective appropriations.
III	Management of didactical and pedagogical aspects.	Tools.	Instruments.
IV	Management of subjective strategies.	Resistance.	Engagement.

CONCLUSION AND FUTURE TRENDS

This chapter compared two focus groups, to identify some dimensions of the teachers' appropriation of the use of iPads. The authors underlined the importance of teachers' perceptions to indicate the specificities of their experiences and to recognize the complexity of a process of appropriation. The changes and evolution they observed highlight the role of different elements during the process of iPad appropriation: The limitation of technical constrains; the resistance in changing traditional practices; the absence of specific social supports; the missing transformation of iPads from tools to instruments for different didactic activities. These results confirm some trends scholars had already highlighted (Boéchat-Heer & Arcidiacono, 2014; Fisher, Higgins & Loveless, 2006). Moreover, this research shows that iPads bring new possibilities to the learning environment, especially if scaffolding and training systems accompany the processes of appropriation. The authors consider that the teachers' professional development, related to the introduction of new technologies, can be improved only if teachers are continuously involved in processes of sense-making for their activities. They have to be active agents (Ligorio, Impedovo, & Arcidiacono, 2017), playing a role in the process of negotiation and discussion about the appropriation of new tools. It is also important for teachers to benefit of pedagogical and didactic trainings to use tablets. Such trainings could focus on the presentation of applications having an educational added value for the process of teaching/learning (Boéchat-Heer, 2018b). Indeed, during teachers' training, technological tools are often used within a traditional setting. Consequently, the students' and teachers' experiences are rather limited and tend to reproduce always the same uses (Impedovo, Said, & Brandt-Pomares, 2016).

The authors found that teachers use digital tablets as a support for their educational activities, without a real change of their usual teaching practices. The tablet appears mainly as a tool available to students, as a calculator or a dictionary; the configuration of the classroom does not change, the students are not necessarily involved in networking activities, and everybody remains at his/her place, more or less as during a traditional lesson. This configuration is somehow maintained by teachers, who are afraid to lose the control of the classroom and preoccupied to experience some difficulties. Teachers who do not want to lose their authority or even their legitimacy as professionals claim for keeping these aspects as they are. For this reason, the authors are convinced that it is important to integrate a technology innovation through a project that is shared within the school, as a component of its culture. Moreover, if the institutions promote innovation through shared understanding, teamwork and acknowledgement of the risks that are related, the teachers indicate to be more likely to engage themselves. These teachers need to be coached and accompanied in this process of integration, by establishing projects that promote the use of technologies in the teaching/learning practice through the management and/or the support of specialists in the field. In particular, the integration of tablets requires more flexibility and, from the teachers' perspective, constant creativity, strong motivation, but also time and patience. It is also important to promote learner-centered teaching. Fullan (1982), as well as Cuban (1993), argue that real changes cannot occur in school without a change in the teachers' practice. These changes include new materials, new approaches to teach, and a new set of beliefs. The student-centered learning is translated into an increased personalized instruction, with a focus on learning strategies that are initiated by the students. The authors are convinced that these components must be taken into account in designing successful teacher trainings.

They also consider the possibility of completing the analysis of the process of appropriation through the observation of the direct use of the iPad in the classroom. It will be interesting to focus on the presumed educational value of iPads, to understand which is its impact on the students' learning. According to the importance of coaching, providing inputs for the self-efficacy and positive beliefs about the teachers' practices in the use of a technological tool, it would be appropriate to assess the influence of different factors (e.g., the support, the management, the training, the technical assistance, and the stakeholders' views) to improve the teachers' use of innovations and to promote changes in education.

As in this chapter the authors investigated the teachers' perceptions as they emerged from different discussions, the researchers consider that their approach had the merit to obtain precious elements about how the participants reflected about their appropriation of a technological tool. Although the data were limited in their size and did not allow for any generalization, the authors intend to highlight the insights and the implications of their study for a better understanding of the process of appropriation. This will open new avenues in considering the forces and the limitations of introducing innovative pedagogical models in education, such as robots and virtual or augmented reality. A comprehensive approach considering the interactive nature of any process of appropriation will be a useful framework for future research in the field.

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Chapter 14
Scaffolding Children's Participation in Schools' Environmental Health:
The Role of Teacher Mediation and Digital Tools

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ABSTRACT

The goal of the research reported in this chapter is to explore if children can participate in schools' environmental health, while being supported by teacher mediation and eco-sensors. Eco-sensors should be used as epistemic mediators to support children in acquiring and interpreting environmental data to suggest solutions to schools' environmental health problems. Teacher mediation can scaffold children's epistemic practices to promote children's participation in scientific inquiries, centered on environmental health problem solving. A web-based platform is used as a database and to share, in multiple representations, the data acquired and organized by children. This research includes two case studies on two environmental health problems: sound pollution and air pollution. The identification of children's epistemic practices and of teacher mediation is made using audio recordings, and pre- and post-tests are used to assess other learning results. The results showed that digital sensors and teacher mediation scaffolded children's participation in environmental health.

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INTRODUCTION

Sound pollution and the lack of quality of indoor and outdoor air quality are central problems in Portuguese schools (Pereira et al., 2014; Madureira et al., 2015), causing teaching and learning problems and declining well-being (Pereira et al., 2014; WHO, 2015a).Those problems are addressed in the Portuguese National Program for School Health (von Amann, 2015). This Program for School Health recommends the participation of teachers and students in projects to improve the school environmental health. In this framework, the Eco-Sensors4Health research project (Eco-sensors for health: Supporting children to create eco-healthy schools) aims at supporting elementary schoolchildren, in communities of practice (Lave & Wenger, 1998), to participate in the enhancement of Portuguese schools' environmental health.

The Eco-Sensors4Health Project promotes the use of electronic sensors by schoolchildren to acquire and read environmental data. Furthermore, this research also aims to find if children can analyze and interpret such data (contextualizing, and using background knowledge), and subsequently communicate the new knowledge, to support their own environmental health decisions (Boulos et al., 2011; Sheth, 2009). This research uses a scientific inquiry strategy, which makes use of electronic sensors to identify and solve environmental health problems, while eliciting schoolchildren epistemic practices (Silva, Lopes, & Silva, 2013). In this context, the research presented in this chapter is focused on two case studies, centered on noise and indoor air pollution, in which teacher mediation and digital sensors are used to support children in identifying and suggesting solutions to such school problems, this way participating in improving schools' environmental health.

Furthermore, the Eco-Sensors4Health collaborative platform makes it possible to introduce, share, search and visualize environmental health data, acquired and signified by children with the sensors, namely in the two aforementioned case studies.

Following this introduction, next section presents the topic of this chapter, based on the literature review. The research methodology is then presented. Results are subsequently revealed. The discussion and conclusions close the text sections. At the end of the chapter, the bibliographic references and acknowledgements are presented.

Background

The concept of environmental health is centered on creating health-supportive environments and encompasses the assessment and control of the environmental factors that can potentially affect health (World Health Organization [WHO], 2018). The Eco-Sensors4Health project, and the research presented in this paper, aim at improving environmental health in schools, through the assessment of environmental health problems by children and through children's intervention on related environmental factors that may affect health. In this project, daily ICT, such as digital sensors support children participation and eco-innovation, towards the creation of healthy and sustainable schools.

In the last decade, the use of sensors, namely sensors embedded in mobile devices, such as tablets and smartphones, has become ubiquitous, at all times and in all places (Sagl, & Resch, 2015). Citizens acquire information about their environment and publish it in diverse settings, such as social networks, platforms of voluntary geographic information projects, and citizen science projects, thus creating knowledge that influences decisions in social life, but also in political life and in science (Boulos, et al., 2011; Elwood, 2008; Laituri & Kodrich, 2008; Zook, Graham, Shelton, & Gorman, 2010).

The Senses@watch project (Gouveia, Fonseca, Câmara, & Ferreira, 2004) was a pioneer project in using citizen sensory data together with environmental sensors for environmental monitoring and change. Notwithstanding, in the last decade, several environmental health projects have been including people as sensors, as for instance the Scipinious.com, used by citizens to communicate environmental health information in Katrina crisis (Laituri, Kodrich, 2008), projects and services as CrisisCamp Haiti, OpenStreetMap, Ushahidi, e GeoCommons used with similar objectives in Haiti earthquake crisis (Zook, Graham, Shelton, & Gorman 2010).

In this perspective, citizen science, or citizen sensing, can overcome the goal of having citizens equipped with low-cost sensors to acquire environmental and health data (Lupton, 2015). A critical approach to the use of sensors in health and environmental health promotion can empower citizens in controlling and using sensed data for change (Boulos et al., 2011; Castell et al., 2015; Lupton, 2015).

Since the beginning of the 21st century, and especially after the release of affordable and easy to use sensors, didactic sensors have been integrated in diverse children centered teaching activities (Druin, 2009). It is important to distinguish two main uses of didactic sensors: i) in platforms for physical computing and programmable tangibles (Blikstein, 2013); ii) in plug and play didactic kits of sensors for sensing the environment.

The use of didactic sensors in platforms for physical computing have been developed in the last thirty years, being twofold (Blikstein, 2013): from theory-driven development (e.g. Lego/Logo, Crickets, Topobo and Cubelets) to technology-driven (e.g. Phidget, Arduino). The plug and play didactic kits of sensors for sensing the environment are not centered on programming and robotics, they are centered on the acquisition of data in the context of mobile participatory environmental sense making activities (Rogers, Connelly, Hazlewood, & Tedesco, 2010; Silva et al., 2010).

In the last fifteen years, especially after the delivery of Virtual Globes, like Google Earth, tools such as mobile phones, GPS sensors, as well as other environmental sensors were used in an educational participatory way to monitor environmental and health parameters in projects, such as: Ambient Wood (Rogers et al., 2005); MobGeoSen in Schools (Kanjo et al., 2008); Urban Tapestries and Social Tapestries (Angus et al., 2007); SchoolSenses@Internet (Silva et al., 2009); and Participate (Chamberlain et al., 2014).

Those projects developed platforms to integrate and made it possible to visualize the environmental data acquired by students, during the participatory exploration and monitoring.

The Eco-Sensors4Health Project aims at promoting the use of electronic sensors by schoolchildren to acquire and read environmental data. The research presented in this paper also aims to find if children can analyze and interpret such data, and subsequently communicate the new knowledge, to support their own environmental health decisions (Boulos et al., 2011; Sheth, 2009). In this way, in this research a scientific inquiry strategy is developed to identify and solve environmental health problems, eliciting schoolchildren epistemic practices (Silva et al., 2013; Lopes, Branco, & Jimenez-Aleixandre, 2011; Kelly & Takao, 2002), which are practices that construct knowledge and are similar to scientists' practices.

Teachers' mediation has been referred as a fundamental process in the development of digital literacy, with teachers having a key role in scaffolding young people in developing the critical thinking skills, required to use technologies to support the processes of making sense of the context they live in and to actively participate in problem solving (Hague & Payton, 2010).

This research illustrates how technologies can be used to foster young children's capacities to interact with their surrounding environment, making decisions to solve everyday problems of their schools. Furthermore, this research also evidences the potential of a collaborative platform to communicate the data acquired by the children to inform such environmental health decisions.

Methodology

This research is centered on two case studies (Creswell, 2008; Yin, 2003), developed with primary school classes in Ciência Viva School (CVS), which is integrated in a science museum, the Lisbon Pavilion of Knowledge. This is a specific context, since each class stays in CVS for a week to develop an intensive and innovative program of technology enhanced experiential science learning.

Two research questions were defined:

- RQ1: What kinds of schoolchildren epistemic practices can be elicited by a scientific inquiry that makes use of electronic sensors to identify and solve environmental health problems?
- RQ2: Can electronic sensors be used in a scientific inquiry to support children in identifying and suggest solutions to school environmental health problems?
- RQ3: What learning results can be evidenced in the scientific inquiry, using a pre and posttest?

Characteristics of the Case Studies

The Case Study 1 (CS1) is focused on Sound Level, while the Case Study 2 is focused on the concentration of Carbon dioxide (CO_2) in the air (see Table 1), since high concentrations of CO_2 are often considered as indicators of relevant concentrations of other indoor pollutants (Olivier et al., 2015).

The participants of the CS1 were: two female teachers of the CVS, which are also researchers of the Eco-Sensors4Health project; the two female teachers of the two classes (C1 and C2) of two schools of Lisbon; and the students of those two classes that participated in all the activities of the case. In C1, there were nineteen participant children of the 3rd year, seven girls and twelve boys. In C2, there were there were eighteen participant children of the 4th year, four girls and fourteen boys. In CS2, the participants were: the two female teachers of the CVS; the female teacher of the class; and twenty seven participant children (twelve boys and fifteen girls) of the 4th year that participated in all the activities of the case.

The CS1 used the sound sensors integrated in the iPads. The CS2 used the PASCO – PS- 2110 Carbon dioxide sensors. Both CS used the free SPARKvue app in tablets.

The activities of the two Case Studies configure a scientific inquiry, and have similar structures (see Table 1). Due to the intensive schedule of each primary school project, the three sessions of each Case Study were not long: the 1st session were designed to last 75 minutes, the 2nd session 20 minutes and the 3rd session 90 minutes.

The children's tasks in session 1 of CS1 include:

- Put the hands on the throats while speaking and describe the sensation;
- Use a pencil and a metal hanger to hear the sound of a pencil hitting the hanger with the hanger against his/er ear, and with the hanger a few centimeters distant from his/er ear. Say which of the sounds is stronger. Interpret the results;

Table 1. Structure of the case studies

Structure of the Sound Level case study (CS1)				Structure of the Carbon Dioxide Case Study (CS2)		
1st session	**2nd session**	**3rd session**		**1st session**	**2nd session**	**3rd session**
What is sound?	Measuring and recording outdoors	Data analysis		How can we know that air is around us if we do not see it?	Measuring and recording outdoors	Data analysis
What is needed to have sound?		Data interpretation		What is air made off?		Data interpretation
Sound propagation		Conclusions		Measuring and recording indoors		Conclusions
What sounds do we produce? Measuring and recording indoors		Concluding Video				Concluding Video

- Observe the behavior difference of the sugar grains on tightly stretched and poorly stretched adherent film on the top of a drum, when producing sound with a stick on a pan lid. Interpret the results;
- Use an iPAD to acquire sound level data while making silence, clapping hands, singing, and working in group. Register, in the registration form, the minimum sound level, while making silence, the maximum sound level, while clapping hands, and the average, while singing and working in groups.

In session 2, children are asked to acquire and register sound level data while making silence, clapping hands, and singing outdoors. In session 3, children are asked to complete their registrations, to analyze and interpret the registrations and to present the conclusions.

In the session 1 of CS2, the children's tasks include:

- Observe the teacher's presentation on the composition of air;
- Use a plastic bag to demonstrate that there is air in the classroom;
- Observe the air coming out of a balloon, and describe the sensation produced in the body. Interpret it;
- Use the CO2 sensor to measure the concentration of that gas in the exhaled air, in the air of the room during the activity, in the air of the room after opening the door, and in a bottle for which one of the children breathed out. Register and interpret the acquired data;

In session 2, children are asked to acquire and register CO2 concentration at the Pavilion door, in the garden, and near the road. As in CS1, in session 3, children are asked to complete their registrations, to analyze and interpret the registrations and to present the conclusions.

Data Collection and Analysis

The filled registration forms and the pre and post-tests allowed monitoring the identification and suggestion of solutions to school environmental health problems. The participant observation performed by a project researcher, together with the audio recordings allowed checking the types of teacher mediation and the epistemic practices. Children's epistemic practices were systematized in ten types (Lopes, Branco, & Jimenez-Aleixandre, 2011; Aboim 2014): Describe (EP1); Ask questions (EP 2); Make estimates/Forecasting (EP 3); Use sensors (EP 4); Interpret (EP 5); Control variables (EP 6); Formulate hypotheses (EP 7); Organize information (EP 8); Create representations (EP 9); Relate (EP 10).

Teacher mediation was systematized in eight types (Lopes, Cravino, Branco, Saraiva, & Silva 2008; Aboim 2014): Contextualize the problem (TM1); Present the task in the form of a challenge (TM2); Ask questions, stimulating the sharing of ideas and valuing students' thoughts (TM3); Respect and encourage students' autonomy (TM4); Synthesize information (TM5); Guide and support students in the development of tasks (TM6); Make resources available (TM7); Conduct formative evaluation (TM8).

The Eco-Sensors4Health web based collaborative platform (http://www.eco-sensors4health.pt) was used as a database and to share, in multiple representations, the data acquired and organized by children.

The construction of the pre and post-tests had as starting point the main areas of environmental literacy defined by Roth (1992) and used by Erdogan (2015): Knowledge, Skills, Affect and Behavior. The pre and post-tests were created with the following categories: Knowledge, Environmental Awareness, Attitudes, Personal Investment and Responsibility, Perception of the Physical Environment. The pre and post-tests were also examined to complete the formative learning evaluation, complementing the in-process evaluation.

The nonparametric Wilcoxon test was used to determine if the answers of children to the questions of the pretest and of the posttest are different in a statistically significant way. The nonparametric Mann–Whitney test was used to determine if the answers of boys and girls to the 'Knowledge' questions of the posttest are different in a statistically significant way.

Results

Epistemic Practices and Teacher Mediation

The examples of children's epistemic practices, elicited by different types of teacher mediation, during the three sessions of the scientific inquiry that used digital sensors in environmental health problem solving are presented in Tables 2, 3, and 4. Some of these epistemic practices were not executed by all the children, but others were performed by every child, as is the case of "Organize information".

In session 1, it was possible to identify almost all the types of children's epistemic practices (EP). Only the EP "Create representations" was not observed. The EP "Control Variables" was only observed in CS1. With the exception of the "Organize information", all the other EP were developed in dialogue with the Teachers/Researchers.

The children's EP identified in session 1 were mainly preceded by the following types of teacher mediation: "Present the task in the form of a challenge"; "Ask questions, stimulating the sharing of ideas and valuing students' thoughts"; "Guide and support students in the development of tasks"; "Make resources available".

In session 2, it was possible to identify five of the ten EP: "Make estimates/Forecasting"; "Use sensors"; "Interpret"; "Organize information"; and "Relate". These practices were preceded by the following types of teacher mediation: "Present the task in the form of a challenge"; "Ask questions, stimulating the sharing of ideas and valuing students' thoughts"; "Synthesize information"; "Guide and support students in the development of tasks".

Table 2. Examples of children's epistemic practices in the session 1 of Case Studies 1 and 2

Epistemic Practices	Case Study 1 - Sound	Case Study 2 – Carbon dioxide
EP1 Describe	T/R2: Let's put our hand on our throat and say our name [**TM 2 – Present the task in the form of a challenge**] Child: It vibrates.	By suggestion and with supervision of the T/R1 [**TM 2 – Present the task in the form of a challenge**] **[TM6 Guide and support students in the development of tasks],** after opening the door of the classroom, children read the values of CO_2 concentrations and report its decreasing in time.
EP 2 Ask questions	T/R2 was producing sound with a stick on a pan lid near sugar grains on tightly stretched and poorly stretched adherent film on the top of two drums [**TM6 Guide and support students in the development of tasks**]; [**TM7 Make resources available**]; Child: And if you tap on the film?	(After measuring the concentration of CO_2 in the bottle containing the exhaled air.) Child: It does not make much sense, since there is more O_2 than CO_2, we breathe out more CO_2 every two seconds, and there are millions of people in the world. It does not make much sense!?
EP 3 Make estimates/ Forecasting	T/R1: I'm putting sugar on top of the adherent film. What do you think will happen if I make a sound? [**TM 3 – Ask questions, stimulating the sharing of ideas and valuing students' thoughts**] Child: It will vibrate. T/R1 What is going to vibrate? [**TM 3**] Child: The film. T/R1 And what will happen to sugar? [**TM 3**] Child: It will fall.	T/R1 removed the sensor from the bottle containing the exhaled air. T/R1: If I put the sensor back in the bottle, will I get the value that I measured there previously? [**TM 3 – Ask questions, stimulating the sharing of ideas and valuing students' thoughts**] Child: No. Because CO_2 came out of the bottle.
EP 4 Use sensors	By request of T/R1 **[TM6 Guide and support students in the development of tasks]**, children measured sound level in different activities: making silence; clapping hands; singing. Each child makes a task at a time (measuring and searching the values).	By request of T/R1 [**TM6 Guide and support students in the development of tasks**], children measured the concentration of the CO_2 in the room (two hours after the beginning of the class), before and after opening the door.
EP 5 Interpret	T/R1: And why do you think it did vibrate? [**TM 3 – Ask questions, stimulating the sharing of ideas and valuing students' thoughts**] Child: Because of the noise. Child: when you move away, the sugar will skip less, because the sound is farther and will lose energy	By request of T/R1 [**TM6 Guide and support students in the development of tasks**], children compared the data acquired with the sensor with the values of the CO_2 scale, verbalizing the potential effects of the measured concentrations.
EP 6 Control variables	T/R2 was producing sound with a stick on a pan lid near sugar grains on tightly stretched and poorly stretched adherent film on the top of two drums [**TM6 Guide and support students in the development of tasks**]; [**TM7 Make resources available**]; Child: And if you tap on the film?	
EP 7 Formulate hypotheses	T/R1: When I do this, the sound comes to my ear, where? [**TM 3 – Ask questions, stimulating the sharing of ideas and valuing students' thoughts**] Child: Through the air T/R1: But when I do this, the sound comes to my ear, where? [**TM 3**] Child: Through the iron	T/R1: Do you want to continue with this high concentration of CO_2 in the classroom? [**TM 3 – Ask questions, stimulating the sharing of ideas and valuing students' thoughts**] Children: No. T/R1: What can we do? **[TM 6 – Guide and support students in the development of tasks]** Child: Open the door.
EP 8 Organize information	By request of T/R1 [**TM6 Guide and support students in the development of tasks**], children register, in their registration forms, the minimum value of sound level during silence, the maximum value during clapping and the average value during singing, and group work.	By request of T/R1 [**TM6 Guide and support students in the development of tasks**], children register the value of the CO_2 concentration acquired with the sensor in the empty room (629 ppm), during the activity, two hours after the beginning (1650 ppm), and after opening the door (913 ppm). They also registered the value measured in a bottle with breath out air (22620ppm).
EP 10 Relate	T/R2: In the echo, will the sound waves always continue to hit the walls? [**TM 3 – Ask questions, stimulating the sharing of ideas and valuing students' thoughts**] Child: No, they stop. T/R2: Why? Child: Because they lose force, energy. T/R2: So, you said that the echo is a sound that repeats itself increasingly weaker, because it is losing its energy [**TM 4 – Respect and encourage students' autonomy**] **[TM8 - Conduct formative evaluation]**	T/R1: Can you tell me an experience to prove that there is air here in this room? **[TM 6 – Guide and support students in the development of tasks]** Child: We can fill a syringe with air. T/R1: And then what? **[TM 6]** Child: We fill a balloon with the syringe

Table 3. Examples of children's epistemic practices in the session 2 of Case Studies 1 and 2

Epistemic Practices	Case Study 1 - Sound	Case Study 2 – Carbon dioxide
EP 3 **Make estimates/ Forecasting**	R: What do you think will be louder, sing the Happy Birthday or clap? [**TM 3 – Ask questions, stimulating the sharing of ideas and valuing students' thoughts**] Child: Sing the Happy Birthday. I sing very loudly. Child: No. Clapping hands.	
EP 4 **Use sensors**	By request of T/R1 [**TM 2 – Present the task in the form of a challenge**] [**TM6 Guide and support students in the development of tasks**], children measured sound level during silence, clapping, and singing. Each child makes a task at a time (measuring and searching the values).	By request of T/R1 [**TM 2 – Present the task in the form of a challenge**] [**TM6 Guide and support students in the development of tasks**], children, in turns, measured the CO_2 concentration outdoors. Near the road, they measured 2470 ppm, and 5000 ppm, after a car passed by.
EP 5 **Interpret**	T/R1: Why is the sound level greater when you are silent on the street than when you are silent in the classroom? [**TM 3 – Ask questions, stimulating the sharing of ideas and valuing students' thoughts**] [**TM 5 – Synthesize information]** Children: Because there are the leaves of the trees, the cars, the bikes, the people	T/R1: What is happening? [**TM 3 – Ask questions, stimulating the sharing of ideas and valuing students' thoughts**] Child: When a car passes by, it increases.
EP 8 **Organize information**	By request of T/R1 [**TM 2 – Present the task in the form of a challenge**] [**TM6 Guide and support students in the development of tasks**], children reported the data to T/R1.	By request of T/R1 [**TM 2 – Present the task in the form of a challenge**] [**TM6 Guide and support students in the development of tasks**], children reported the data to T/R1.
EP 10 **Relate**		T/R1: Why does the concentration of carbon dioxide increase, when a car passes by? [**TM 3 – Ask questions, stimulating the sharing of ideas and valuing students' thoughts**] Child: Because burning gasoline releases carbon dioxide.

In session 3, the epistemic practices "Interpret", "Formulate hypotheses", "Organize information", and "Relate" were identified in both CS. These epistemic practices were preceded by the following types of teacher mediation: "Present the task in the form of a challenge"; "Ask questions, stimulating the sharing of ideas and valuing students' thoughts"; "Synthesize information"; "Guide and support students in the development of tasks".

Children's epistemic practices took place during the experiments, and during the experimental use of sensors to explore the environmental health school problems. There were three types of teacher mediation that didn't immediately preceded children's epistemic practices: Contextualize the problem; Respect and encourage students' autonomy; Conduct formative evaluation.

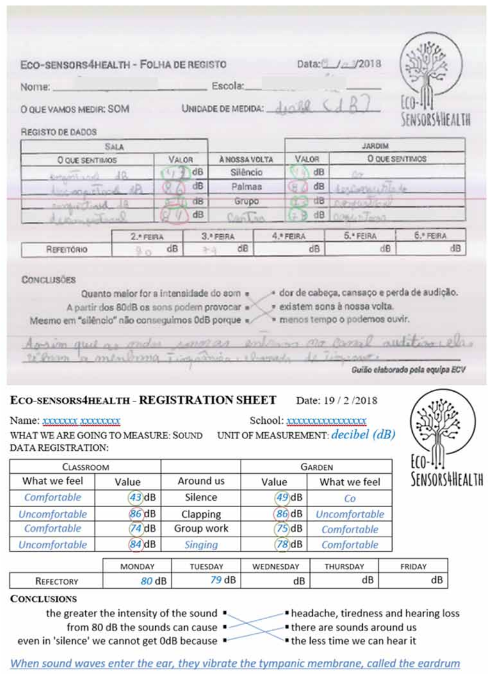
Visualization of Data Acquired and Registered by Children

As already mentioned, all children of CS1 were able to register sound level data in their registration forms (organize information). Figure 1 shows the sound level data acquired and registered by one child of Class 1. In the same way, all children of CS2 were able to register carbon dioxide concentration data in their registration forms.

Table 4. Examples of children's epistemic practices in the session 3 of Case Studies 1 and 2

Epistemic Practices	Case Study 1 - Sound	Case Study 2 – Carbon dioxide
EP1 **Describe**	T/R2 was producing sound with a stick on a pan lid near sugar grains on tightly stretched and poorly stretched adherent film on the top of two drums [**TM6 Guide and support students in the development of tasks**]; [**TM7 Make resources available**]; Child: that one bounced little and that one bounced a lot	
EP 3 **Make estimates/ Forecasting**	Child: It is to verify if this one [poorly stretched adherent film] is going to break and that one [tightly stretched adherent film] don't	
EP 5 **Interpret**	T/R2: We made silence and we measured 42dB. What should be the value of silence? [**TM 3 – Ask questions, stimulating the sharing of ideas and valuing students' thoughts**] [**TM 5 – Synthesize information]** Child: 0 dB. T/R2: Is it possible 0 dB? **[TM 3]** Children: No. T/R2: Why? **[TM 3]** Child: Because there is always our breath. (…) (…) Child: you moved away and when the sound waves arrived here they already had less energy	Child: Inside the bottle there was more carbon dioxide accumulated than out of the bottle, where carbon dioxide was more spread. T/R2: Concentrated (…) [**TM 8 – Conduct formative evaluation]** T/R2: What was the cause of the higher values near the road? [**TM 3 – Ask questions, stimulating the sharing of ideas and valuing students' thoughts**] Child: The exhaust pipes of the cars.
EP 7 **Formulate hypotheses;**		T/R2: If we are near the safety limit of carbon dioxide concentration, what is your suggestion? **[TM 2 – Present the task in the form of a challenge]** Child: We should open a door, to make air circulate, or open a window.
EP 8 **Organize information**	By request of T/R1 [**TM 2 – Present the task in the form of a challenge**] [**TM6 Guide and support students in the development of tasks**] [**TM7 Make resources available**] children completed the registration forms with the data acquired outdoors, with the help of T/R2 [**TM 6 – Guide and support students in the development of tasks]** (…)	By request of T/R1 [**TM 2 – Present the task in the form of a challenge**] [**TM6 Guide and support students in the development of tasks**] [**TM7 Make resources available**] children register the concentrations of CO_2 measured outdoors. They also register the values of the CO_2 concentration in the empty room, during the activity, and after opening the door.
EP 10 **Relate**	By request of T/R1 [**TM 2 – Present the task in the form of a challenge**] [**TM6 Guide and support students in the development of tasks**] children classified the measured sound levels with the words "comfortable" and "uncomfortable", using the sound scale. (…) T/R2: Why did you hear louder with your hands cupped in the ear? [**TM 3 – Ask questions, stimulating the sharing of ideas and valuing students' thoughts]** Child: Because the hands reflected the sound. T/R2: Because the hands channeled the sound [**TM 8 – Conduct formative evaluation]**	Child: (…) it would not be the same if we let this air to go out of the bottle to the room, it would not be so high, because the room has a larger space and the air circulates. the larger the space, more air. As the bottle was very small, the air was tight in the bottle. (…) T/R2: At the Pavilion door, we measured 450 ppm, and in the garden 265 ppm. [**TM 5 – Synthesize information]** [**TM 3 – Ask questions, stimulating the sharing of ideas and valuing students' thoughts**] Why this difference? Child: Because there are more plants (…) T/R2: What's the name of the process? **[TM 3]** Child: Photosynthesis. T/R2: And at the Pavilion door? **[TM 3]** Child: Because there are more people coming in and out and releasing carbon dioxide

Figure 1. Registration form filled by a child of Class 1 of CS1



ECO-SENSORS4HEALTH - FOLHA DE REGISTO Data: [illegible]/2018

Nome: Escola:

O QUE VAMOS MEDIR: SOM UNIDADE DE MEDIDA: [illegible]

REGISTO DE DADOS

SALA			JARDIM	
O QUE SENTIMOS	VALOR	À NOSSA VOLTA	VALOR	O QUE SENTIMOS
[illegible]	[illegible] dB	Silêncio	[illegible] dB	[illegible]
[illegible]	86 dB	Palmas	[illegible] dB	[illegible]
[illegible]	[illegible] dB	Grupo	[illegible] dB	[illegible]
[illegible]	[illegible] dB	[illegible]	[illegible] dB	[illegible]

	2.ª FEIRA	3.ª FEIRA	4.ª FEIRA	5.ª FEIRA	6.ª FEIRA
REFEITÓRIO	80 dB	[illegible] dB	dB	dB	dB

CONCLUSÕES

Quanto maior for a intensidade do som • • dor de cabeça, cansaço e perda de audição.
A partir dos 80dB os sons podem provocar • • existem sons à nossa volta.
Mesmo em "silêncio" não conseguimos 0dB porque • • menos tempo o podemos ouvir.

[illegible]

Guião elaborado pela equipa ECV

ECO-SENSORS4HEALTH - REGISTRATION SHEET Date: 19 / 2 /2018

Name: xxxxxxx xxxxxxxx School: xxxxxxxxxxxxxxxx

WHAT WE ARE GOING TO MEASURE: SOUND UNIT OF MEASUREMENT: *decibel (dB)*

DATA REGISTRATION:

CLASSROOM			GARDEN	
What we feel	Value	Around us	Value	What we feel
Comfortable	43 dB	Silence	49 dB	*Co*
Uncomfortable	86 dB	Clapping	86 dB	*Uncomfortable*
Comfortable	74 dB	Group work	75 dB	*Comfortable*
Uncomfortable	84 dB	*Singing*	78 dB	*Comfortable*

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
REFECTORY	*80* dB	*79* dB	dB	dB	dB

CONCLUSIONS

the greater the intensity of the sound • • headache, tiredness and hearing loss
from 80 dB the sounds can cause • • there are sounds around us
even in 'silence' we cannot get 0dB because • • the less time we can hear it

When sound waves enter the ear, they vibrate the tympanic membrane, called the eardrum

Although each child has registered the acquired data in his/her registration form, measurements were made in groups, in a collaborative way, and every child registered the values obtained by his/her group.

In Figure 2, it is possible to visualize a graphic, produced by the collaborative platform, after a query of the data acquired and registered (organized) by children in CS1, in what concerns the activities of silence and clapping hands in the classrooms and in the garden. From left to right, it is possible to observe a first set of points that represent the sound levels (minimum values) measured by children, while in silence in the classroom. A second set of points represents the sound levels (maximum values) measured by children, while clapping hands in the classroom. These values are higher than the first ones and most of them are above the safe limit for hearing health, since "Eighty-five decibels is considered the highest safe exposure level up to a maximum of eight hours" (WHO, 2015b, p.3). Nevertheless, much lower levels can cause learning problems, since background noise and poor acoustics can decrease speech intelligibility, annoy and distract people (Woolner & Hall, 2010). The third set of points represents the sound levels (minimum values) measured by children, while in silence in the garden. It is noteworthy that the values in this set are higher than the ones in the first set, since there is more background noise in the garden than in the classroom. The fourth set of points represents the sound levels (maximum values) measured by children, while clapping hands in the garden.

In Figure 3, it is possible to observe the values, displayed by the collaborative platform, of carbon dioxide concentration in air, acquired and registered (organized) by children in CS2. The analysis of these values evidences that the concentration of carbon dioxide are below the level recommended (protection threshold), 1250 ppm, to indoor air (Portaria n.º 353-A/2013) at the entrance of children in the classroom (09:30am), but it rises until 11:30am, since children are working in the classroom with the door closed, even exceeding the protection threshold in one of the classrooms. However, after opening the classroom

Figure 2. Graphic, produced by the collaborative platform, after a query of the sound levels data, acquired and registered by children in CS1, in what concerns the activities of silence and clapping hands in the classrooms and in the garden (abscissa coordinate: hours of 19th February, 2018)

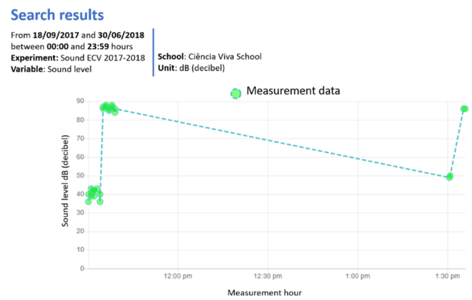


Figure 3. List of the values of carbon dioxide concentration in air, produced by the collaborative platform, after a query of the data acquired and registered (organized) by children in CS2

Search results

From **18/09/2017** and **29/06/2018**
between **00:00** and **23:59** hours
Experiment: CO2 ECV 2017-2018
Variable: Carbon dioxide in air

School: Ciência Viva School
Unit: ppm (parts-per-million)

Date	Hour	School	Place	Sensor	Value	Intervention
05/03/2018	09:30	Ciência Viva School	Classroom 1	Carbon dioxide sensor	629.00 ppm	
05/03/2018	11:30	Ciência Viva School	Classroom 1	Carbon dioxide sensor	1650.00 ppm	
05/03/2018	11:35	Ciência Viva School	Classroom 1	Carbon dioxide sensor	913.00 ppm	Classroom door open
05/03/2018	13:30	Ciência Viva School	Garden	Carbon dioxide sensor	281.00 ppm	
05/03/2018	13:35	Ciência Viva School	Near the road	Carbon dioxide sensor	27868.00 ppm	
06/03/2018	09:30	Ciência Viva School	Classroom 1	Carbon dioxide sensor	590.00 ppm	
06/03/2018	11:30	Ciência Viva School	Classroom 1	Carbon dioxide sensor	945.00 ppm	
06/03/2018	11:35	Ciência Viva School	Classroom 1	Carbon dioxide sensor	813.00 ppm	Classroom door open
Date	Hour	School	Place	Sensor	Value	Intervention

door, the carbon dioxide concentration decreases. As expected, the lowest value was registered in the garden and the highest value was registered near the road.

Suggestions of Children to Solve the Environmental Health School Problems

The examination of the filled registration forms (Figure 1) also allowed the identification of solutions to school environmental health problems, suggested by children. Regarding Class 1 of CS1, 19 participant children filled the registration form. In the "Conclusions" field, following the Teacher/Researcher (T/R) request to write something about what they have learned about hearing protection, six children wrote about the need to protect the eardrum, six children highlighted the importance of not staying in noisy places, three children advised about the need of using earplugs, and five children didn't fill the "Observations" field.

In what concerns Class 2 of CS1, 20 participant children filled the registration form. In the "Conclusions" field, children mimicked the exemplifying words of T/R ("hearing health depends on us"). This way, eighteen children paraphrased the sentence "hearing health depends on us", and two children didn't answer.

Table 5. Statistical analysis data of 'Knowledge' questions related to the topic of each intervention

Experiment	Question "A strong sound level is harmful to health?"			Question "To ventilate the classroom is important for health?"		
	Average and standard deviation		Wilcoxon	Average and standard deviation		Wilcoxon
	Pre	Post		Pre	Post	
"Sound pollution" intervention	3,3 (1,4)	4,3 (0,7)	**-2.639 p<.05**	4,1 (1,0)	4,1 (1,2)	-0.550, p>.05
"Air pollution" intervention	4,5 (0,9)	4,5 (0,8)	-0.312, p>.05	4,1 (0,8)	4,7 (0,6)	**-2.627 p<.05**

In CS2, twenty-six participants completed the sentence "One of the ways of renewing indoor air is", in the registration form. Nineteen children suggested to "open the door", fourteen children suggested to "open the window", four children suggested to reduce the production of pollution, one child suggest aeration, and another child suggested the presence of more plants.

Results of the Pre and Posttests

In the pre and posttests, the answers to the questions related to environmental and health awareness were very positive. For instance, in both CS the pre and posttest averages were above 4 (1 to 5 scale), reaching 4,44 (CS1) and 4,70 (CS2) in what regards agreement to "I'm concerned about health". Regarding personal investment, in CS2 posttest, the average agreement to "I can do something to solve my school's environmental problems" was higher than in CS1 (4,88 vs 4,03), with 96% (CS2) of the children enhancing or maintaining their strong agreement.

The answers related to 'Knowledge' questions improved (Table 5) after the intervention related to the question topic.

Children who participated in the "Sound pollution" intervention significantly improved their answers on the posttest to the question "A strong sound level is harmful to health?" (Wilcoxon= - 2.639, p<.05), but not to the question "To ventilate the classroom is important for health?" (Wilcoxon= -0.550, p>.05).

Similarly, children who participated in the "Air pollution" intervention significantly improved their answers on the posttest to the question "To ventilate the classroom is important for health?" (Wilcoxon= - 2.627, p<.05), but not to the question "A strong sound level is harmful to health?" (Wilcoxon= -0.312, p>.05). It is important to mention that the CS2 children have participated in the sound pollution activities in the year before. This way, it is understandable that they had a strong agreement to the "A strong sound level is harmful to health" both in the pre and posttest.

The analysis of gender differences in the posttest 'Knowledge' questions related to the topic of each intervention showed that there were no significant gender differences (Table 6), as evidenced by the results of the Mann–Whitney test (p>.05 in all the cases). This was a very positive result, as much as the answers to the two questions in both CS1 and CS2 were very positive, with a very positive agreement to the sentences "A strong sound level is harmful to health" and "To ventilate the classroom is important for health". Furthermore, the T/R1 and T/R2 reported that they didn't notice differences between boys and girls in what concerns participation and engagement in debates, and experimental activities with and without sensors.

Table 6. Nonparametric Mann–Whitney test analysis of gender differences in the posttest 'Knowledge' questions related to the topic of each intervention

Experiment	Question "A strong sound level is harmful to health?"			Question "To ventilate the classroom is important for health?"		
	Average and standard deviation		Mann–Whitney test	Average and standard deviation		Mann–Whitney test
	Girls	Boys		Girls	Boys	
"Sound pollution" intervention	4,5 (0,5)	4,2 (0,8)	U=98,000 p>.05	4,0 (1,4)	4,1 (1,0)	U=130,500 p>.05
"Air pollution" intervention	4,6 (0,6)	4,3 (0,9)	U=77,500 p>.05	4,6 (0,5)	4,8 (0,6)	U=72,000 p>.05

DISCUSSION AND CONCLUSION

The two case studies (CS1 and CS2) developed in this research were centered on the use of eco-sensors by schoolchildren in a scientific inquiry to identify and solve their school's environmental health problems (noise and air pollution). During CS1 and CS2, it was possible to identify a set of schoolchildren epistemic practices (EP) that are fundamental in acquiring, signifying and communicating data (describe; ask questions; make estimates; use sensors; interpret; formulate hypotheses; organize information; and relate), and that allowed the identification of environmental health problems. "Control variables" and "create representations" are more complex EP, almost not observed in CS1 nor in CS2. These EP need longer processes of inquiry to be developed (Aboim, 2014).

As in previous studies (Silva et al., 2013), most of the EP were immediately preceded by teacher mediations (TM), and/or by manipulation of epistemic mediators (Magnani, 2004), such as experimental resources, sensors, and registration forms. TM that challenge, question, make synthesis or guide students' tasks were the most frequent right before children's EP. The sessions that included more diverse strategies (e.g. Session 1) were the ones that elicited more types of EP. For instance, expository strategies elicited the Describe and Ask question EP, experimental explorations elicited the Make estimates and Interpret EP, and use of sensors strategies elicited the Organize information or Relate EP. This is related to the diversity of TM and of epistemic mediators and can inform future inquiry design to elicit EP and children participation.

The identification of environmental health problems was frequently observed during CS1 and CS2 in teachers-students dialogues and in the registration forms. The data registered by children in the registration forms were introduced in the Eco-Sensors4Health web based collaborative platform, this way sharing the data acquired by children with the digital sensors. Moreover, the platform allows multiple searches and visualizations of environmental health data acquired and signified by children with the sensors, namely in the two case studies reported in this chapter.

The suggestion of solutions to those problems was achieved by the great majority of students in the sensors-based scientific inquiries of both CS2 and Class 1 of CS1, and supported by the registration forms, which are epistemic mediators that include tables to be filled by children with data acquired with the eco-sensors, together with a field to be completed with conclusions and suggestions. In Class 2 of CS1, children were influenced by the task assignment formulation, with children paraphrasing the words of the Teacher/Researcher instead of writing their own suggestions, making clear the advantages of more open assignments to elicit the children's suggestion of solutions.

Regarding the formative assessment with pre and post-tests, children acknowledged concern for environment and for their health in both CS. However, in CS2, children agreed in a stronger way, compared to CS1 answers, to the personal investment question, concerning ability to do something to solve school's environmental problems. This result is consistent to the emphasis of CS2 on formulating and implementing solutions to high CO_2 concentrations, measured with eco-sensors. In CS1, the emphasis on noise problem solving was on protecting ears from strong sounds, also measured with eco-sensors. Accordingly, in the post-test, all the students of CS2 recognized the importance of ventilating the room for health, while in CS1 students improved the recognition of the effects of strong sounds to human ears and to health.

In what concerns the questions related to 'Knowledge', the results indicated that participating in the interventions of the case studies did influence children's understanding of the topics addressed, improving their knowledge of environmental health conditions.

Additionally, the statistical analysis of data evidenced that there were no significant gender differences in what concerns children's answers to the 'Knowledge' questions. Complementarily, the Teachers/Researchers reported, based on participant observation, that they didn't notice gender differences in what concerns participation and engagement in debates, and experimental activities not even with the digital sensors. These are very important results, since evidence positive learning results for all children, both boys and girls, regardless of the still open STEM and Digital Skills gender gaps (UNESCO, 2017; World Economic Forum, 2016). It seems likely that the female teachers (and role models), the digital sensors free of gender stereotypes, the hands-on activities, project-based learning, and inquiry, with experimentation, practice, real-world experience, reflection and conceptualization, as well as more time and experience with technology may have contributed to this success, namely in what concerns girls (UNESCO, 2017).

In both CS, children showed difficulties in disagreeing to the following negative statements: "When we are silent, we do not hear sounds in the classroom"; "There are no pollution problems at my school". The abstractedness of these statements together with the need to disagree to negative sentences may have hampered this task, although it was expected their disagreement after the CS. More research is needed to study the appropriateness of these questions.

The mobile nature of eco-sensors and the collaborative activities of gathering and interpreting data require that students move around the room instead of being seated at the tables. To use mobile technologies, such as eco-sensors, in pedagogical activities in the classroom and allowing students to become active builders of knowledge implies changes in the traditional role of teachers and students and a flexible use of the classroom space (Ferreira et al., 2015). Teachers' role is increasingly to be a facilitator to support students to improve their skills and to become critical participants in their own learning (Hague & Payton, 2010). To scaffold critical thinking skills, it is crucial to promote digital literacies in the curriculum, acknowledging the changing nature of knowledge and recognizing that young people need different kinds of skills and approaches in a digital era (Hague & Payton, 2010; Ferreira et al., 2015). The use of eco-sensors in curricular activities is an example of how it is possible to use technologies to promote students' higher-level thinking. Considering the role of teachers' mediation in eliciting children's epistemic practices, it is important to recognize that teachers' training on digital competences, and not only on ICT skills, is essential to support the use of mobile technologies, such as eco-sensors, in pedagogic activities with children (Tammaro & D'Alessio, 2016).

This research illustrates how cross-activities which integrate the use of technologies in the context of curricular activities can promote higher proficiency levels of digital competences. Using the DigComp 2.1 Digital Competence Framework for Citizens (Carretero et al., 2017) one can identify specific digital competences enhanced by the involvement of the students in collaborative activities with eco-sensors to solve environmental health problems: information and data literacy (browsing, searching, filtering data, information and digital content; evaluating data, information and digital content; managing data, information and digital content) and communication and collaboration (interacting through digital technologies; sharing through digital technologies; engaging in citizenship through digital technologies; collaborating through digital technologies).

Interactive technologies, such as the eco-sensors used in this research, can turn children into active participants, stimulating attention and motivation to explore and learn (Corona et al., 2013). This paper reported research that made visible the possibility of allowing the participation of children in authentic (Chinn, & Malhotra, 2002; Fenton, 2008) and meaningful environmental health problem solving in their elementary school, through the use of mobile learning in scientific inquiries that included children epistemic practices, scaffolded by teacher mediation and epistemic mediators (Reiser, 2004), such as eco-sensors.

Future work will include the enhancement of the pre and posttest, based on the results of this research, as well as the replication of these Case Studies, with longer scientific inquiry activities, in other Portuguese schools. In these future Case Studies, the Eco-Sensors4Health web based collaborative platform will also be used, since it showed potentialities, as an epistemic mediator, namely in what concerns data interpretation and relation by children in environmental health inquiries and problem solving.

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Chapter 15
Teachers' Attitudes Towards the Use of Tablets in Six EFL Classrooms

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ABSTRACT

This research study intends to explore teachers' use of tablets to in six EFL classrooms. The case study covers one private primary school in Istanbul, Turkey. Through the analysis of semi-structured interviews, the aim is to find out the factors affecting EFL teachers use of tablets, their attitudes towards using these devices, and the advantages and disadvantages they see in using tablets in their teaching. The study focuses on teachers' perspective as they are by and large ignored when it comes to the introduction of new technologies in educational institutions.

INTRODUCTİON

Tablets are a relatively new form of technology that have increasingly entered into the sphere of education as a tool to enhance student learning. Many schools mandate to their students to bring their own tablets in order to access online learning tools, applications, and digital textbooks used both inside and outside of school. In a 2017 nationwide survey by Common Sense Media in the U.S., 98% children from birth to 8 live in a home with mobile devices, 95% of families with children this age have a smartphone, 78% have a tablet, and 42% of children have their own tablet device; 71% parents report that they have downloaded apps (including educational apps) for their children to use; 67% parents whose children use screen media say it helps their child's learning, and 80% of them at least somewhat agree that they are satisfied with the amount and quality of educational screen media available for their children (Rideout,

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2017). In addition, touchscreen devices have been gaining wide acceptance in school settings, which has been a global phenomenon (Chou et al., 2017). For example, with the rapid growth of mobile touchscreen technologies, BYOD (bring your own device) has become a feasible pedagogical strategy which is aimed at promoting students' active engagement during learning (Nortcliffe and Middleton, 2013). This research study intends to explore teachers' use of tablets to promote mobile learning in six EFL classrooms. The case study covers one private secondary school in Turkey. Through the analysis of semi-structured interviews, the aim is to find out (1) how teachers use these tablets in their teaching, (2) the factors affecting teachers' use of tablets in the classroom, and (3) their beliefs on integrating these devices into their teaching. The study focuses on teachers' perspective as they are by and large ignored when it comes to the introduction of new technologies in educational institutions. The purpose of this case study is to explore teachers' perceptions on using tablets in their teaching at a private K12 school. In this case study, we aim to demonstrate the factors affecting teachers' use of tablets in their teaching. Overall, tablets have a huge potential for enhancing learning but as with all tools the most important element which influence the process is the teacher and his / her classroom practice.

Since teachers' attitudes plays a vital role in technology integration, this study also focuses on teachers' perspective which is often neglected during technology implementation, however, it plays a crucial role for the effective technology integration (Boy & Motteram, 2013; Attia 2011). Along with the integration of technology into teaching, a change in pedagogy occurs. Teachers are becoming facilitators, and they help students comprehend and assess the information gained via new technologies (Hoffman, 1996; Lawson & Comber 1999). This research explores the findings from a small-scale exploratory study that intends to explore teachers' use of tablets in six EFL classrooms in a private secondary school in Istanbul; these findings are discussed in relation to our understanding of concept of mobile learning in the literature. Therefore, the use of tablets for learning and teaching not merely inside the classroom but also outside the classroom will be discussed. Moreover, the factors affecting teachers' use of tablets in teaching will be discussed, and categorized accordingly. Finally, the roles teachers believe tablets should have in teaching and learning will be examined and evaluated based on teachers' experiences with using tablets in teaching, along with the advantages and disadvantages they have observed so far.

BACKGROUND

The use of Tablets in Education

Tablets are like game-changers in education (Logan, 2013), and many schools decided to use mobile devices, mainly tablets in teaching, as they are cheaper than computers, and have user-friendly touch-screen functions interfaces. Even though computers are widely used at schools, tablets change the use of technology due to its advantages, such as weight, battery life, built-in camera, and touch-screen (Clarke and Svanaes, 2012). Teachers need time to learn how technologies devices work, and they should think how the use of tablets promote critical thinking to increase student engagement (Reich and Holland, 2013).

It is acknowledged that teachers should not use tablets only as a consumption tool. Teachers need to make reasonable decisions about technology and pedagogy, and take into consideration the needs of their, students, they may tend to use the new technologies like the old ones; however, the affordances of new devices should be explored, and used accordingly (Motteram and Sharma, 2009). With the help of mobile learning, classroom walls are now melted, and learning can take place anywhere/ anytime.

Tablets are now relatively cheap, and there are many high quality mobile devices available for both schools, evaluating its use in learning and teaching is necessary. Even though tablets have the potential to provide the best educational content, insufficient technical infrastructure, and the lack of teacher training indicates that there has been some resistance to their widespread adoption (Clarke and Svanaes, 2012). Clark and Luckin (2013) raise some issues related to the use of tablets in teaching, e.g. places and people that learners interact with has an important role "in their developing understanding of knowledge". They further discuss the mobility of tablets, and their advantages for learners and teachers to build experiences and meanings across various places.

Research suggests that the use of tablet computers in educational settings hasincreased tremendously over the past decade (Clark & Luckin, 2013; Blackwell,2014; Montrieux et al., 2015). During the past few years mobile technologies, such as tablet computers, have been integrated in classrooms, such as in teaching,learning, and assessment, with relatively great success (Montrieux et al., 2015; Denison, Bate & Thompson,2016).

It is acknowledged that every new technology comes with its challenges. Technology somewhat complicatesteaching, and one should not be expected to be able to adapt to this new paradigm quickly and smoothly (Davis, 1991). Teachers need to be eager about the opportunities to deliver more to their learners in every way (Jacques, 2012). With the use of tablets, traditional instructional methods can no longer be exclusively used, new thinking must be incorporated to achieve learning goals. Prior to investment on tablets, needs analysis should be conducted at institutions.

In the Technology, Broadband and Education report chaired by Bokova (2013), it is discussed that owing to the spread of mobile technology, the delivery of education is no longer limited to classrooms, teachers should try to incorporate these technologies in their teaching practices; they also should be aware of why, not only how, they are expected to utilize these technologies

The report indicates that when the use of mobile technology is considered, there are two important issues to promote sustainable and effective technology integration: (1) teacher preparation, (2) motivation to utilize technology; teachers need to be provided with adequate technical and pedagogical training prior to and following the technology implementation.

The report further discusses that research on new pedagogical models, which includes teaching with technology, is crucial since this will be essential to understand the factors affecting teachers and students in a positive way during the technology implementation. In the report, the necessity for agreed policies for technology use to develop and sustain effective technology integration is also underlined. Besides, the report highlights that new technologies should be evaluated by the government, and the educational systems should be redesigned as appropriate. Finally, according to the report, what is essential for educational systems to improve is the empowerment of both students and teachers to use the new technology.

Teachers' Attitude

Many studies highlight the importance of teacher's attitude towards technology use as crucial factor for the effective technology integration. Woodrow (1992) discusses the necessity of having a positive attitude towards technology use in teaching, and Prensky (2008) holds the view the perception of teachers who lack a positive attitude towards technology is an obstacle. He further states that these teachers tend to follow traditional methods, and some believe that they protecting their students thereby. Hermans et al. (2008) also discusses the negative effect of traditional attitudes of teachers' on technology use. Judson (2006) makes a comparison between teachers who hold traditional beliefs and teachers who hold constructivist beliefs, and he alleges that the former usually use use low-level technology, whereas the latter usually use more high-level technology.

Mumtaz (2000) discusses the non-availability of teaching experience with technology, and lack of time essential for teachers to use technology effectively in their teaching, as some of the factors preventing teachers from using technology. He further states that teachers may not be willing to utilize technology although they have the devices, along with a supportive network; they also need to be sure that technology can make their lessons more interesting, and more fun for them and their students, more motivating and more enjoyable. Teachers should observe the advantages of technology use in their students before the implementation process. Nonetheless, adopting a new idea, changing their teaching practices is difficult for most teachers. Rogers (2003) claims that people need "time" to be able to adopt new technologies, and he discusses five main factors which affect one's decision to accept or reject an innovation: (1) relative advantage, has an advantage when compared to the prior innovations; (2) compatibility, compatible with present practices; (3) complexibility, easy to understand and use; (4) observability, shows visible results; (5) trialability, can be tested on a limited basis prior to its integration. Rogers (2003) stated that individuals' perceptions of these characteristics predict the rate of adoption of innovations.Ertmer & Ottenbreit-Leftwich (2010) claim that learning about technology is equivalent to asking teachers to hit a moving target; the tools are constantly changing; hence teacher will not be able to have 'complete' knowledge about the tools available. Ertmer (2010) believes that teacher knowledge has a main effect on teachers' decisions; teacher knowledge affects their thinking; thereby it affects their teaching practices. He further insists that it is crucial to explore teachers' attitudes, and help them to expand their knowledge base about technology as they, in turn, will need to help their students to utilize recent technologies.

The motivational affordances of tablets have previously been investigated, and teamwork, scaffolding, self-directed learning and device personalisation were found to be important for learners (Ciampa, 2014). According to the findings of the Banas, the results are parallel with the Bill & Melinda Gates Foundation's 2012 report "Technology and Effective Teaching." According to this report, based on a survey of 400 teachers from across the U.S., a large majority of classroom teachers use computer-related technology in their classrooms, but are still wary. The report revealed that 67% of teachers use technology in every class and 85% use it daily. Also, according to the report, the teachers' goal was to help their students learn -they remained skeptical, however, as there was little widely accepted proof that technology tools provided real value for student learning.

Methodology

The present study attempts to investigate the attitudes of non-native and native EFL instructors, teaching at a private secondary school, towards the use of tablets, explore whether there are any differences between their feelings and also, find out to what extent they integrate tablets into their class practice. In this case study, we aim to demonstrate the factors affecting teachers' use of tablets in their teaching. This research does not include quantitative data; further research could include both qualitative and quantitative research methods. Furthermore, this research focuses on the teacher perspective but for future research, a learner perspective can be explored.

The aim of this study to answer the following questions:

- What are the factors affecting private EFL secondary school teachers use of tablets?
- What are the attitudes of EFL teachers working at a private secondary school on tablet use?
- What advantages and disadvantages teachers see in using EFL tablets in their teaching?

Sample

The case site is a private secondary school located in Istanbul, Turkey which was one of the earliest adopters of the tablets as an educational tool in the classroom. Six participants were selected based on recommendations from the principal of the private secondary school.

Setting

For the purposes of this study, the qualitative data were gathered from randomly selected six instructors working at least ten years in a private secondary school so they are all experienced teachers. All of them started using tablets three years ago in their teaching. In other words, the only criteria for participant selection were year of experience and tablet use. The purpose of this criterion is to learn more about the role of tablets in a classroom environment.

Participants

In addition, four of the participants were Turkish EFL instructors who graduated from various departments. Two of the participants were from Belgium and UK. As for the participant's degree of education four of the participants had an Bachelor's degree. Two of them had MA degree. The participants were randomly selected from instructors using tablets for at least two years and working in the same institutions.

Procedure

All interview sessions were recorded and fully transcribed. The transcripts provided the basis to produce summaries of participants' statements and their key perceptions about tablet use in classroom practice. For further analysis a code system was generated. Establishing codes can be accomplished deductively based on an established theoretical foundation or inductively using the data collected (Kuckartz, 1999). These general codes were complemented by researchers adding further codes to the code system while analyzing the transcripts.

Data Collection Instruments

In an attempt to find out the relationship between the use of tablets and their attitudes towards it were collected from the following method:

Table. 1 Interviewee profiles

Participants	Level and experience	Tablets use	Demographic background
I1	Intermediate and advanced learners 14 years 9 years in primary, secondary and high school	3 Years	Non-native female
I2	pre-int now taught all the levels 12 years	4 years	Non-native female
I3	Intermediate level more than 16 years (since 1998)	7 years knew it theoretically before using	Native male
I4	Elementary ten years second university	3 years	Non-native female
I5	Intermediate level Students more than 16 years	2 years	Non-native female
I6	Upper- I-intermediate level (fourth level) 16 years of experience	4 years	Native male

Semi-Structured Interviews

The study utilized only qualitative research methods. To explore the research questions in this study, an interview form was devised to identify the teachers' use of tablets. The reason why we used semi-structured interviews were conducted with teachers. Semi-structured interviews allowed for flexibility when interviewing participants, since the technology was new and it wasn't possible to determine in advance all the issues that might arise. The interviews were transcribed and analyzed using content analysis to extract the key themes. The current study uses a qualitative research design of 6 20- to 30-minute semi-structured teacher interviews to explore teachers' attitudes on using tablets in their teaching at a private secondary school.

A qualitative design was suitable for this research for three reasons: first, the observations allowed for a richer understanding of what actually goes on in preschool classrooms with tablets, which is currently absent from the present research literature; second, the teacher interviews empowered teachers, who, as Buckingham (2007) notes, are often left out of technology decisions in a top-down approach to integration; and third, the sample was necessarily small provided the limited schools using tablets with such young children, such that quantitative measures would not be valid.

Yin (2009, p: 4) mentions that "the more that your questions seek to explain some present circumstance (e.g., "how" or "why" some social phenomenon works), the more that the case study method will be relevant". He also states the use of explanatory questions such as "how and "why", which are commonly used in case studies. Our research questions mainly focus on how and why questions as we intend to explore teachers' attitudes, how they use tablets, and why they use it this way. Attia (2011) highlights that case studies are extensively used when exploring teacher attitudes.. Stake (1995) also explains that case studies depend on careful choice of cases. Initially, we were planning to restrict our research to EFL teachers using tablets but then we decided to include EFL teachers. We intended to explore how they are using tablets in teaching.

Suter (2011) argues that good case studies are mainly captivating to read and appealing; those who read case studies gain a new perspective to deal with problems. He also underlines the significance of 'usefulness' of case studies. Thus, we conducted our research to be able to help teachers who are already using tablets in teaching, or planning to use them in the future.

Interview Questions:

- 1. Which level do you teach, and how long you have you been teaching?
- 2. How you did you start using tablets and what motivated you to do so?
- 3- How long have you been using tablets in your teaching?
- 4- How did you feel about tablets before using it?
- 5- How do your students react to using tablets for learning?
- 6- What advantages and disadvantages do you see in using tablets in teaching?
- 7- Can you tell us what your aims are in using tablets in teaching, and what you hope to achieve by using tablets?
- 8- How does your school implement a policy on tablet use?
- 9- Is there anything else you would like to add?

Data Analysis

Soy (1997) believes that the researcher analyzes the data utilizing various interpretations so as to find the relationship among the cases and the research questions, and embraces new opportunities and perceptions. He claims that particular procedures involve creating categories, flow charts or other visual representations; and he further states that a case study researcher analyzes the evidence with an open-mind in order to come up with reasonable conclusions for the initial 'how' and 'why' research questions.

Yin (2009) suggests starting the data analysis by asking questions. We broke the data retrieved from the interviews into relevant categories. Since data analysis develops gradually in the course of the research, the interviews were carefully examined as good qualitative data analysis reveals consistent and relevant themes, and concepts (Suter, 2011). Nonetheless data analysis can be compared with 'being up the creek'; the researcher can use a software program which may serve as a paddle. After trying two different software programs, we ended up using NVivo that helped us to analyse the interviews. We created codes while we were reading the data; most of these evolved while we were reading the data, yet some codes came from the interview questions.

Reliability and Validity of the Study

The qualitative data gathered from semi-structured interviews. The process of qualitative data analysis began with the open coding of the data followed by inducing categories from these codes, which were then gathered under the aspects of the attitudes of the EFL teachers. The categories and themes were subject to the checking of inter-raters. To identify the degree of inter-rater reliability, two experts in the field of English Language Teaching identified themes from the codes. It emerged that the raters achieved 90% agreement on the general themes apart from the different verbalizations of similar concepts.

Table 2. Teacher motives of using tablets at school

External	Internal
A part of my job School was asking it for a while Push of a school My son motivated	No internal motivation

Results

Conducting the interviews with 6 EFL teachers, we first categorized the data, and then interpreted them in accordance with the connections that came out as a consequence of the reduction of the data. We also asked follow-up questions, and re-analyzed the data to be able to come up with relevant categories. As this is qualitative research, data analysis gradually developed during the research; so we analyzed and interpreted the interviews carefully by taking into consideration that good qualitative research reveals associated themes, relevant categories, and new conceptions (Suter, 2011). The data gathered from the interviews were put under eight main categories which were layout, teacher motives, attitude, needs and opportunites and limitations, and school implementation. It can be seen in the eight tables below that there were various comments on the categories specified.

In table two, you can see the categories, we come up with. When EFL instructors were asked about their feelings before using tablets, 60% of them stated that they were scared before trying it. In relation to this point, three of the participants made the following comments:

"First of all, it was scary because it was like this. There is a huge pool that I didn`t have any idea *about it and I have seen very young people using it more competently than me and that scared me a lot." (Interview 3)*

"I get worried that they don`t know how to engage with the books and also worry about the handwriting I find that students have really poor handwriting as a result of techonology integration." (Interview 1)

"I and a few other colleagues; however, felt excited about the initiative and were motivated as we were worried about technology integrations and pedagogies." (Interview 4)

When categories in table 3 is analyzed, it can be seen that teachers see tablet use as a scary challenge. 20% of the participants saw teachers who use technology lazy. On the other hand, 20% of participants stated that they had positive attitudes towards tablets. Another 60% of the participants did not know how to integrate technology before using tablets. The following comment reflects this belief: *"To be honest, I enjoyed and welcomed the challenge. It is just a matter of spending time on planning how to use it." (Interview 2)*

To use technology to support meaningful student learning, teachers need additional knowledge of the content they are required to teach, the pedagogical methods that facilitate student learning, and the specific ways in which technology can support those methods. According to some studies, when teachers learn how to use technology within their specific content areas and/or grade levels, they can more readily transfer that knowledge to their own classrooms (Hughes, 2005; Snoeyink & Ertmer, 2001/2002). Sixty percent of the teachers mentioned that they did not feel confident when they started using tablets.

The following extract is a good example of it: *"Although we attended some 'technical' sessions, I did not feel confident going into Class not having enough knowledge about m-learning pedagogies and instructional design." (Participant 2).*

Table 3. Teachers' attitude towards tablets

Teachers	Students
Lazy teachers use technology Not sure how to integrate it Scary Weak Challenge Don't have time for technology integration	competent/ confident Sts get distracted Not focus on the language

Table 4. Needs of the teachers

Needs of the students	Needs of the teachers
need for autonomy write more & speak more	Resources Orientation Back-up Tech-support In-service training Consistency

The study reveals that tablets are mainly used in similar ways to other (older) technologies in teaching. Even though there are some examples of how teachers use tablets as creative tools, most of them are mainly using tablets in the same way that they use desktop computers - to practise vocabulary, to motivate students, and to practise language. This is the result of lack of training, unstable internet connections, poor performance of tablets, the challenge of finding right apps, constraints imposed by the school administration, and the different ways in which students use tablets, and perhaps adopting new technologies without adequate policy formulation for technological integration in the first place.

All of the participants mentioned that students are confident when they are using tablets in the classroom and it is not something new for them. According to teachers, tablet use does not have a novelty effect on learners because they are already familiar with it in their daily life.

All of teachers mentioned that they need back up support and time to facilitate their teaching process. 100% of the participants mentioned that schools need to be consistent while making-decisions and integrate teacher to the process. Tondeur et al. (2016) consider that teachers pedagogical beliefs are related to teachers' technology use and suggest that technology use can lead to the creation of new, reconstructed, or reaffirmed beliefs. They suggest that technology should be perceived as an enabler for change and teachers' beliefs should be perceived as an enabler for technology integration. Based on the results from both data sets in this study, conclusion that can be drawn is that the use of technology depends on teachers' dispositions or attitudes. This study found that teachers' pedagogical beliefs and their use of tablet computers are co-dependent and should be considered as 'bi-directional' (Tondeur et al., 2016) with both influencing each other.

60% of the research participants reported that they are usually pleased with the fact that tablets have increased student motivation although some participants complained about students who were using tablets only to play games. None of them stated how they used games in their teaching, and also encouraged their students to play educational games outside the classroom. This shows that even if something works in one context, there is almost no guarantee that it will work in other contexts. It also brings to

Table 5. Student reaction from the eyes of teachers

Negative	Positive
indifferent not novelty not a second nature for them already know what to do distracted unfocused silly escape from learning	excited involved motivated comfortable confident enjoy intrinsic motivation want to use

Table 6. Opportunities and limitations of mobile learning

Theme	Opportunities	Limitations
Access and availability of information	Research real world problem solving	Distraction undeveloped information literacy
Learning styles and technology design	Design elements include more learning styles (tactile, kinesthetic, visual, auditory), multiple intelligence, special needs in education, (dyslexic / eye disorder)	Design elements negatively impact learning (keyboard, size, app availability)
Convenience and usability	Ease of use intuitive design variety of apps	Connectivity troubles paralyze learning Unstable/unreliable applications impact learning
Sharing and collaboration	Collaborative learning and group work	No ownership of technology/shared resource

the surface the issue of teachers' attitudes where we see almost opposite views of different teachers in similar school contexts.

All of the participants reported that they observed enthusiasm in their students. One teacher described the mobile learning activities as a "fresh" way to learn. Another called the tablets "fun, exciting, easy." One response summarizes the general sentiment about the novelty of mobile learning: "It's nice to switch things up, and using the tablets was a 'fun' way to learn something that's useful towards our degree." Teachers also reported their fears about"getting familiar with newer technology" and "emerging technology." A teacher appreciated old schools teaching methods. According to the participants, students show the excitement over new technology.

Teacher responses indicated that mobile technology supports collaborative learning environments in which students are expected to discuss concepts, debate questions, and build knowledge together. They also noted how tablets promoted greater interaction and sharing during in-class activities and discussions. For example, one teacher reported, "Students feel like they got more involved with class discussion and group discussion when using tablets rather than just lecturing." Another teacher told, "The tablet gave my students a chance to connect concepts and ideas quickly and efficiently with my peers." (Participant 1).

In general, most of them were not very satisfied with the way the tablets introduced by the government and their institutions as they were not given the opportunity to be involved in the decision-making process, they had no other option but to use tablets and to accept the limitations in terms of the way that

Table 7. Disadvantages of using tablets at school

For the student	For the school management
I get worried – no engagement with the books Handwriting – poor handwriting Play games Distraction Don't use them enough- didn't replace anything Escape point Extention of their body Allow / control Restrict / hard to monitör	Parents send messages during class time Parents are concerned

Table 8. Teachers' views on the tablet as a teaching tool

Internal	External forces	Learner autonomy
Effectively search to reach information Maximize learning Time saver Planning time reduced Different ways to express themselves x 3 differentiated instructions Make them write Open perspective Creative	No personal aims Part of my job School pushed	Not responsible Not mature enough

the tablets were set up and what could be accessed. Nonetheless, they were mainly positive about using tablets in their teaching. They stated that tablets were useful tools for language teaching and learning and some even mentioned that the use of tablets helped students become more motivated, and improved teacher-student relationship.

"I think, there are lots of advantages in using tablets. But, I concern that they will be too much addicted to the tablets. And also, they prefer them to play games rather than to learn/study something." (Participant 5)

All teachers recognize that distraction is an issue with the tablet use in education, although they regard this as an inevitable part of using any technology. Expectations are clearly laid out in terms of behavior around the tablets and school work by the teacher at the beginning of the each class. An example given by the teacher is that when a student is caught on a shopping application they should not have been on, they lose tablet privileges for one week.

All of the participants see tablets as a distraction. For them it is a thing that prevents students from e concentrating on their lessons. Even though all of the teachers look for learner autonomy, they want to control their learners.

As discussed in the data analysis chapter above, the participants' evaluation of their teaching experience with tablets include both positive and negative comments, with the reason for the negative comments mainly stemming from the school administration or government tablet initiatives and policies.

All of the participants stated that they use tablets because of the external forces such as shool administrators, coordinators. None of the teachers mentioned that they have inner motivation to use tablets in education. Although when they say tablets facilitate learning process, supplies creative environment,

Table 9. Factors affecting school implementation

Rules	Contiguity	Restrictions	Decision-making
Tight	Inconsistent / unclear / not clear	Safe side No policy No restriction Not allowed outside the classroom Break time – need to talk / play	Only the administrators x

100% of the participants claimed that they only use tablets while they are giving homework so teachers use tablets instead of notebooks.

In the study, 100% of the teachers reported that creating learner autonomy is the most important part while integrating tablets in education. In our context, learner autonomy refers to a student's ability to set appropriate learning goals and take charge of his or her own learning. 20% of the teachers also stated that students are not mature enough to decide their needs.

It is acknowledged that teachers should be involved in the decision-making process to facilitate technology integration (Eshet et al, 2000). However, none of the teachers were asked to express their opinions when their institution decided to use tablets, and all of them were simply told to use tablets. As for the decision-making in the classroom the example below which shows the importance of involving teachers into the decision-making process.

"I think administration at our school has done a very poor job about rules surrounding this...they should have consulted teachers. I teach, I teach the kids and there has been no feedback required from me, so I think administration has done a very poor job at our school about that, and you know the kids see it as a toy, when you give it them during the breaks, they don't go out the classrooms anymore." (Interview 5).

In brief, the findings of the semi-structured interviews revealed that both native and non-native EFL instructors perceived technology integration to be a crucial part of the language teaching proces. Integrating pedagogy,creativity, critical thinking skills during the teaching time will change students' point of view because 100% of the teachers think that students use tablets only for playing games and social media.

DISCUSSION AND CONCLUSION

This paper has provided a case study of the use of Apple's tablet in a private secondary school setting. The teachers interviewed found that the tablets has features and a design to make it a very useful tool for education. Tablets can be used to support engagement and collaboration amongst groups of students working on a project although careful attention needs to be paid to ensuring that students don't dominate the device in a group situation, and to ensure they stay on task and don't get distracted. However, without a proper learning environment, management and facilitation, the device's potential may not be realized. It is important to have a good management framework in place, both in the classroom and behind the scenes. There needs to be a plan for managing things like recharging batteries, application deployment, backups, and protecting, repairing and replacing tablets as needed. In addition, choosing appropriate applications from the large range available can be difficult and thus schools will need to have a process in place to manage this.

The answers of the research questions indicate the need for pedagogical and technical teacher training. Even though all the participants had gone through some pedagogical and technical challenges, they were willing to use tablets; their answers indicate that this is mainly because they believe the necessity to make use of technology in teaching, and had already witnessed its benefits especially to motivate their students

Distraction is an important concern. It can also occur when students who are not meant to use the tablets come in contact with those who are meant to. However the teacher noted that due to the tablet's portability, students with tablets can be easily separated from those doing paper-based work. In terms of control, the teacher says that because the tablet is "so open and visual" (being placed on a desk), they are able to instantly see if children are off task. When the tablet is not used, students simply flip the tablet so that the screen is facing the desk, which prevents them from "fiddling" with the device throughout the lesson.

School's tablet initiatives in education are promising but technical and pedagogical readiness is very important and the core thing here is teacher training; if the teachers are not ready, then students cannot use the tablets in the desired way. As Hoffman (1996) claims dropping and dipping does not work; he believes that dropping computers into the classes, and dipping teachers in a little training will not work and while we have had various studies warning us of these issues, each new technological introduction seems to face the same set of hurdles.

Prior to integrating tablet into our teaching, we need to ask ourselves what value it is going to add to learning and teaching. If students only play games on the tablets, then the new technology is seen as a waste of time. Nevertheless, this study indicates that technology can solve educational problems and add to the teacher's repertoire such as special needs students, but when we move from one context to another the results can vary remarkably.

The way the tablet is managed out of the classroom is essential in order to get the best out of the device but in this study we see that students use tablets to take notes. Out of the classroom refers to the more, 'administrative' side of the tablet. As seen in the case study, applications are not selected by teachers to meet the needs of their the classroom and virtual hard drives were set up, giving students and teachers the ability to easily retrieve and store work. Applications are chosen by the school's Educational Technologies department.

Having teachers manage and facilitate a learning environment around the tablet emerged as an essential part of using the tablet successfully in an educational setting. The most effective use of the tablet varies depending on age, subject area and learning outcome. For example, gaming applications are heavily used in the junior school, whereas gaming applications in the senior school are only used in the subject of mathematics. However, in the senior school, the use of the tablet is mainly focused on software applications such as word processing, publishing and web browsing.

Implications and Suggestions

The current situation is problematic and likely to be more. We need to be prepared for an uncertain future, and as the informants mention pedagogy is always behind technology. Hence, we should learn from this and try to be prepared. It is difficult to predict where mobile learning will be even in five years time; such is the pace of change.

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Chapter 16
ICT Adoption Among Higher Education Teachers:
A Case Study of a University in the Awareness/Exploration Stage of Blended Learning Adoption

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ABSTRACT

This chapter aims to shed light on university teachers' adoption and use of information communication technologies (ICT) at a university in its awareness/exploration stage of blended learning adoption. The goal was to identify how teachers' attitudes to innovation adoption influences the adoption of ICT for teaching/learning. An online survey showed substantial differences between first adopters and followers regarding the perceived importance of factors affecting ICT adoption ("financial support/stipend" and "the availability of online training for teachers"), and perceived usefulness of learning management system activities (quizzes, discussion boards, and assignments). Identifying first adopters and followers can assist universities in the awareness/exploration stage in recognizing the ways in which first adopters differ from followers and consequently help both groups to facilitate a strategic and optimal ICT adoption and implementation of blended learning.

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INTRODUCTION

It has been widely accepted that universities have to adopt the use of information and communication technologies (ICT) in their pedagogical processes if they are to remain competitive. This is particularly important for recently established universities as they have to compete with institutions with richer academic traditions. Universities try to improve students' learning and increase access, flexibility, and cost effectiveness of their programs by implementing blended learning (Graham, Woodfield, & Harrison, 2013).

The use of blended learning in higher education is not only rapidly increasing, it is actually becoming the new norm in course delivery, as predicted by Norberg, Dziuban and Moskal (2011). In fact, blended learning, if correctly implemented, can help institutions to

(Graham, Allen, & Ure, 2005): (1) enhance pedagogy, (2) increase access and flexibility, and (3) improve cost-effectiveness. Furthermore, it can also improve the teachers' and students' satisfaction (Graham et al., 2013). However, some negative aspects of blended learning should be acknowledged. Benson, Anderson, and Ooms (2011) noted that university teachers often find preparing for blended learning time-consuming as it requires extra administrative effort and investment of time in content development. Furthermore, they report that supporting technologies are often prone to failure. The same authors also noted the difficulties of identifying relevant teaching/learning materials due to the enormous number of resources available on the internet. In regard to time, Humbert (2007) reported issues in blended learning implementation when moving from teacher led towards a students centered learning approach. Despite these negative aspects, blended learning is becoming the standard mode of course delivery in modern universities. Hence, this chapter aims to shed light on university adoption of blended learning.

BACKGROUND

ICT Adoption Among Teachers

ICT have been regularly used in higher education teaching and learning for quite some time and blending face-to face and computer-mediated teaching approaches is fast becoming the norm (Brown, 2016; Graham, 2018). There are substantial differences in the use of terms and definitions to name and describe blended teaching practices (Garrison & Kanuka, 2004; Oliver & Trigwell, 2005; Sharpe, Benfield, Roberts, & Francis, 2006) among different universities and individual researchers. In this chapter we will use Graham's (2006) definition, where blended learning denotes a combination of traditional face-to-face and online instruction.

Studies have identified numerous factors that affect the adoption of ICT among university teachers. Brown's (2016) systematic review of literature about university teachers' adoption of blended learning identified several external and internal factors that play important roles. Among the external factors, past studies, for example, highlighted the importance of technology (e.g., availability and reliability of technological infrastructure and its ease of use), academic workload (e.g., additional time for planning and designing blended learning), the institutional environment (e.g., institutional policies and readiness to support blended learning), and students (e.g., student feedback, improved student learning). The internal factors comprised teachers' attitudes and beliefs about teaching and learning, their past experiences and attitudes towards technology, as well as their own digital literacy.

Using Graham's et al. (2013) Blended Learning Institutional Adoption Framework, Porter and Graham (2016) found that substantial differences exist in university teachers' ICT adoption behaviors that reflect their attitudes towards innovation adoption. These in turn determine the extent to which institutional strategy, structure and support decisions facilitate or hinder ICT adoption among university teachers. Thus, for example, online professional development is valued by teachers from the innovators and early adopters groups, while the early majority require evidence of the value of ICT adoption in teaching and learning. On the other hand, ICT adoption among teachers from the late majority and laggard groups is facilitated most with technical support and one-on-one training. Finally, Porter, Graham, Bodily and Sandberg (2016) further specified how institutional strategy, structure and support decisions could meet the needs of these groups of teachers to enhance their use of blended teaching and learning practices.

Adoption of Blended Learning in Higher Education Institutions

Blended learning implementation and adoption at the institutional level received little attention until recently. Research by Graham et al. (2013) found that the adoption of blended learning at universities goes through three distinct stages: from the initial Stage 1—Awareness/exploration stage of blended learning adoption universities move to Stage 2—Adoption/early implementation of blended learning, and evolve to Stage 3—Mature implementation/growth. The boundaries between these stages are rather fuzzy as the three stages form a continuum. Transitions between these stages are influenced by institutional strategy, structure, and support that can facilitate or deter university teachers' decisions to adopt blended learning. While substantial data are available about the more developed stages of blended learning implementation (i.e., Adoption/early implementation and Mature implementation/growth), much less is known about universities in the Awareness/exploration stage.

Theories Behind Adoption / Acceptance of Innovation and Technology

In the field of innovation dissemination, several theories have emerged, receiving considerable attention in the field of ICT (Momani, Jamous, & Hilles, 2017): *Technology Acceptance Model* (TAM), Unified *Theory of Acceptance and Use of Technology* (UTAUT). Furthermore, other theories (e.g., *Theory of Reasoned Action* – TRA, *Theory of Planned Behavior* – TPB, *Social Cognitive Theory* – SCT) successfully explained the rationale for not adopting ICT. One of the widely accepted theories explaining the diffusion of innovation processes in specific populations or social systems is Rogers' (2003) *Diffusion of Innovations* (DOI). One distinctive feature of DOI is the categorization of a population based on its innovation adoption attitude, which still represents the most widely accepted categorization approach in this field. According to Rogers, there are five distinct groups, each with its own particular personal characteristics, presented in Table 1.

There are many critics of Rogers' assumption of the normality of innovation adoption distribution. In the study by Porter and Graham (2016) the percentage of participants representing each of Rogers' categories was substantially different from Rogers' distribution (innovators: 2.9%, early adopters: 30%, early majority 49.5%, late majority 16.7%, and laggards 1%). As argued by Peterson (1973), in several situations adoption patterns are likely to exhibit non-normal adopter distributions. Nevertheless, Rogers' categorization offers a plausible explanation of a population's different behaviors when ICT innovations are introduced in education (e.g., Baykal, Sokmen, Korkmaz, & Akgun., 2005; Loogma, Kruusvall & Ümarik, 2012; Rusek, Stárková, Chytrý & Bílek, 2017).

Table 1. Rogers' (2003) categories of innovation adopters and statements used for the self-categorization in our study

Category	% of population	Main characteristics	Statement used for the categorization
Innovators	2.5%	- desire to be the first to try the innovation - willingness to take risks - first to design/develop innovations - no particular need to encourage this population to acquire innovations	I actively follow the innovations in the field of ICT, I often test new ICTs before others and adapt them to didactic use even before they become widely available.
Early adopters	13.5%	- have a role as opinion leader - prefer leadership roles - aware of the need for change - do not require particular evidence to adopt innovations	I regularly follow innovations in the field of ICT, and I carefully tailor/adapt them to didactic use. I am often among the first ones who use new ICTs, so colleagues often perceive me as a role model and follow my recommendations.
Early majority	34%	- adopt innovations before the late majority - rarely in leadership roles - require proofs about the innovation's effectiveness before the adoption decision	I prefer to wait and start using new ICTs only when their value becomes tangible or my colleagues recommend them. Normally, I'm not among the first to start using new tools, however, I am not among the last.
Late majority	34%	- skeptical of introducing innovations, - adopt them after the early majority - require evidence regarding how others successfully tried/adopted the innovation	I have nothing against new ICTs, but I am cautious and start using them in the pedagogical process when it becomes required.
Laggards	16%	- very conservative, traditionalist group - hardest category to convince to introduce innovations -in most cases pressure from the majority is required to adopt innovations	I am aware that my colleagues appreciate new ICTs, but prefer to use traditional teaching methods. I intend to use these methods also in situations when pressure on teachers to use new ICTs will be applied.

Ajzen's (1991) in his *Theory of Planned Behavior* stressed the importance of attitude toward a certain behavior, which aside from subjective norms, and perceived behavioral control, have in impact on individuals' behavioral intentions, and thus, their actual behavior. In other words, measures of attitude toward ICT innovation correspond to the measures of actual behavior regarding ICT innovation adoption and use. Hence, individual teachers' perceived general attitudes towards the adoption of ICT are potential indicators for classifying them in the corresponding Rogers' adopter categories. Also Loogma, Kruusvall, & Ümarik (2012) classified the teachers of vocational secondary and professional higher education institutions into the aforementioned categories by assessing the self-reported attitudes towards the adoption of ICT.

Despite the fact that there are several studies regarding the adoption of ICT in universities, the results of our literature review indicate that there is a lack of relevant studies exploring ICT adoption in young, recently established universities in the awareness/exploration stage of blended learning adoption. The majority of studies focuses on the adoption of a particular ICT in a course or even part of the course and do not take into consideration the adoption process at the university level. The goal of this study was to identify how teachers' innovation adoption category influences the adoption of ICT for teaching/learning at a university in the awareness/exploration stage of blended learning adoption.

METHODS

In order to respond to the research question, a single-case study design as defined by Yin (2018) combined with a survey was used. The rationale for using this type of design was that currently the university under consideration represents a unique opportunity to observe and analyze ICT adoption among university teachers as it is in the awareness/exploration stage. In fact, this university, established in 2002, represents a tabula rasa regarding the formal introduction of blended learning in its study programs as previously there were no official initiatives, strategies or guidelines for the implementation of blended learning or use of ICT in teaching/learning. The implementation of ICT was left to individual teachers' initiatives and was performed ad-hoc. This case represents a revelatory case as: (1) there is a lack of insight about the dynamics of ICT adoption in universities in the awareness/exploration stage; and (2) the data regarding the implementation of ICTs in teaching/learning is inaccessible or non-existent.

Case Presentation

The university under consideration was established in 2002, and in 2018 it comprised seven member institutions, with approximately 5000 students. It is located in a bilingual territory (Slovenian and Italian are both official languages) of the Republic of Slovenia, European Union, located approximately 10 km from Italy and 25 km from Croatia. During the time of the study, the university under consideration had 277 university teachers and 80 university collaborators, a total of 357. 150 of these teachers responded to our online survey: 106 completed the questionnaire (i.e., to the last page), however, eight respondents were excluded from the sample as they did not participate in the pedagogical process in the academic year 2017/18.

The final sample included 98 participants. The response rate was 27.5%, which is the typical for similar studies that use online surveys (e.g., Awadhiya & Miglani, 2016; Salinas, Nussbaum, Herrera, Solarte & Aldunate, 2017). The majority - i.e., 63.3% - were females and 36.7% males; the average age was 43.2 years (SD = 9.4); the youngest participant was 28, the oldest 65. The majority of participants (75.5%) were employed full time, 13.3% part time, 10.2% by contract. More than one third were assistant professors (39.8%), 18.4% assistants, 15.3% associate professors, 8.1% full professors, 9.1% senior lecturers; 7.1% lecturers; 6.1% lectors; 2.0% of participants had other roles in the pedagogical process (e.g., expert collaborators), but were still directly involved in teaching.

Data Collection

The survey was performed between 6 March and 6 June 2018. A web questionnaire was developed with 1KA (Version 17.05.02) (2017). The web address to the questionnaire was sent at the beginning of this period by email to all eligible participants via the rector's office. Each recipient was encouraged personally to respond, a reminder to complete the questionnaire was sent twice.

Instrument

The questionnaire was designed for the purpose of the project "*INOTEZ - Innovative knowledge acquisition with the use of ICT*" (for details, please, refer to the Acknowledgements). A systematic literature review was performed from October to December 2017 in order to design the instrument. Different questionnaires and studies regarding faculty use of ICT were analyzed; of these "2017 ECAR Faculty Technology Survey" (Pomerantz & Brooks., 2017) served as a starting point for the preparation of the final questionnaire.

The questionnaire consisted of different sections, the majority of them were used for other project purposes (i.e., preparation of management guidelines for adopting ICT in teaching/learning, identification of differences in actual use of ICT between different departments, identification of IT security problems). In the continuation of the chapter only questions relevant for this specific study are considered.

The self-categorization question was designed by considering the main characteristics of Rogers' (2003) categories of innovation adopters and research-based descriptions of each of the innovation adoption categories used by Porter and Graham (2016). Participants were invited to select one of the five statements from Table 1 that best describes their attitude to the use of ICT in the pedagogical process. According to Ajzen's (1991) *Theory of Planned Behavior* this self-categorization of the participants in the aforementioned categories, can provide reliable information about their actual or future behavior.

In the questions regarding the use of ICT for their own education, participants were asked to report their previous experiences in using online courses for their formal/informal education.

The perceived importance of different factors affecting ICT adoption in course delivery was measured on a five-point scale with a range from 1 "*no effect at all*" to 5 "*has a relevant effect*". The factors were identified in the literature review and presented as question items. The items are presented in Table 2.

The perceived usefulness of different Learning Managements System (LMS) activities was measured on a four-point scale with a range from 1 "*not useful at all*" to 4 "*very useful*". The rationale for using the four-point scale was that participants in their responses did not have the possibility to provide a neutral (i.e., middle of the scale) response in order to passively label each LMS activity as useful/not useful. LMS activities (presented as question items) were identified from a set of Moodle 3.3.1 activities, which were available during the survey.

Statistical Analysis

IBM SPSS 22.0 was used for performing univariate and bivariate statistical analyses. Initially the descriptive statistics was performed (mean, standard deviation, median, quartiles). The Shapiro-Wilk test was used for the normality of distribution of the numeric variables. As the majority of variables were ordinal and their distribution substantially deviated from normality, the Mann Whitney U test and the Chi-square test (χ^2) were used for assessing the differences in participants' responses. In case more than

20% of all contingency table cells had an expected frequency < 5, the Fisher exact test was computed. GPower 3.1.9.2 (Faul, Erdfelder, Lang, & Buchner, 2007) was used for calculating effect sizes and statistical power. The level of statistical significance was set at 0.05.

In our study, Rogers' categories of innovators and early adopters were coded as first adopters, early/late majority and laggards as followers. There were a number of reasons for grouping participants in these two distinct categories: (1) the relatively small number survey participants; (2) substantial deviation from Rogers' distribution (see Results); (3) fewer categories facilitate the preparation of strategies and guidelines for ICT adoption; (4) the simplification of categories may assist university management in understanding the blended learning adoption dynamics. Last but not least, Moore (1991, pp. 15) finding that there is a "*deep and dividing chasm that separates early adopters from the early majority*" also supports our choice of the cut-off point in the adopters' categorization.

Ethical Considerations

The approval for performing the survey was given by the university management. It was confirmed as a part of the InoTeZ project plan (please see Acknowledgements). The survey was anonymous, the participants had the possibility to provide a non-response or to withdraw from the study at any time, without consequences. There was no possibility to determine neither the respondents' identity from the collected data. The questionnaire did not include any distressing elements that could result in negative moods and/or stress for the respondents.

RESULTS

Of all participants, 9 (9.2%) identified their general attitude to the use of ICT for teaching/learning as innovators, 24 (24.5%) as early adopters, 50 (51.0%) as early majority, 12 (12.2%) as late majority, 2 (2.0%) as laggards. One participant did not provide a response to this question. The distribution of the sample under consideration was significantly different ($\chi^2(4) = 205.9$, $p < 0.001$) from the distribution of Rogers' innovation adoption categories, presented in Table 1, as there were more innovators, early adopters and early majority participants than expected. No substantial differences in the distribution of the adoption categories between the sample under consideration and the sample in Porter and Graham (2016) were identified (Fisher Exact test: $p = 0.099$). After the categorization of participants in the two simplified groups, there were 33 (34.0%) first adopters and 64 (66%) followers.

The average number of years of work experience in education was 13.5 (SD = 8.4), median 11.0. There were no significant differences ($U = 902.5$, $p = 0.241$) in the number of years of work experience between first adopters and followers. No significant differences in the gender distribution of first adopters and followers were identified ($\chi^2(1) = 1.49$, $p = 0.270$).

The majority of the participants (80; i.e., 83.3%) did not use online learning for their formal education yet. Statistically significant ($\chi^2(1) = 6.73$, $p = 0.009$) differences in responses between first adopters and followers were identified: approximately one third of all first adopters (30.3%) and only 9.5% of all followers already used an online learning for their formal education. Slightly more than half of all participants (57.3%) already used an online learning for their informal education: the difference between first adopters and followers ($\chi^2(1) = 3.16$, $p = 0.075$) was therefore not statistically significant.

Table 2. The perceived importance of factors affecting ICT adoption by first adopters and followers

	All		First adopters			Followers			Mann-Whitney U test	
Factor	**χ**	**SD**	**Me**	**Q_1**	**Q_3**	**Me**	**Q_1**	**Q_3**	**U**	**p**
The availability of technical support	3.9	1.1	4	4	5	**4**	3	5	977.0	0.527
The availability of face-to-face training	3.8	1.2	4	3	5	**4**	3	5	974.5	0.517
The availability of pedagogical support	3.7	1.2	4	3	4	**4**	3	5	1043.5	0.921
The availability of online guides	3.5	1.2	4	3	5	**4**	2	4	899.0	0.316
Equal payment for face-to-face and online teaching	3.5	1.4	4	3	5	**4**	2	4.5	843.5	0.095
The availability of online training	3.2	1.3	4	3	5	**3**	2	4	**770.0**	**0.026***
Temporary course load reductions	3.2	1.5	4	3	4	**3**	2	4	867.0	0.140
Management decision	3.1	1.1	3	3	4	**3**	2	4	895.5	0.202
Financial support/stipend	3.0	1.6	4	3	5	**2**	1	4	**706.0**	**0.006****
Positive evidence from research	3.0	1.2	3	3	4	**3**	2	4	876.0	0.195
Effect on tenure/promotion	2.9	1.5	3	2	4	**3**	1	4	813.0	0.059

Legend: SD – standard deviation; Me – median value; Q_1 – Quartile 1; Q_3 – Quartile 3; * $p < 0.05$; ** $p < 0.01$

Results in Table 2 show the factors affecting ICT adoption ranked by the average level of perceived importance. The availability of technical support, face-to-face training, and the availability of pedagogical support were ranked as the first three most important factors, while the factor effect on tenure/promotion was ranked as the last, with an average value below the middle of the scale - i.e., indicating no effect of the factor on ICT adoption.

Statistically significant differences in the perceived importance of factors affecting ICT adoption were identified between first adopters and followers for two out of 11 factors. The *Financial support/stipend* factor's median, first and third quartiles, were significantly higher for first adopters (U=706.0, p=0.006), representing a moderate effect size (0.600) with statistical power of 0.871. Furthermore, a similar result was also identified for *The availability of online training* factor. Its median, first and third quartiles, were also significantly higher for first adopters (U=770.0, p=0.026), representing a moderate to small effect size (0.438), with statistical power of 0.648.

Table 3 shows the LMS activities/tools ranked by their perceived usefulness; the non-users of these activities/tools provided the non-response. The activity *Assignments* was rated as the highest, followed by Books, Grading of assignments, and *Glossaries*. On the other hand, five activities/tools (i.e., Workshop, SCORM/AICC-packages, Wikis, Chat, and Blog) were rated below the middle of the Likert scale, thus, reflecting a slightly negative perceived usefulness of these activities/tools by the participants. Of the activities/tools, *Blog* was rated with the lowest mean value. Significant differences in the perception of usefulness of LMS activities/tools were identified between first adopters and followers for three out of 16 activities/tools: (1) *Assignment* was perceived to be more useful by first adopters than followers, where the median value of perceived usefulness for first adopters was 4, while it was 3 for followers (moderate to small effect size 0.429 with statistical power of 0.477); (2) *Discussion board*, where the median value for first adopters was 3.5, while for followers it was 3 (small effect size 0.370 with statisti-

Table 3. Perceived usefulness of different LMS activities/tools by first adopters and followers

	All		First adopters				Followers				Mann-Whitney U test	
LMS activity/tool	$\bar{x}$	**SD**	**n**	**Me**	Q_1	Q_3	**n**	**Me**	Q_1	Q_3	**U**	**p**
Assignment	3.5	0.7	30	4	3	**4**	61	3	3	4	698.0	**0.035***
Books (activity)	3.3	0.7	26	3.5	3	**4**	54	3	3	4	585.0	**0.172**
Grading of assignments	3.3	0.8	28	4	3	**4**	56	3	3	4	684.5	**0.301**
Glossaries	3.3	0.8	21	4	3	**4**	39	3	3	4	372.0	**0.525**
Plagiarism plugins (e.g., Turnitin)	3.2	0.8	27	4	3	**4**	48	3	3	4	523.5	**0.130**
Lesson	3.2	0.7	19	3	3	**4**	50	3	3	4	419.5	**0.402**
Databases	3.1	0.7	19	3	3	**4**	48	3	3	4	412.0	**0.488**
Discussion boards	3.1	0.8	30	3.5	3	**4**	54	3	3	3	613.0	**0.044***
Choice	3.0	0.8	22	3	3	**4**	42	3	3	4	404.0	**0.370**
Quiz	3.0	0.8	29	3	3	**4**	48	3	3	3	516.0	**0.037***
Response	3.0	0.8	20	3	3	**4**	52	3	3	3	451.0	**0.327**
Workshop	2.9	0.9	19	3	3	**4**	42	3	3	3	259.0	**0.066**
SCORM/AICC-packages	2.9	0.7	13	3	2	**3**	25	3	3	3	161.0	**0.956**
Wikis	2.9	0.9	19	3	2	**4**	35	3	2	3	314.0	**0.717**
Chat	2.7	0.8	28	3	2	**3**	46	3	2	3	609.0	**0.669**
Blog	2.6	0.8	22	3	2	**3**	34	2.5	2	3	316.5	**0.302**

Legend: SD – standard deviation; Me – median value; Q_1 – Quartile 1; Q_3 – Quartile 3; * $p < 0.05$; ** $p < 0.01$

cal power of 0.362); (3) *Quiz*, where the third quartile value for first adopters was 4, while it was 3 for followers (moderate effect size 0.500 with statistical power of 0.555).

DISCUSSION

The aim of our study was to shed light on university teachers' adoption and use of ICT at a public university that is in its awareness/exploration stage of blended learning adoption. Furthermore, we tried to determine how the individuals' innovation adoption category influences the adoption and use of ICT for teaching/learning.

Our study indicates that educating university teachers in ICT use for teaching/learning and providing adequate technical support are the most important determinants of ICT adoption in teaching/learning, especially in universities in the awareness/exploration stage of blended learning adoption (Table 2), i.e., Stage 1. Similar results were noted by different authors (Porter & Graham, 2016; Tshabalala, Ndeya-Ndereya, & van der Merwe, 2014). In the study by Porter and Graham (2016), conducted at a university in the adoption and early implementation stage of blended learning adoption, i.e., Stage 2, over 32% of all the participants said that the availability of adequate technical support would influence their adoption decision. We can conclude that by investing time in training and educating university teachers and providing them adequate technical support that is easily accessible (Humbert, 2007), universities ensure that university teachers "*are experienced, proficient and up-to-date in the use of technologies*" (Kirkwood, 2014, pp. 18)"and can achieve effective ICT innovations and usage. Lack of training easily endangers the process of blended learning adoption (Tshabalala et al., 2014).

Both Humbert (2007) and Porter and Graham (2016) found that there is a difference in the importance that university teachers grant to technical support among different innovation adoption categories. Porter and Graham (2016) stated that fewer innovators and early adopters, which are in the first adopters group of our study, consider technical support as important as later adopters (our followers group) do. Our results do not show this difference, probably because the university under consideration in this study is in a different blended learning adoption stage than the institutions studied by Porter and Graham.

From our results we can also conclude that it is very important to present ICT innovations and usage to university teachers by using traditional learning approaches and not by forcing them on the teachers in online trainings as the availability of face-to-face training ($\bar{x} = 3.8$) turned out to be more important than the availability of online training ($\bar{x} = 3.2$). This is probably a consequence of the lack of experience that most participants have with online learning for their own education. As our results show, most participants (83.3%) did not learn online for their formal education and slightly more than half of them (57.3%) learned online for their informal education. On the other hand, *the availability of online training for teachers* is a factor that is perceived as significantly more important to first adopters than to followers (Table 2) and consequently affects ICT adoption for first adopters. The perceived importance of this factor is probably higher for first adopters because 30.3% of first adopters already learned online as part of their formal education compared to only 9.5% of followers. Porter and Graham (2016) indicated another reason why online training is probably more important than face-to-face training. The authors argued that innovators, who are part of our first adopters' group, probably perceive online training for teachers "*as a way to better organize their technology exploration efforts*" (Porter & Graham, 2016, pp. 758). It seems therefore plausible that followers find online training less attractive due to their lack of experience with online learning.

Our results indicate that only one factor was perceived as non-important and had no effect on the adoption and use of ICT for teaching/learning. Participants ranked as last, with an average value below the middle of the scale, the factor *Effect on tenure/promotion* (Table 2). Participants probably ranked this factor that way because the current tenure and promotion policy of the university under consideration does not include any requirements or minimal standards for the usage and adoption of ICT for teaching/learning. The existing policy on tenure/promotion requires university teachers primarily to have a certain number of scientific publications and conference presentations over a specific time span (Slovenian Quality Assurance Agency for Higher Education, n.d.). In the study by Porter and Graham (2016), tenure/promotion and another factor, mentioned in the next paragraph, were reported as less influential than others. The authors suggested that "*respondents may have indicated that tenure/promotion consideration would have no influence on their decision, which may be due to the process by which their school conducts its tenure or 'continuing faculty status' (CFS) decisions*" (Porter & Graham, 2016).

The other factor that is less influential besides tenure/promotion according to Porter and Graham (2016) is the presence of financial stipends. Our results are similar and indicate that this factor is generally not perceived as a factor that affects ICT adoption, as the average value of all participants' responses is in the middle of the scale, i.e., 3, and indicates a neutral effect (Table 2). However, the median of first adopters' responses is 4 and of followers' it is 2, which indicates an apparent effect on the adoption of ICT for first adopters. The *Financial support/stipend* factor is thus perceived as significantly more important to first adopters than followers. These completely different perceptions of the effect that financial incentives have on ICT adoption should not be ignored by universities in the awareness/exploration stage of blended learning adoption.

Participants of our study also rated the perceived usefulness of activities/tools and resources, which are present in a typical LMS. The activity *Assignment* was rated by all participants with the highest mean value, followed by the resource *Book*, the tool *Grading of assignments*, and the activity *Glossary* (Table 3). The usage of the highest rated activity *Assignment*, besides resources such as internal or external web pages and files such as documents and presentation slides, is usually what allows individuals and consequently institutions to evolve and step toward the use and adoption of blended learning stage (Kenney & Newcombe, 2011). Thus, it is not a coincidence that our results show a significant difference between first adopters and followers in the perception of usefulness of the activity *Assignment*, which is perceived as more useful by first adopters than followers.

Two other activities, that had a perceived usefulness ranked in the middle of the scale, i.e., 3, *Discussion board* and *Quiz*, are perceived as more useful by first adopters than followers. Teachers at Stage 2 universities usually use discussion forums, quizzes, podcasts and video materials to empower case-study-based teaching, action learning, facilitate group work and peer-learning (Benson et al., 2011) and to increase engagement in the class (Graham, 2007). Furthermore, they also increase efficiency in classroom communication (Benson et al., 2011). By using these LMS activities/tools that are typically used in Stage 2 universities, the first adopters at a Stage 1 university are patently leading the way towards greater adoption of ICT tools for blended learning.

Our study shows that factors such as *Financial support/stipend* and *The availability of online training*, which affect ICT adoption, are perceived by first adopters as substantially more important than by followers (Table 2). When encouraging greater adoption of ICT innovations in teaching/learning at universities in the adoption/exploration stage, it is thus important to identify these two groups of adopters and prepare promotion and implementation strategies, policies and trainings that are tailored to the traits of each group.

Limitations of the Study

This study is based on a single-case study design. Including other similar cases of universities in the study will probably underscore the validity and reliability of our findings. Despite the fact that the results provide interesting insights regarding the awareness/exploration phase of blended learning adoption in a university, particular attention should be paid to the generalization of the results. The participants of this study were assigned to different categories of innovation adoption by using self-categorization. Although widely used, this categorization approach is subjective (see Porter & Graham, 2016) and probably diminishes the validity and reliability of this and similar studies.

The results of this study would probably be more reliable if the usefulness of different LMS activities/tools would be assessed by using the LMS raw database. This database provides the actual number of implemented LMS activities and logs of their use by university teachers and students. However, these records do not reveal their actual preference. Combining both data would probably provide better insight regarding the usefulness of different LMS activities. Furthermore, in Table 3 the activity *Book* was probably misunderstood to some degree by the participants for the PDF books that are uploaded to the LMS as study material. In some identified cases this activity was not implemented in practice as expected.

The majority of statistically significant differences between first adopters and followers have a statistical power below 0.8, which is the minimum recommended according to Cohen (1988). This is due to the relatively small sample size. Despite the fact that we spent considerable effort to increase the participants' responses, the response rate was 27.5%, which is still comparable to similar studies (see subsection Case presentation). However, the identified moderate effects still provide important information regarding the differences in regard to ICT adoption between first adopters and followers.

Finally, the percentage of participant categories that are defined as laggards and late majority in Rogers' (2003) DOI was substantially lower than expected. Their non-response to this web questionnaire probably reflects their inertia in regard to the adoption of ICT innovations. In fact, the questionnaire used in this study was web based and thus also an ICT innovation for many eligible participants. Despite the fact that all eligible participants were invited many times to respond, we were unable to increase their numbers. We suppose that the population of laggards and part of the late majority population ignored the online questionnaire in the same way they usually ignore other ICT initiatives.

SOLUTIONS AND RECOMMENDATIONS

Teachers' general attitude to ICT innovations represent valuable information for the university management dealing with the adoption and use of ICT in teaching/learning. Our results indicate that in case of substantial divergence from Rogers' distribution of adopter categories a dichotomous first adopters/followers categorization can provide valuable insights into the ICT adoption dynamics at universities in the awareness/exploration stage of blended learning adoption. In fact, the use of these simplified categorizations can substantially facilitate the analysis.

Management should identify the differences in the university teachers' perceived relevance of the factors that affect the adoption and use of ICT and the usefulness of different LMS activities/tools between first adopters and followers. Such data will not only provide insight in the diversity of attitudes to ICT but will also provide a valid reference for the preparation of a blended learning promotion plan and its implementation in practice. Furthermore, the differences identified can provide valid information for the preparation of education materials tailored to first adopters and followers among this university's teachers.

Although other universities in the awareness/exploration stage of blended learning adoption may also find other differences in teachers' attitudes to ICT adoption or their teachers may find other LMS activities/tools more useful, we believe our approach and findings can still assist them in their endeavors to advance their blended learning adoption from Stage 1 to 2. However, our recommendations represent only a part of what modern universities, interested in blended learning, should follow. Furthermore, the development of detailed tutorials and guidelines for implementing the transition will be of immense help to these institutions.

FUTURE RESEARCH DIRECTIONS

Our findings call for further research in this field in order to gain a more nuanced understanding of the awareness/exploration stage of blended learning adoption in universities and the dynamics of transition to the next stage. Some of the potential future research directions could be: (1) the development of a standardized instrument for the categorization of the participants; (2) the assessment of psychometric characteristics of the developed instrument; and (3) the translation of the instrument in different languages.

Furthermore, in order to better asses the actual stage or level of adoption, more objective indicators should be included and tested in further studies. Porter and Graham (2016) suggested the use of indicators which rely on the respondents' actions rather than their self-perception. Hence, the use of objective data, such as LMS logs would better explain the participants' actual behavior. In fact, LMS logs are "big data" that represent a valid source of information, which are able to shed light on the participants' actual behavior in the virtual learning environment (Park, Yu, & Jo, 2016). The application of modern approaches, such as data mining and artificial intelligence, could provide additional insight and provide valid information for the improvement of ICT adoption in teaching/learning at the individual and organizational level. In fact, data mining techniques and artificial intelligence can be used to develop "*virtual tutors*" or "*virtual assistants*", which, based on the data, could provide university teachers practical recommendations and suggestions, which would be tailored to them, their courses and students. Similar tools could be developed and tested for the needs of researchers and responsible persons at universities, helping them to check different indicators (that are currently unknown) and identify the "*da facto*" first adopters, who represent a role model for followers. According to (Moore, 1991, pp. 10-11), it is important to establish and "*maintain a momentum in order to create a bandwagon effect that makes it natural*" for the followers to follow the first adopters and thus adopt and use ICT innovations in teaching/learning.

Conclusion

The categorization of university teachers as first adopters and followers could represent a valuable tool for planning/implementing the blended learning adoption process. Our study demonstrates that the dichotomous categorization suggested by this study (first adopters vs. followers), which is based on Rogers' five categories of innovation adopters, can simplify the analysis of the blended learning adoption process and help to identify differences in the factors affecting ICT adoption and the perceived usefulness of LMS activities (e.g., quizzes, discussion boards and assignments). Identifying these two groups of teachers can assist universities that are in the awareness/exploration stage of blended learning adoption, to recognize the ways in which first adopters differ from followers and consequently to facilitate strategic and optimal adoption and implementation of blended learning tailored to teachers.

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KEY TERMS AND DEFINITIONS

Awareness/Exploration Stage of Blended Learning Adoption: The first stage in the blended learning adoption process by the universities, which is characterized by lack of institutional strategy and adequate technical/pedagogical support for teachers-adopters.

Bandwagon Effect: A phenomenon where people do something because other people are doing it.

Blended Learning: Combination of traditional face-to-face and online instruction.

Blended Learning Adoption Stages: A three-stage framework representing the stages of blended learning adoption at universities (developed by Graham, Woodfield, & Harrison. 2013).

Categories of Innovation Adopters: Everett Rogers classified the population according to their innovation adoption attitude in five adopter categories: innovators, early adopters, early majority, late majority, and laggards.

Diffusion of Innovations: The theory, developed by Everett Rogers, that explains the dynamics of the adoption of new ideas and technology, thus, also ICT.

Learning Management System (LMS): A software application used for the delivery of (online) educational courses and other forms of trainings. Other important LMS functionalities are administration of courses, users, and their roles; plugins, etc.; tracking; reporting, etc.

Chapter 17
Online Informal Language Learning Among Foreign Language Teachers:
Activities and Purposes Analysis From a Complex Dynamic Systems Perspective

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ABSTRACT

Today's online world provides foreign language users and learners with a multitude of opportunities to engage in a variety of language activities. A social group that can derive major benefits from the availability of online resources in different languages is foreign language teachers. Based on an 'emic' approach, this study involves case studies of three experienced foreign language teachers that used diaries over a period of eight weeks to report on every instance of online use of their predominant foreign language and English. Semi-structured interviews were used to obtain insight into online behaviour that was not specifically related to the eight-week period of diary-keeping. The results indicate that the online uses of the three participants, although they belong to the same social and age groups, display great variety in terms of online activities and the predominant language used to perform these activities.

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INTRODUCTION

Today's online world provides foreign language users and learners with infinite opportunities to engage in a multitude of different receptive, productive, and interactive language activities. A social group that can derive major benefits from the availability of vast and diverse online resources in different languages is foreign language teachers. The internet is a rich source of materials that they can tailor to the needs of their learners. In addition, foreign language teachers often teach a language that is not their mother tongue (Canagarajah, 1999) and the online resources can help them to stay in touch with authentic language use and to further develop their foreign language competence. Therefore, language teachers can be considered good examples of successful and experienced language learners (Valmori & De Costa, 2016).

Research into online informal language learning has been limited to online use among secondary school and university students (Kusyk, 2017; Trinder, 2017; Lai, Hu, & Lyu, 2018; Lee & Dressman, 2018; Lyrigkou, 2018). However, students were reported to be unable to appropriately reflect on the association between online language use and language development (Sockett & Toffoli, 2012). Based on the premise that foreign language teachers would be better equipped to reflect on online foreign language use and development, this study presents case studies of three experienced higher education foreign language teachers from Slovenia: two teachers of Italian and one teacher of German.

To our knowledge, to date no research study has attempted to find if online informal language learning helps non-native foreign language teachers to maintain and to further develop their language skills, in particular when their predominant foreign language is not English. Therefore, this study will use the complex dynamic systems (CDS) theory to attempt an investigation into the nature of online informal language activities in the participants' predominant foreign language and English as the global *lingua franca*, and to explore how these are interconnected with their predominant foreign language and English language development.

Literature Review

The framework for this research study is provided by online informal learning of English. This refers to the receptive, productive, and interactive activities that non-native speakers of English conduct online in their leisure time for personal and professional purposes in authentic online communicative events that involve the English language (Sockett, 2011; Sockett & Toffoli, 2012). By analogy, because online language activities can be performed in foreign languages other than English, in this chapter we will use the term online informal language learning in general (see also Isbell, 2018).

More experienced learners tend to have a metacognitive awareness of the benefits that online language use brings and may intentionally engage in online activities with a secondary aim to improve their language competence (Trinder, 2017). However, online participation usually does not entail an explicit intention to improve one's foreign language (Sockett & Kusyk, 2015; Kusyk, 2017). Instead, the users' primary intention is entertainment, communication with other users, and engagement in content that is personally or professionally relevant (Sockett, 2013). In this way, language development is a secondary product of online activities, and as such shares numerous features with naturalistic language development (Sockett & Kusyk, 2015; Kusyk, 2017).

The online role of foreign language teachers is two-fold: it involves foreign language use as well as development. Importantly, the level of language ability is an element that significantly determines the language teacher's confidence (Seidlhofer, 1999). Moreover, it also affects how much the students learn, the amount of the foreign language used in class, and the teaching approach (Chambless, 2012). The target language competence of foreign language teachers is a core dimension of their professional competence along with their language awareness or knowledge of the language as a system, and pedagogical skills set (Trappes-Lomax, 2002; Richards, 2010).

The theoretical framework that to date most research into online informal learning of English has relied on is that of CDS. Different terms may be used to refer to complex systems. For example, if emphasis is placed on their dynamism and ability to change over time, the term ‘dynamic systems’ might be preferred. Alternatively, when the focus is their adaptability and learning ability, ‘adaptive systems’ would be used instead (Larsen-Freeman & Cameron, 2008a). Therefore, the CDS theory emphasises the unique range of resources, strategies and relationships that contribute to the non-linear development of the language of each user and objects to reductionist views underlying exclusively quantitative research (Sockett, 2013). According to Van Geert (2008), a system is represented by any network of identifiable constituent parts. One of the most important premises of CDS theory is that it does not recognise simple cause-effect relationships between variables but rather focuses on co-adaptation, change, and emergence of new modes of behaviour that result from interactions among system components or systems themselves (Ellis, 2006; Larsen-Freeman & Cameron, 2008; Larsen-Freeman, 2015). This represents a shift of the object of research from the product to the process, which can only be studied in retrospect and not predicted (Larsen-Freeman & Cameron, 2008a; Larsen-Freeman & Cameron, 2008b; Larsen-Freeman, 2015).

According to Sockett & Toffoli (2012) and as presented by Van Geert (2008) four elements of the CDS theory are particularly relevant for research into online informal learning of English: the initial conditions for each language user, attractor and repeller states, co-adaptation between systems, and phase transitions. The initial conditions, understood as the condition of the system when the researcher starts observing it (Verspoor, 2015), will be different for each language user. The specific nature of language use of each language user, their language experience (Larsen-Freeman & Cameron, 2008a) and age (Larsen-Freeman, 2015) may have a significant impact on language development. Attractor and repeller states are the main driving forces of CDS (Van Geert, 2008) and are important for continuous and stable relationships of language users with online content (Sockett, 2013). According to Larsen-Freeman & Cameron (2008a), attractors are the preferred modes of behaviour that result from repeated experience and that the system keeps returning to also after a shift. Attractors can be divided into fixed point attractors in which the system stabilises, cyclic attractors to which the system periodically moves, and chaotic unpredictable attractors that may be disturbed by the smallest of perturbations (Larsen-Freeman & Cameron, 2008a). On the other hand, repellers divert the system from the path that it would naturally follow without a disturbance (for example, an individual would regularly follow a TV series until this is suddenly no longer available online). Co-adaptation refers to a type of causality according to which change in one system or component will result in a change in another (Larsen-Freeman & Cameron, 2008a; Larsen-Freeman & Cameron, 2008b). An example is when increased exposure to a foreign language online leads to better language knowledge that may in turn result in higher interest in online resources. This can be referred to as connected growers (Van Geert, 2008) or co-evolution if it occurs over a longer timescale (Larsen-Freeman & Cameron, 2008a). Finally, phase transitions are possibly dramatic and sudden changes before the system settles in a new attractor state. Because of the numerous interactions among system components and systems, changes are generally not linear in nature. Thus, sudden changes and the emergence of new modes or patterns of behaviour can occur. This holds true for languages, which are seen as systems subject to constant reorganisation resulting from the interaction with the context of communication (Van Geert, 2008; Larsen-Freeman & Cameron, 2008a).

It can be argued that several other elements of the CDS theory are useful to understand online informal language learning and change: the unique trajectories that each user's language system will follow, the effects of perturbations to the system, and the importance of context. The initial conditions of each language user will be different and unique but so will the trajectories or paths of development that their language systems will travel on. Therefore, what we need to observe is the trajectory of the system understood as the movement of the system across the state space (Larsen-Freeman & Cameron, 2008a; Larsen-Freeman & Cameron, 2008b). The trajectory of the system will depend on its initial conditions and interactions with other systems and their components, for example authentic online informal language activities (Larsen-Freeman & Cameron, 2008a; Sockett, 2013). A perturbation can be defined as an external influence that will disturb the trajectory of the system and possibly change its course (Van Geert, 2008). An example of a perturbation is a teacher intervention that requires the learners to engage in activities that are different from what they are usually asked to do. By definition, a CDS is open to outside influences emerging from the context (Larsen-Freeman, 2015). The parameters of the context are understood as parameters of another system that may shape the users who will in turn shape their contexts by choosing and manipulating the online language activities (Larsen-Freeman & Cameron, 2008a). This relationship can be defined as reciprocal causality (Thompson & Varela, 2001).

Research Questions

As previously mentioned, to our knowledge the online informal learning of languages other than English and English among foreign language teachers, who that have the metacognitive knowledge to be able to competently reflect on their online language use, has not yet been the subject of research. Therefore, the research questions of this study are:

- Which activities do the participants engage in online in their predominant foreign language and English language?
- How are these activities interconnected with the participants' predominant foreign language and English language development from a CDS perspective?

Method

The methodology for this study was based on the premise that case studies will provide a thorough insight into the initial conditions, attractor and repeller states, trajectories, and context of foreign language teachers as online language users and experienced language learners, as well as examples of co-adaptation between systems and phase transitions resulting from potential perturbations. This is in line with the need for 'emic' methodologies that are based on individual language users as study participants (Larsen-Freeman & Cameron, 2008b; Sockett, 2013; Larsen-Freeman, 2018). In addition, case studies allow the researcher to study in depth an activity or process of one or several individuals (Creswell, 2018), in this case the activity of online informal language learning and use of the predominant foreign language and English among three foreign language teachers.

Research Instruments and Data Collection

Three experienced foreign language teachers of languages other than English (two teachers of Italian and one teacher of German), fluent in English, were asked to record every occurrence of online use of their predominant foreign language and English (but not any other languages that they might speak) over an eight-week period between February and April, 2018. The objective of these diaries was to obtain data on their online involvement across a relevant timescale in sufficient detail (Larsen-Freeman & Cameron, 2008a). Diaries can be used in qualitative research to enable an observation of everyday behaviour in a relatively discreet manner, to capture the immediacy of the experience, and to provide accounts of activities and processes over time (Symon, 2004).

The diary template is an adapted, updated, and upgraded version of the template used by Sockett and Toffoli (2012). It consists of five columns (date, brief description of the activity, approximate time in minutes, the device used, and notes and comments on the effect of each activity on the participants' language development) and six rows with prompts eliciting activities related to each language skill that would facilitate the subsequent analysis ('I read', 'I wrote', 'I listened to', 'I spoke about', 'I watched', and 'I used the internet to').

After the analysis of the diaries, in-depth semi-structured interviews were used for clarification, which is in line with the requirements to use multiple methods in order to understand change in CDS (Larsen-Freeman & Cameron, 2008a). In addition, semi-structured interviews enable an insight into the participants' experience and the meaning that they derive from it through selecting and reflecting upon relevant details (Seidman, 2006). Therefore, another objective of semi-structured interviews was to obtain an insight into online behaviour that was not specifically related to the eight-week period of diary-keeping but generally habitual for each participant.

Participants

The three participants were chosen based on convenience sampling as they were the ones that responded to an invitation to participate in this study.

Participant 1 (P1), MA, lecturer, is a teacher of German for specific purposes in business and economic studies. She is 57 years old and has 35 years of experience in foreign language teaching. Her research interests include language pragmatics and discourse analysis. Using the Common European Framework of Reference for Languages (CEFRL) Companion Volume scales (Council of Europe, 2018), she placed her German language competence at level C2 for all language skills. She reported that her English language competence is at level B2 for overall listening comprehension, overall spoken production, and overall spoken interaction, and at level C1 for the other skills.

Participant 2 (P2), PhD, assistant professor, primarily works as a teacher trainer for future teachers of Italian as a foreign language, but also teaches Italian for beginners. She is 50 years old, and has 28 years of foreign language teaching experience. Her main research interests are language teaching methodology and foreign languages for specific purposes. Using the CEFRL Companion Volume scales (Council of Europe, 2018), she placed her Italian language competence onto level C2 for all receptive skills and level C1 for all productive skills, interaction, and mediation. She reported that all her English language skills are at level B2.

Participant 3 (P3), PhD, assistant professor, works as a teacher of Italian for specific purposes in economics and business. She is 57 years old and has 34 years of experience in foreign language teaching. Her main research interests include pragmatic and linguistic analysis of Slovene and Italian business texts, contact linguistics, textual production of non-native speakers compared against the foreign language standard, and development and consolidation of communicative competence in languages for specific purposes. Using the CEFRL Companion Volume scales (Council of Europe, 2018), she self-assessed her Italian language competence to be at level C2 for all language skills. She reported that her English language skills are at level C2 for the receptive skills, and at level C1 for the productive skills, interaction, and mediation.

All three participants are native speakers of the Slovene language. The interviews were conducted in the Slovene language in June, 2018.

Data Analysis

The data were analysed following the procedures of qualitative research (Kordeš & Smrdu, 2015). Content analysis was first employed to explore the participants' diaries in which they recorded each instance of online use of their predominant foreign language and English over eight weeks. This stage involved calculating the time spent online on each language (English and the predominant foreign language) and on each language skill, and repeated reading of the participants' diaries in order to obtain familiarity with all relevant aspects related to their online informal language learning. Diary comments were then coded into theoretically related topics by language skill and CDS element analysed. In addition, the initial conditions for each participant were analysed. Based on these results, the framework for the in-depth semi-structured interviews was designed.

In the second stage, the in-depth semi-structured interviews were transcribed and coded for common themes to emerge. These were then grouped into categories by language, language skill as elicited in the diary, and then by theoretical CDS constructs that underpin this study.

Results

Tables 1-3 present the participants' regular online activities, and divide them in terms of language skill (reading, writing, listening, watching, speaking, and general Internet use) and language used (predominant foreign language or English). The presented data exclude specific activities that were reported once and that cover a short period of time, for instance reading tourist destination information.

For Participant 2, the use of YouTube has been placed under the skills of both listening and watching. The reason for this is that she would only listen to the spoken text without watching, for instance while cooking or before falling asleep, but she would also engage in audio-visual consumption of YouTube content for professionally relevant material.

First, from the data presented in *3.2. Participants*, we can infer that the initial conditions of the three participants were similar in many respects. All belong to the same age group (between 50 and 57 years of age), are employed at higher education institutions in Slovenia, are teachers of foreign languages other than English, and are proficient users of their predominant foreign language and at least independent users of English. In addition to differences that reach beyond the scope of this research (e.g., personalities, learning styles), two differences can be observed from the participants' descriptions: firstly, P1 and P3

Table 1. Participant 1 – online activities in German and English over eight weeks (February-April, 2018)

	German	English
Total time spent online	179 hours	79 hours
Reading	101 hours (academic papers, Zeit Online, classroom materials, emails)	11 hours (online newspapers)
Writing	25 hours (emails)	5 hours (translation from Slovenian)
Listening	1 hour (WhatsApp messages)	60 hours (music)
Watching	25 hours (YouTube clips)	1 hour (YouTube clips)
Speaking	4 hours (Skype teaching)	0
General Internet use	23 hours (looking for general information)	2 hours (looking for general information)

Table 2. Participant 2 – online activities in Italian and English over eight weeks (February-April, 2018)

	Italian	English
Total time spent online	33 hours	132 hours
Reading	25 hours (student papers and slides, circulars and newsletters, emails)	21 (academic papers, emails)
Writing	0	30 (academic paper, conference abstracts, emails)
Listening	0	28 (music videos and YouTube interviews)
Watching	3 hours (YouTube lectures)	50 hours (music, YouTube interviews, documentaries, films, YouTube lectures)
Speaking	1 hour (WhatsApp call)	0
General Internet use	4 hours (looking for YouTube lectures in Italian)	3 hours (looking for academic phraseology, references)

Table 3. Participant 3 – online activities in Italian and English over eight weeks (February-April, 2018)

	Italian	English
Total time spent online	111 hours	227 hours
Reading	56 hours (academic papers, daily news, emails)	45 hours (academic papers, daily news, emails)
Writing	33 (academic paper, classroom materials, emails)	102 hours (academic paper, emails)
Listening	9 hours (daily news on the radio)	0
Watching	1 hour (TV interview, daily news)	60 hours (daily news, documentaries, films)
Speaking	1 hour (phone conversation)	0
General Internet use	11 (dictionaries, looking for terminology and presentation data)	20 hours (dictionaries, looking for terminology and presentation data)

are teachers of languages for specific purposes while P2 is a teacher trainer, and secondly, P1 is not a holder of a PhD title nor of the position of assistant professor, which characterises P2 and P3.

The trajectories of the systems of the participants' online use share some similarities but are also significantly different. They will be presented in detail in the coming section, in which we will use the participants' diary entries (DE) and interview data (ID) to present the online activities that they perform in their predominant foreign language and English by language skill. For each skill the identified attractor and repeller states, instances of co-adaptation, perturbations, phase transitions, and effects of the context will be presented.

Reading Skill

Attractors

Fixed and cyclic attractors were found in relation to the participants' online reading. In the timeframe of diary keeping, all participants were involved in reading activities that are not always done with the same intensity. These can be defined as cyclic attractors that repeat over a period of time. P1 was editing a journal issue in German (ID): "*This was when we started working on the journal issue in German. This is why I was intensely reading academic papers. So this period was different. In general, I certainly read a couple of papers in German and a couple in English every month, because of the content but also because of the language*." P2 was reading and marking student papers in Italian, which for her is common every academic year between February and April (ID): "*Reading student papers, yes, it was February*." P3 was preparing for the submission of a paper in Italian and another in English (ID): "*I was keeping the diary at a very intense time after which I submitted one paper in Italian and another in English*."

A fixed attractor for P3 is reading academic papers in Italian and English while P2 mostly reads them in English and not her predominant foreign language, which is Italian. This is how she explained her reasons for this (ID): "*I read and write papers in English because I cannot survive with Italian. There are no indexed journals in Italian that would focus on teaching methodology topics. You can find journals for pure linguistics and literature but not methodology. If there is one, it only accepts invited papers. /…/ Italian is my teaching language and English is my research language.*"

In terms of reading for entertainment purposes, reading the daily news in both languages seems to be a fixed attractor for P1 and P3. In the interviews both expressed a combined meaning-focused and form-focused approach to reading that allows them to stay in touch with authentic language use, for instance P1 (ID): "*Because the language that Zeit Online journalists use is truly amazing and their column writers are really excellent*." Online reading with a clear intention of developing her language competence was reported by P3 (ID): "*I sometimes read dictionaries for fun.*"

In addition to academic papers and the daily news, for P1 another fixed attractor is looking for and reading texts in German which she then uses as supplementary material to course books in her classroom (ID): "*I have core materials, the course books are the file rouge of the course but they are partly outdated because you cannot change them very often so every year I supplement them with fresh materials*." All participants reported having core materials for their courses available in print or online form, which means that intense weekly online involvement with the purpose of looking for classroom materials was not necessary. For P1 German is also the language that she most frequently chooses for entertainment purposes (ID): "*This is my strongest foreign language and this is why I automatically choose it*."

Repellers

Regarding the repellers, the opposite of attractors, the necessity to publish in English can be seen as a repeller for the participants to read academic texts in their predominant foreign language. Another problem is the difficulty to find relevant papers in their predominant foreign language and the concomitant ease of finding them in English (P3-ID): "*I do use Italian databases but the keywords that I use often do not yield the expected results. And then I immediately move to English*."

Co-Adaptation

The availability of online dictionaries and the internet as the largest language corpus has led to the emergence of forms of co-adaptation. This is how P2 uses online resources to enhance her vocabulary knowledge in both languages (ID): "*When I read student papers and I am not sure myself of the correct phrase, I check multi-word units online by putting them between quotation marks so I check the frequency and contexts of different options*."

Phase Transitions

A phase transition from reading on paper to online reading was reported by P2 (ID): "*Firstly I did not read manuscripts on the screen. But then the changes were so frequent and I had so many versions of the various manuscripts that I decided not to print them anymore. /…/ Another advantage of this was that I had the digital manuscripts with me at all times and could read them anywhere*."

Context

Regarding context as a part of CDS, it can determine online reading activities in several ways, for example through the moment of time in the academic year or paper submission deadlines, as presented above. Another clear example of the influence of the online context on reading content was reported by P1 (ID): "*At the bottom of each article, Zeit Online has links to related articles, and then you can click on The Guardian, so it takes you to the same topic in another newspaper*."

Writing Skill

Attractors

In the eight-week period of diary keeping, P1 did not report writing academic texts. On the other hand, for P2 and in particular P3 this was a time of intense academic writing, which is another example of cyclic attractor. While P2 only wrote academic texts in English which has recently become, as stated above, her "*research language*", P3 spent a considerable number of hours writing in English and in Italian. Nevertheless, she agreed with P2 on the need to write academic papers in English (ID): "*The academic community uses English, we have come to terms with that and now we swim in these waters. At the beginning it was really unusual to write about Italian in English. /…/ But if you want to collect the promotion points, you have to use English*."

An example of fixed attractor is the motivation to enhance or to maintain the level of one's language competence. P2 expressed the motivation to improve her academic English and not Italian (ID): "*At my age, I really do not feel like learning academic Italian. What for? I actually feel motivated to learn academic English*." Similarly, P3 thinks that the knowledge of English is a precondition to be a member of the international research community (DE): "*We need to keep in touch with both languages, simply to show that we are part of this community*."

Writing emails is a fixed attractor for P1 and P3. P1 writes emails in German when she sends essay feedback to her students. P2 rarely writes emails in her predominant foreign language. It may be assumed that her giving feedback to her students is included in the reported reading of student papers and slides presented in the reading diary section. On the other hand, she reported occasionally writing emails in English, for example to conference organisers. P3 writes emails both in Italian and in English.

Repellers

None among the three participants reported posting social media comments or updates. When asked if they had social media accounts, only P1 stated having a Facebook account which she mostly uses for instant messaging. P3 explained why posting online for her is a repeller (ID): "*I rarely expose myself. This might be conditioned by my personality. The fact that we are linguists creates another problem to most of us. It is not only content that matters but also the form. When you write, well, maybe this is my personal problem, it has to be well written and well thought-out*."

Co-Adaptation

P2 and P3 found several strategies to use online resources to assist their academic writing. These can be understood as examples of co-adaptation between online resources and the participants' writing process. The first identified strategy is imitation (P2-ID): "*I copy whole language chunks, these are syntactic language chunks*." Another strategy is using Google Translate (P2-ID): "*I have put the English abstract into Google Translate and got the text in Italian. If the English is good, the Translate works very well. I can correct the things that do not make sense or are obviously wrong. So I used English as my intermediary language to get to academic Italian.*" Next, they use online dictionaries (P3-ID): "*I first use an online dictionary, Merriam Webster, Il Sole 24 ore, Il corriere della sera, all these dictionaries, they are active on my desktop all the time*.", and search engines to access the Internet as a language corpus (P2-ID): "*Honestly, I do not use online dictionaries, I am ashamed of that but I do not. I prefer using quotation marks and throwing the expression into the Internet junkyard, not even Google Scholar, to see the results of the basic search and the contexts of use*."

Another example of co-adaptation between systems (in this case the teacher and her students) was reported by P3 (ID): "*I used Viber with students to prepare a field trip to Venice. /…/ We did everything in a Viber group. I had suggested email but they recommended Viber instead and I went along*."

Phase Transitions

P3 reported a phase transition in her writing (ID): "*I think that my style of writing has changed and has become more business-like, and the sentences more complex and possibly too long*."

Context

Writing can also be affected by the personal context, as mentioned by P1 (ID): "*I used to be a member of Booking and Airbnb, I had apps, this is online. I was there in the role of hotelier. But I have stopped doing that for personal reasons*."

Listening Skill

Attractors

Listening in the online world does not take as much of the participants' time as reading and writing. For P1 a fixed attractor is listening to music in English but not in German as her predominant foreign language (ID): "*I listen to music on my laptop. I listen to what I like, in English and sometimes Italian. But not German, I generally do not like it.*" P2 reported listening to music and interviews that she plays on YouTube (ID): "*I do not always watch because I try to only listen. It is dark, I have a headache, I am tired, and I close my eyes and I listen without watching*." On the other hand, P3 did not report any listening in English. A cyclic attractor for her is listening to the radio daily news in Italian.

Repellers

P2 used to listen to Italian songs because she wanted to use them in class with her teacher trainees. However, her dislike for modern Italian music turned this into a repeller (ID): "*I used to 'youtube' for Italian canzoni because I had this fixed idea in my head that they would motivate my 'professional children'. /…/ I am too old for these modern lyrics, I want them to make sense.*"

Co-Adaptation

An instance of co-adaptation between the skills of listening and the online world was described by P3 (DE): "*Digital media enable a user-friendly listening experience. I can access the desired content at any time, I can replay unclear or interesting sections, stop the recording whenever this is necessary and resume later, check the pronunciation in online dictionaries and so on*."

Audio-Visual Reception

Attractors

For P1 and P2 a fixed attractor in audio-visual reception seems to be YouTube clips. P1 predominantly watches YouTube clips in German for teaching purposes (ID): "*The Galileo channel is great. I certainly prepare one video every 14 days and we then work on it in class*." On the other hand, for P2 audio-visual reception is mostly done in English for entertainment purposes but with a secondary aim of improving her listening comprehension and speaking in English (ID): "*I had another reason for doing this so intensely. I knew I would be attending the IATEFL conference in Topolšica and I wanted to be able to better understand others because the only language used there would be English anyway*." Moreover, she also thinks that online audio-visual reception helps her with contemporary Italian (ID): "*Yes, 'you-*

tubing' is important for my Italian, to keep in touch with medium high spoken Italian, because I think this is beneficial to the Italian that I speak and use." Another fixed attractor for P2 is watching films in English online while P3 prefers different types of documentaries, films, and news programmes in English.

Repellers

For P2 a repeller to using YouTube in Italian was a lack of relevant content that she could use for professional purposes in her teacher training. As a result, an attractor in English developed (ID): "*I was looking for something like this in Italian for almost three hours and did not find anything. /…/ Then I watched teaching class models and class sections in English, these are transferable to other languages*." Other repellers mentioned by the participants are the repetitive nature of TV series, for instance P1 (ID): "*I do not watch any series. They are all the same. This might be generational but it has never occurred to me to watch series online*.", and dubbed programming, for instance P3 (ID): "*Then you immediately see it is dubbed. This is a disaster!*"

Co-Adaptation

Several instances of co-adaptation between systems can be found in relation to audio-visual reception. The first one refers to using captions in the original language or another language, also with the intention of improving one's language competence (P3-ID): "*I mostly use original language captions. I memorise better this way if I hear and see the word. It anchors in my memory if more than one sensory channel is involved. /…/ Anyway, I have a notebook and I write down words and expressions and occasionally I look back at these words and I can simply remember them better*." Other examples of co-adaptation are repetition of unclear or interesting parts, and use of online dictionaries while watching.

Phase Transitions

An interesting evolutional trajectory of her audio-visual reception skill was described by P2. Several years ago the level of development of her audio-visual reception skill in English was a repeller (ID): "*When I tried watching without subtitles, I got frustrated and then I did not actively look for these situations. Nobody will frustrate me in my free time!*" Then she decided she would start writing papers in English and attend conferences with English as the working language, which considerably contributed to the development of all her language skills in English. At the beginning of the diary-keeping period, a perturbation was introduced into her system. Under the pretence of giving her listening assignments to put into her diary, she was sent links to Caro Emerald songs on a daily basis. In fact, a group of friends prepared a surprise for her 50th birthday and took her to a Caro Emerald concert and wanted her to get familiar with the songs and lyrics. Listening to songs soon led to an intense use of YouTube for entertainment purposes, first in English (DE): "*I am losing the feeling of language frustration. I can understand quite a lot, it is easier if I use captions*." This process led to a clear phase transition (DE): "*My audio-visual and listening comprehension in English has significantly improved in one or two months of intense use*." A change in the role of captions from attractor to repeller followed (DE): "*Now I prefer YouTube without captions, so I can only listen and watch, probably because I feel that my comprehension is improving*." Effective audio-visual comprehension and finding personally and professionally relevant clips in English then led to the co-adaptation between two language systems (ID): "*Because of external influences and* *the positive effects that I perceived in English, I made a positive transfer to Italian and discovered that this is one of the ways to go. /…/ Now I sometimes choose Italian also for entertainment*." Finally, she started looking for language teaching methodology links in both languages, which can be seen as another stage of co-adaptation (ID): "*Yes, I started 'youtubing' in Italian with professional objectives in mind*."

The concomitant effects of several systems resulted in the development trajectory described above. The first contributing factor was that P2 had got a smartphone as a birthday gift (there had been two tablet devices in the household before that) only one month before she started keeping the diary of online language uses (ID): "*A precondition to 'youtube' in bed is to have a smartphone*." Secondly, because of health problems between February and April, 2018, she spent more time than usual in bed.

Context

Finally, an example of reciprocal causality between the online context and the user was described by P2 (ID): "*The more often you click a topic, the more often will you be offered related input that you have actually chosen yourself. In this way the probability of you choosing the same input increases*."

Speaking Skill

Attractors

All participants in this study hardly ever speak any language online. A cyclic attractor for P1 is delivering online Skype one-on-one classes of German, which can be identified as an example of co-adaptation (ID): "*I teach children with disabilities that are a result of brain injury. /…/ Some may have very short concentration spans. /…/ It is not very time efficient to get together for 20 minutes for face-to-face classes, me going there or the parents driving them. Also geographically, when I am outside Ljubljana, this does not matter*."

Repellers

An identified repeller to online spoken communication might be a lack of technical knowledge (P1-ID): "*This is absolutely beyond some people, even of my age, what you and I are doing right now, a Skype interview*."

Co-Adaptation

In the opinion of P1, co-adaptation between systems in the form of smartphone apps used as a replacement of complex written or spoken communication through other channels may have a detrimental effect on language competence (ID): "*Communication is increasingly moving toward entering data into apps. I think that this may lead to language attrition, including the attrition of your mother tongue. Here the speech act theory does not play any role because in apps there are no speech acts*."

DISCUSSION

The main objective of this chapter was to explore the online uses of three foreign language teachers in their predominant foreign language and English, and observe how these activities are interconnected with their predominant foreign language and English language development through a CDS perspective.

First of all, despite belonging to the same specific social group of foreign language teachers and to the same age group in the same country, the online uses and development trajectories of the three participants seem to display great variety in terms of attractors as well as predominant online language. The results indicate that online language use among the participants can be divided into three broad attractor categories: language use for teaching purposes (for example, looking for classroom materials), language use for research purposes (for example, reading academic papers), and language use for entertainment purposes (for example, audio visual reception of films or documentaries). Of the three categories, the online uses of language for teaching and for research purposes seem to be more powerful attractors than the online uses for entertainment purposes.

The online language used for teaching purposes tends to be the participant's predominant foreign language for P1 and P3, both are teachers of languages for specific purposes. On the other hand, the online language for teaching purposes of P2, a teacher trainer for Italian, appears to be predominantly English. For example, she would look online for model classes in English than she would then adapt into Italian for her teaching needs. Importantly, all participants confirmed that they have core materials for their courses available in print or online form. Hence, online resources are used to supplement the existing materials but not to design core course resources.

The predominant language for research purposes is different for each of the three participants. In general, P1 uses both German and English but during the diary-taking period her predominant language was German because of her editing work, which can be seen as a cyclic attractor. P2 decided that she would no longer publish in Italian (because of fewer publication opportunities acting as a repeller) and thus her predominant research language has become English, which she is motivated to improve. Finally, P3 continues to publish papers both in English and in Italian. The determining contextual difference between P2 and P3 seems to be their research interests: while P2 publishes papers that focus on language teaching methodology, P3's papers focus on linguistics, which may give her more publication opportunities in Italian if compared to P2.

Finally, the predominant language used for entertainment purposes seems to be German for P1, and English for P2 and P3. These findings confirm that online use trajectories will be unique for every individual (Sockett & Toffoli, 2012; Sockett, 2013).

If compared against previous studies, the present study revealed several similarities as well as differences. The predominance of receptive compared to productive and interactive activities seems to be the first similarity between the foreign language teacher participants in this study and student participants used in other studies (Kusyk, 2017; Trinder, 2017; Lyrigkou, 2018; Jurkovič, 2019). We must not forget, however, that teachers engage in intense productive face-to-face spoken interaction in their predominant foreign language on a daily basis with their students. A second similarity is that online activities may fluctuate depending on the time of the year as a result of cyclic attractors (Sockett, 2013; Sockett and Kusyk, 2015; Kusyk, 2017).

On the other hand, the participants in other studies clearly indicated that for entertainment purposes they predominantly use online resources in English, for example when watching video content, listening to music, using social media, and reading (Kusyk, 2017; Trinder, 2017; Lyrigkou, 2018). In this study, however, entertainment seems to be a tertiary attractor for online involvement, following teaching and research purposes. In fact, among the participants, the only one having a social media account is P1 (Facebook) although all participants use messaging apps, such as Viber and Whatsapp. These differences in online use may be attributed to language experience (Larsen-Freeman & Cameron, 2008a) as well as age (Larsen-Freeman, 2015) as important initial conditions. Another reason for their non-involvement in social networking sites might be a lack of awareness how these may contribute to the creation of personal learning networks and continuous professional development (Xerri, 2014).

Previous studies showed that students should be considered online language users rather than language learners because of their focus on meaning rather than on the linguistic form (Sockett & Toffoli, 2012; Sockett & Kusyk, 2015; Kusyk, 2017). Nevertheless, this study corroborated Trinder's (2017) findings that experienced language users seem to be able to combine the awareness of the learning process with their online uses, in particular with reference to receptive skills. Similarly, Isbell's (2018) findings challenge the limitation of online informal language learning to leisure use. Among foreign language teachers the intentional focus on the form and not only meaning clearly indicates their need to stay in touch with contemporary foreign language use and thus maintain or improve their level of language competence as one of the constituents of foreign language teachers' competence (Trappes-Lomax, 2002; Richards, 2010). However, in terms of language development, only two phase transitions were reported by the participants in this study, one concerning the audio-visual reception skill in English at level B2 and one concerning the writing skill in English at level C1. Possibly, phase transitions that occur at level C2 are too subtle, fine, and gradual to be easily detected or noticed also by experienced and proficient language learners.

Finally, it seems that online language involvement not only allows foreign language teachers to gain language competence from a multimedia approach as lifelong learners. Another dimension that should be addressed is the changes that online engagement causes to their learning skills and habits. In fact, the respondents reported performing several activities that were not possible or not easily accessible in the pre-digital age. These are, for instance, the use of the Internet as a language corpus to validate the adequacy of multi-word units when reading students essays or writing academic papers, using captions to enhance audio-visual comprehension, or providing one-on-one distance language classes through Skype.

CONCLUSION

This study has given information on the online resources used and activities carried out for online informal language learning among three foreign language teachers in Slovenia. It has also addressed the use of English and their predominant foreign language regarding the activity context, purposes and limitations. This is why this chapter describes patterns of behaviour or dynamic system trajectories that cannot be universally indicative of the online behaviour of other users that do not belong to the same specific social group and/or age category.

This research has shown that the theoretical framework of CDS can be appropriate to research the online involvement of experienced language users and learners. In fact, instances of fixed point and cyclic attractors, repellers, and co-adaptation were found. Furthermore, the importance of initial conditions and contextual factors was corroborated, and two instances of phase transitions identified among experienced and proficient language learners and users.

Given that, to the authors' knowledge, this is the first study that explores online informal language learning among foreign language teachers, additional quantitative, qualitative, and mixed-methodology studies are needed. They will shed a light onto differences between teachers of English and teachers of languages other than English, and foreign language teachers belonging to different age categories. In addition, the online needs of foreign language teachers working in higher education are possibly different than those of teachers at the pre-tertiary level. Similarly, the online needs and uses of teachers of languages for general purposes will probably be different from those of teachers of languages for specific purposes while the habits of plurilingual users will be different that those of bilingual or monolingual users. These differences, however, will need to be established by further research.

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Chapter 18
The Changing Role of the Teacher in ICT-Supported Foreign Language Instruction: A Multiple-Case Study

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ABSTRACT

This chapter aims to explore the teacher´s role in foreign language instruction (FLI) supported by information and communication technology (ICT). The recent research on the impact of ICT on the teacher´s role in FLI indicates changes in the role of the teacher. However, there has been little empirical evidence on the nature of this change in foreign language classes. To fill this research gap, a multiple-case study of three teachers and 78 students in three secondary school classes in Slovenia was conducted. This chapter presents an in-depth analysis of sections of semi-structured interviews and class observations exploring the five categories of change of the teacher role identified by Podgoršek. The findings confirm these categories in general, but they also show which sub-categories of change are hard to achieve in real school environment.

INTRODUCTION

The use of technology such as personal computers, smart phones, tablets and Internet for foreign language (FL) teaching is a research area that has gained much attention since the introduction of these technologies into schools in the 1980s. The teaching profession sets high standards for teachers, who are expected to master the subject they are teaching, the teaching methodology, and much more, including new technologies. The integration of technology in the education system comes with high expectations, and yet in practice there is still a large gap between the highly developed technologies and the classroom

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methodologies of ICT-supported teaching (Davies, 2002; Gerlič, 2011; Lei, 2010; Jung & Latchem, 2011; Podgoršek, 2015).

ICT can be defined as a *"diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information"* (Blurton, 1999). The study builds upon the concepts of Computer Assisted Language Learning (CALL), Technology Enhanced Language Learning Environments (TELLE), Web-Enhanced Language Learning (WELL), and Mobile-Assisted Language Learning (MALL) that emphasize the various successively emerging technologies. The context of our study is not limited to any specific technology, and for this reason the general terms of ICT or technology will be used in this chapter.

The main purpose of this study is to provide a deeper insight into the teacher´s roles in ICT-supported teaching. The research on the impact of ICT on the teacher´s roles in FLI indicates a change from the transmissive to constructivist and facilitating roles of the teachers, as Warschauer and Healy (1998) pointed out in describing the teacher as "a facilitator of learning rather than the fount of wisdom". However, there has been little empirical evidence on the nature of this change in FL classes. The aim of this study is to fill this research gap and to offer an insight into three cases of FL teaching in the secondary level classes in Slovenia. The perception of computer uses in the classroom from the teachers´ and students´ perspectives will be explored.

BACKGROUND

Already in 2001, Wheeler claimed that the role of the teacher must change. He described the following four key reasons: some teaching resources would become obsolete, some forms of assessment would become redundant, it would not be sufficient for the teacher merely to transmit content knowledge, and the teacher should use new methods, such as problem solving (Wheeler, 2001, p. 13).

The literature review revealed different approaches to addressing the teacher roles in teaching different subjects. Even if not directly related to ICT-supported FL teaching, these approaches are valuable in the process of reflecting on the teacher's roles. In the context of teaching Gaelic language through TELLE, Murchú (2005) connects the roles with typical activities. He defines designing, planning and organizing as key, i.e. the role of instructional designer. Five additional roles are that of trainer giving individual instruction, of collaborator when learning with or from colleagues and students, of team coordinator assigning students to project or portfolio teams, of enabling advisor or facilitator giving assistance, advice and suggestions to enable students' autonomous learning, and that of mentoring and assessment specialist as a new role in which both the teacher and the students reflect on their performance. Murchú (2005) also observes that many teacher roles were inter-changeable with student roles.

In the context of task-based language teaching (TBLT), Willis (1996) differentiates between the roles of facilitator, course guide, language guide, adviser, chairperson, and monitor. Van den Branden (2016) approaches the teacher role in TBLT from three perspectives, the teacher as mediator of students´ language development, as a change agent in the innovation of second language education, and teacher as a researcher.

Castrillo (2014) identified the main roles of the language teacher within Massive Open Online Courses (MOOCs) according to several stages: before, during, and after the MOOC. The main task of the teacher is in the first stage where s/he acts as structure designer, content generator, assessment designer and communication tools and structure designer. During the MOOC, the main roles are facilitator and curator. After the MOOC, the teacher acts as a researcher (Castrillo, 2014, p. 72). The teacher plays another two roles throughout all the stages as course manager and administrator (Castrillo, 2014, p. 83). The described classification is to some extent transferable to the language learning context of our study that was conducted in face-to-face learning environment with the teacher physically present all the time.

Wang (2015, p. 168) conducted a study of the teacher roles in Multi-User Virtual Environments (MUVEs). The most prominent teacher roles in the pre-task phase are the technical and social roles, followed by the monitor and motivator roles. The role of the teacher during the task is to motivate, monitor, and support the students. The most prominent teacher role in the post-task phase is that of language guide, followed by the motivator, monitor, and social roles. Some teacher roles changed throughout the phases, but four roles were identified in all phases: monitor, motivator, language guide, and social role. The tasks in some roles in ICT-supported instruction are expanded, e.g. the role of a colleague extends to collaboration through technology and the social role extends to teacher activities of encouraging and motivating students in an online learning environment.

In addition to the above literature review, the main findings of the study by Podgoršek (2016, p. 116) will be summarized. Based on the open-ended responses of 132 teachers collected in an online survey, five categories of the changes of the teacher roles when teaching with technology were identified:

Extending approaches to teaching and methods of teaching

- *The teacher guides and directs students in obtaining knowledge.*
- *The teacher's role as a lecturer is supplemented by that of the teacher who guides, directs, and moderates student activities while supervising the learning process.*
- *The teacher, through his/her command of technology, becomes more modern and interesting.*
- *The teacher knows how to motivate students in their learning process.*
- *The teacher facilitates different paths to knowledge.*
- *S/he presents knowledge in a more original and entertaining way.*
- *The teacher learns from the students.*

Shifting the focus to student-centred instruction

- *The teacher is no longer the focal point of instruction.*
- *The teacher knows how to teach students and how to find, order, and use information.*
- *The role of transmitting knowledge is not only the teacher's; the teacher is not the sole source of knowledge.*
- *The teacher loses control over the process.*
- *S/he guides students to practice critical thinking.*
- *The teacher is more focused on the work of the individual.*

A changed relationship between the teacher and the students

- *Exaggerated use of ICT can worsen the quality of the relationship between the teacher and the students.*
- *The students have a better learning experience through personal contact with the teacher.*
- *A more relaxed relationship between the teacher and students.*
- *Through the use of forums and social networks, the teacher comes into better contact with students.*

Increased workload and preparation time for teachers using ICT

- *It's more work for the teacher to prepare ICT-supported materials; during classroom time, s/he is more in the role of an observer.*
- *S/he spends more time giving instructions and directions for work than s/he spends on the activity itself.*

The need for new teacher competences

- *Need for additional training.*
- *Need to keep abreast of developments.*
- *S/he teaches students how to use ICT for learning.*
- *S/he must know how to find the appropriate dosage of ICT in class.*

These categories indicate important areas to which more attention should be devoted. They also signal a shift in the teaching paradigm that is closely related to teacher roles, as one teacher (T) describes it: *"The teacher is no longer the ´all-knowing lecturer´. S/he has a strong rival in the Internet, so s/he has to be able to help students find information, and it is far more important that they know how to find and interpret the information correctly than just being familiar with it."* (T91) (Podgoršek, 2016, p. 128). ICT can play a connecting role when the teacher role inter-changes (Murchú, 2005) with student roles: *"In my observation, the students are a grateful audience when they see the teacher's effort in facilitating different ways of learning, and when they see that s/he learns too, with and from them. This mutual learning and co-creation of the learning process is a good basis for a respectful attitude in class."* (T118). Some teachers in the survey consider an increased workload and more preparation time as the predominant obstacles in the use of technology in instruction: *"ICT offers an FL teacher a lot of opportunities, materials are easier to access, but it takes a lot of time to check and evaluate them."* (T13) and *"The teacher has to invest more into preparing lessons and materials, as this takes a lot of time (searching the Internet, materials evaluation, adaptation and design). The class preparation time can be extended far into the teacher's free time.*" (T83). Although teachers perceive the class preparation as time-consuming, they also recognize the positive effects of the shift towards student-centred instruction, where students are gradually taking more responsibility for their learning: *"While the teacher spends more time on class preparation, in class s/he assists and directs their more or less independent work. The students are more active and autonomous."* (T105). So, during the lesson, teachers can devote more time and attention to individual students. The results also show that further teacher training is of utmost importance. The teacher should know the potential of technology and of efficient ways of ICT use for teaching. Otherwise, they would achieve the exact opposite effect than expected: *"The too frequent use of ICT becomes boring for the students."* (T7) (Podgoršek, 2016, p. 129) and *"The teacher's task is to know the advantages and disadvantages of ICT use in class and to be careful not to exaggerate with ICT* *use, as it can often threaten the quality of the teacher-student rapport."* (T82). When a teacher achieves a high level of ICT-competence, s/he can introduce elements of individualization and differentiation in class, which is the added value of ICT use: *"The teacher is more convincing, and when s/he masters the technology, s/he has more time to devote to individuals."* (T72).

As mentioned in the introduction, teachers are facing the challenge of how to integrate ICT in teaching on a micro level, in class. But also on a macro level, school authorities are facing the challenge of how to introduce technology into the education system. Yeung, Taylor, Hui, Lam-Chiang, & Low (2011) reported on a top-down approach from Singaporean policy makers who have introduced directives to explicitly require teachers to use technology in teaching. The results of testing the assumption that the teachers would then perceive the value of technology and use it in teaching indicate that this approach may not be useful. Lam (2000) comes to a similar conclusion in analyzing FL teachers' reasons in deciding whether to teach with technology or not. The second model is a bottom-up approach in which the teacher's ICT-competence should be enhanced, as Yeung, Taylor, Hui, Lam-Chiang, & Low (2011) are suggesting. When the teachers are motivated and know how to use technology, they would value its potentials. The third model is a combination of the first two: educational authorities offer teacher training that was developed in cooperation between in-service teachers and teacher trainers. Such a model was developed and applied in, e.g. Slovenia within the E-education project (Slo. E-šolstvo) that lasted from 2008-2013. The results were encouraging, however, after the project's completion the developed teacher training did not find a permanent place in the school system.

The above categories indicate what teachers in the survey have observed or experienced in their FL classrooms. But what really happens in the classroom? The study aims to look at three cases to explore this phenomenon in the real environment of secondary FL classrooms in Slovenia.

RESEARCH QUESTIONS

The research questions for this multiple-case study are the following:

RQ1: Which teacher roles were observed or reported?
RQ2: To what extent was there a shift to student-centred instruction?
RQ3: How did the relationship between the teacher and the students change?
RQ4: Did the workload and preparation time for the teachers using ICT increase?
RQ5: Do the teachers need new competences?

METHOD

The multiple-case study was a part of a larger study which also included an online survey. The findings of the first part of the study, a descriptive state-of-the-art analysis of the infrastructure and the use of ICT and teacher's ICT-competences, was reported in Podgoršek (2015). The conception of the teacher's roles in ICT-supported FL instruction was explored in Podgoršek, Istenič Starčič, & Kacjan (2019). In this chapter the results from the multiple-case study will be presented.

The study was conducted in three FL classes in real school environments. The research questions and design were the same for all three cases. This type of case study is particularly suitable for research into the introduction of technological innovations in schools (Yin, 2009, p. 53). Yin (2009, p. 18) defines the case study as an empirical research that explores the modern phenomenon in depth and in the natural environment (Denzin and Lincoln, 2009). In this type of study, the influence of a researcher in the process of teaching is excluded and different methods of data collection can be used.

The methodological approach used in all three classes was task-based language teaching. The tasks were developed by the teachers under the supervision of the researcher, who is also an experienced teacher trainer and task-designer. The task topics were chosen according to the syllabus for the particular class. Since the context of the study is foreign language teaching and not second language teaching where the target language represents a part of student's everyday life in and out of school, the goal was to use one of the key potentials of ICT which is to bring authentic FL into the classrooms. The tasks were designed and made available in the learning environment Moodle, which is used in this school and in many other schools in Slovenia.

Instruments and Data Collection Methods

The multiple-case study was conducted in the school years 2012/2013 and 2013/2014. The instruments used were questionnaires for semi-structured interviews with teachers and students and an observation sheet. The observation of lessons was conducted step by step. The first observation of regular FL lessons was intended to establish contact with students and brief them on the purpose of the research (Vogrinc, 2008). The next time was the first lesson that was the subject of the research. During the observation of the lessons, the researcher made notes and did not participate in the lessons. The classes lasted 45 minutes or 90 minutes (double lessons). Four Spanish lessons, five French lessons and six Italian lessons (the initial observation excluded) were observed. The number of lessons depended on the task that the students were doing.

Interviews with students were conducted in groups of five or six, with one exception when only two students were interviewed. The interviews lasted from 43 to 54 minutes, and the interview with two students lasted 22 minutes. Interviews with teachers were conducted individually and lasted from 40 to 90 minutes. The interviews were conducted face-to-face in Slovene.

Participants

The participants in the multiple-case study were three teachers of Italian, Spanish and French at the same grammar school in Ljubljana. All three are non-native speakers of the FL that they are teaching. Their foreign language proficiency is C2 according to the CEFR level. In order to ensure the most optimal and similar conditions of the classroom-based research, three teachers from the same school were selected. They were also selected because they teach a second and not a first foreign language. This means excluding English as a first FL, since English in Slovenia has been acquiring the characteristics of a second language, and this puts it into a different position compared to the other foreign languages taught.

The participants were 78 students in their third year of grammar school. Their language proficiency level was from A2 to B1. Since the study stretched over several lessons, not all students were present at all times, nor were all of them present for all the interviews. 65 students were interviewed, of these 30 students of Italian, 14 of Spanish, and 21 of French.

Data Analysis

In order to answer the research questions, we conducted a qualitative analysis. Three sources of data were analyzed: the interviews with the teachers and students, and direct class observations. The interviews were first transcribed, then the transcripts were read several times to identify the relevant data referring to the research questions. A deductive approach was used to compare the findings from all three sources with the results of the abovementioned study by Podgoršek (2016) and the literature reviewed. The class observations were conducted by the researcher using an observation sheet.

Reliability and Validity

To ensure the reliability of the study, we kept a chronologically ordered list of procedures performed and described the instruments used in the study. By using triangulation at the level of the data source, at the level of consensual validation and at the level of the approaches used, a more accurate picture of the studied phenomenon was achieved. In order to provide a higher degree of validity, three case studies, following a replication logic, were conducted.

RESULTS

The three cases will be described first, then the results will be presented by examining each research question. To ensure anonymity, the teachers will not be referred to by their real names but by randomly chosen names in the language they are teaching.

The three teachers had some characteristics in common. They are all female, Slovene, and hold a teaching degree equivalent to a masters´ degree in the language they teach. They teach at the same school. Their ICT-competences before the study were different, however there were also some similarities in their ICT use: they had all used the Internet very often for finding information, You Tube and PPT for presentations in class, and had not produced interactive materials or tested or evaluated students' work in an online environment. All three teachers had taken part in teacher training organized for teachers of all subjects at their school aiming to introduce the learning platform Moodle. However, they said that the training was too general to offer useful knowledge for FL teachers.

The tasks that they designed in an online environment for the purpose of our study included listening and video comprehension, quizzes, questionnaires and forums. There were also useful links to different dictionaries and other resources. In all classes the students worked in pairs since not enough computers or laptops were available for individual work. In class, all three teachers gave oral instructions at the beginning of the class, and the tasks were accessible in Moodle.

In the following section the individual teachers will be described. The descriptions cover some topics common to all three teachers and some additional ones are specific to each of them.

Case A: Gianna, the Teacher of Italian

Gianna was the most experienced among the three teachers (24 years of teaching). Her ICT-competence was low ($\mu = 1.35$; min=1, max=4)[1], the lowest among the three teachers. She used ICT in class mostly for showing videos. Her students used ICT in class for finding information, watching videos and doing interactive exercises. Gianna's students did not use a textbook; she prepared paper materials for them. During the case study process she discovered that ICT-supported FL instruction is not a new form of photocopying or doing drill exercises, but a possibility to design different learning activities for students and to enable online learning.

When she got the invitation to participate in the study, as she said in the interview after the study, her thoughts were: *"Okay, I will do my best, just this time again, to see …, in fact, I agreed upon participating with the thought of sabotaging the whole thing, you know, just like a grouch who does not see a point neither in this nor in that."* But her attitude changed during the study. In the preparation phase of the study the researcher and the teachers had some group and individual meetings. The process of getting acquainted and starting to prepare class materials took several months and offered many opportunities to discuss and explore some examples of ICT-supported FL activities. So, Gianna's attitude gradually developed from a *this-is-pointless* attitude to an enthusiastic *ICT-fan-style* attitude. The initial new awareness that helped outweigh her skepticism was*: "ICT is something that you cannot ignore, it is here, and it might just be possible to do something with it."* The second key factor was the social environment of the school, particularly the micro environment among the three teachers in the study who built upon their existing open and helpful attitudes towards each other: *"The rapport between us also seems crucial to me as we helped and encouraged each other."*

Prior to the study Gianna had very limited experience and competence in using ICT in class. It was a first time for her designing tasks for FL learning in an online environment. The topic of the task was *Food and Health*. The tasks were partly well-designed, partly they were too challenging for the majority of the students, who reported that they prefer to learn in a traditional way. But they stressed that they learned new strategies for searching for sources that would help them to develop reading comprehension. Some students said that they needed to take notes in their notebooks in order to learn (clicking and writing on the computer does not help them learn), but there were also some students who stated that they learn better with a computer. This statement of one student of Italian reflects that ICT has not got its place in school yet: *"Too much language learning in online learning environments does not seem a good idea to me. The key goal of the language is to hear it and write the rules into a notebook. You remember more if you write than type."* (Podgoršek, 2016, p. 182). The female students mentioned that some male students were not taking the class seriously and were not mature enough for this kind of instruction. This corresponds to Gianna's observation that the majority of the girls in this class are mature, while the boys act childish. But, when they use computers, they work individually and can progress at their own pace; everybody is satisfied.

In terms of learning effectiveness, this case has not proved very successful despite the fact that the teacher received support in task design. However, it was the first step in a longer process indicating that the teachers needed more support to gain knowledge for creating tasks in collaboration with experts and colleagues at the school, and the students needed more opportunities to practice autonomous learning in online learning environments. On the other hand, Gianna's attitude towards ICT-supported FLI changed considerably enabling her a more productive approach to rethinking her methodological decisions in teaching.

Case B: Elena, the Teacher of Spanish

Elena has 15 years of teaching experience. Her initial ICT-competence was satisfactory ($\mu = 2.2$), she had used ICT in teaching more often than her two colleagues, but the diversity of her ICT use was low. She used ICT very often in class for presentations. Her students often used ICT in class for watching videos and listening to texts.

Elena's attitude towards ICT-supported FL instruction was positive during the duration of the case study. She believed in the potentials of ICT and was open to new ideas. However, she had a firm belief that computers should not have a central position in students' lives and that the generation she was teaching was more in favor of the paper and pencil approach. Quite some of her students confirmed her observation.

Similar to Gianna and Juliet, Elena had some experiences using Moodle, but not for designing TBLT. The topic of the task was *Press and the Media*. The students completed different activities such as quizzes and questionnaires to test reading comprehension and vocabulary. Elena also displayed the summary of the students' results and discussed them with the whole class. ICT was used to help the teacher to obtain instant feedback on student work, which was very positively evaluated by both the teacher and the students. The focus in this activity was shared, as the teacher played the central role partly, as did the students.

All three teachers expressed concerns about the technical problems, but Elena stressed her fears of using ICT in the class, of something not functioning, of losing much time over technical problems: *"It was crucial to me to lose fear of computers and that students learn using them, that was crucial, that this is also a way to learn something new."*

Case C: Juliet, the Teacher of French

Juliet was the youngest and, with six years teaching experience, the least experienced teacher. Her ICT-competence was good ($\mu = 2.5$), she had used different types of ICT occasionally, but not very often. She strongly disagreed with the idea of introducing a compulsory license for ICT-competence for teachers, which was being discussed at that time in Slovenia. Her two colleagues were indecisive concerning this issue.

Juliet's attitude towards ICT-supported FL instruction was neutral, she could not decide whether she could or could not imagine teaching without ICT in the future nor if the use of ICT had a positive effect on the quality of teaching. However, she said that she liked to try out new approaches and that she taught students how to use ICT for learning. In her opinion, the students were fond of ICT-supported instruction.

Juliet had had some experience in designing ICT-supported tasks and good ICT-competences. She had previously taken part in teacher training where she already went through one cycle of trying out this approach, reflecting and revising it, and trying again. Van den Branden (2016) argues that this gradual process of learning is crucial in developing teacher expertise. Juliet was able to build on this process, which resulted in very successful and effective teaching and learning. The topic of the task was *Let´s go on an Erasmus Exchange*. The students understood the goal of the task that was, in their opinion, tangible and productive: *"Yes, this is probably the most interesting thing for us, because there are two things. First, there are many different paths to achieve the goal the way we want, and this is already encouraging. Second, our goal is not something abstract, as in mathematics, but a real life one."* Students learned a lot, they discovered new facts about planning an Erasmus exchange exploring authentic websites, which was very motivating to them.

Her position in the participating class was specific since she was also the class teacher. She knew her students really very well, in her words the students had ´adopted´ her: *"They are adolescents, 15, 16 years old, they need a lot of attention. We work great together, we accomplish a lot, in another French class last year it was harder."* This rapport could be one of the reasons for her excellent selection of the task topic.

After describing the three cases, the research questions will be examined.

RQ1: Which Teacher Roles Were Observed or Reported?

According to the results of the quantitative analyses about the teacher´s role reported by Podgoršek, Istenič Starčič, & Kacjan (2019, pp. 181-182) the majority of the surveyed teachers believed that one major change of the teacher roles when using ICT is the use of different approaches to teaching. In our case study, a task-based approach was chosen. The teacher's role in all three cases was to enable learning in doing a task in an online environment. The idea was to use ICT to design meaningful tasks that could not have been accomplished without the technology, i.e. to facilitate technology-enabled learning (Ertmer & Ottenbreit-Leftwich, 2013).

Juliet, the French teacher, stated that her teacher role changed, ICT enabled her to prepare and design more diverse materials or to find already made materials on the web and offer them to the students in the online learning environment. In her opinion: *"The teacher is no longer in the exclusive role of a knowledge provider, but acts as a guide within a more complex process of student learning."* She also mentioned the role of materials designer that was predominant in the pre-teaching phase. During the task, all three teachers monitored, motivated and supported the students. The students noticed and appreciated this. The predominant role in the post-task phase was that of the language guide giving feedback on language issues. In the French case, the teacher delegated this task to the students who had to read and comment on the texts written by their peers. Students liked this very much because they could recognize some mistakes by themselves. They realized how much, in fact, they already knew about the language if they read texts carefully.

RQ2: To What Extent was There a Shift From Teacher to Student-Centered Instruction?

The shift from teacher to student-centred instruction was the major change in all three case studies. Teachers invested a lot of time and effort in preparing the tasks, thinking about how to motivate students and which resources to offer for supporting students' autonomous learning. During the classes all three teachers were available for students to consult them individually and to devote more time to the students who needed it. They did not have control over the process of learning, they had to trust students to work on their own. If a problem occurred that needed instant attention of the teacher, they addressed it and solved it by themselves or with the help of the students. The students were eager to help the teacher.

The analysis of the interviews with the students revealed basically two categories. One, a larger group, included the students who missed the guidance, structure, and precise step-by-step instructions. The second group was smaller; it consisted of students who loved and enjoyed autonomous learning with almost no need for the teacher.

First, the characteristics of the larger group will be discussed, that is the students who need more guidance. From the teacher's perspective, these were basically more manageable students who felt safe when they knew that the teacher had everything under control. The students said that they did not like the freedom, they did not feel good and that it is difficult to begin learning autonomously if you are not used to it. Some were confused by not having been told exactly what to do and in what order. As one French student said*: "We are in principle accustomed to learning from notebooks, notes, textbooks, and it is easier for me personally to write notes than to learn using a computer."* They also said that the problem may be that they do not know if they are on the right path, if they have solved the task correctly. Some students said that it was difficult to do everything on their own, but they were pleased to see that they succeeded. A Spanish student expressed this succinctly: *"Torment and great."* Some students did not seem to be mature enough for autonomous learning, their ability to concentrate was low, as one student of Spanish said: *"We do not know how to concentrate in order to solve the exercises on the Internet, we resist change."* This indicates the need for a gradual approach to ICT-supported learning, for both, the students and the teachers, as Juliet said: *"You suddenly let them go, they learn their own way, and you are terrified because they do not see your logic [...] I cannot follow their process in the way I usually do. I can conclude things from their behavior, I assume that they have found their own way."* From this statement, it is evident that teachers also needed time and teaching experience to implement a student-centered approach successfully.

The smaller group, the students who wanted to learn autonomously, liked to think independently. These students wanted to regulate the learning process themselves, but also they liked to have had a teacher nearby if they needed her. They were challenged to find their own way and not to have a *"one only correct solution"*, as one student said: *"Yes, I liked it very much, generally, because everything was relaxed, the topics were intriguing and time passed much faster than in our regular French lessons."*

RQ3: How Did the Relationship Between the Teacher and the Students Change?

In all three cases, an open and respectful relationship between the teacher and the students could be observed. Both teachers and students reported a more relaxed atmosphere in the ICT-supported class in which the students could have called the teacher without fear and asked for help, which was also evident in observing the lessons. On the other hand, the students had a better learning experience through personal contact with the teacher. Elena, the Spanish teacher, stated that personal contact between the teacher and the student is very important in enabling the teacher to respond to the students and to adapt the explanations and activities.

Teachers' support of individual students or pairs during the task had positively influenced their rapport. As one student said: *"Yes, it was just great yesterday, because the teacher was able to work with each pair individually."* What students also liked was the possibility to adjust the pace of learning: *"You do everything you need, but if it does not go as fast as it should, it's ok."*

The teachers and some students used emails and communicated in Moodle between the lessons. The reason was the homework that the students were sending to the teacher, which was more an exception than a rule since these students were not used to email communication with teachers. So, communication via email contributed to the organizational aspect of teaching but not to better contact with students.

RQ4: Did the Workload and Preparation Time for the Teachers Using ICT Increase?

According to all three teachers, the workload and preparation time increased considerably. The preparation included the design of task-based activities supported by technology. The preparation was very complex since the teachers had to deal with TBLT and ICT at the same time. TBLT must be well-designed and implemented to achieve its goal (Carter & Nunan, 2001, p. 210). In addition, both the teacher and the student need support and time to move from the transmission mode of teaching to student-centered learning (McDonough & Chaikitmongkolova, 2007).

In class, all three teachers gave oral instructions at the beginning of the class, and the tasks were accessible in Moodle. Again, this approach was used for the first time, so for this reason some instructions had to be repeated and clarified. Elena said that this was a process in which the teachers learned how to find the best approach, they discovered what motivates the students. ICT as a tool was motivating to some extent and the new approach had the typical novelty effect on motivation. The increased workload for the teachers was partly due to the fact that task-based ICT-supported instruction was new to the teachers and not solely because ICT was used. The issue of time and organization proved to be an important one also in the context of lesson organization. The biggest problem was inadequate infrastructure. The classes were equipped only with a computer for the teacher and a beamer. One solution was to book a computer classroom, which was not always possible due to the limited number of computer classrooms. The other solution was to bring laptops, mice, loudspeakers and headsets into the classroom. This was time-consuming and required a lot of organizational effort. This was one of the reasons that ICT-supported classes were so rare, according to the teachers. Problems with organization were also observed by students: *"Well, it seems to me that organization takes too long. To bring laptops, for example, takes at least five if not more minutes."* Elena mentioned that she sometimes allows students to use their smart phones during class. The Bring Your Own Device (BYOD) concept can be a good *ad hoc* solution but teachers should not rely on this. Elena´s statement also shows that mobile devices are not in the core of FL teaching which corroborates the findings of the meta study on the MALL by Burston (2014).

RQ5: Do the Teachers Need New Competences?

Here the answer is definitely yes. In-service teachers need additional training and permanent development of their ICT-competences in their school environment. Let us look at the specific results for our three teachers.

The teachers in our study initially had different ICT-competence levels. The Italian teacher had the lowest ICT-competence while the Spanish teacher had satisfactory and the French good ICT-competence. The three teachers´ use of ICT was quite similar in some ways: they used Internet for finding information and materials, occasionally used online classrooms, but on the other hand they did not produce interactive materials or perform tests or evaluations of student work via the Internet. The results correspond with the average ICT-competence of teachers in Slovenian grammar schools reported in Podgoršek (2015). An average teacher was able to integrate ICT into teaching but s/he had very limited competence for designing technology-enhanced FL learning. However, during the case study, all the teachers improved their ICT-competences. By far the biggest progress was seen in designing materials and planning, implementation and evaluation of the lessons. In the preparation phase, Gianna needed a lot of support in designing the task from the researcher, her colleagues, and ICT administrators at the school. It was very important for her to get a quick response in case of problems and uncertainties. Elena did not need as much support but it was also crucial for her to have someone to ask for advice or help instantly; the exchange with her colleagues was extremely valuable to her as well. Juliet had good ICT-competence and did not need much support, she did not mention the need for a stimulating environment, nor did technical issues seem relevant to her. Her dilemmas were different - she needed more knowledge and skills for designing complex tasks. She said that this is a very slow and time-consuming process for which the teachers do not have time. As Elena also said, if teachers do not have certain skills, it is difficult to learn them because at the school level there is no on demand training for teachers. However, all three teachers had a positive experience with the students, who were more than pleased to offer them help with technical issues.

DISCUSSION

The study explored the teacher's role in ICT-supported instruction. The data was gained from three different sources: (1) teachers; (2) students; and (3) the researcher-observer through interviews and observation. The combination of different methods enabled a deeper and more holistic understanding of the studied phenomenon.

Qualitative data has revealed that the teacher´s role changed considerably in Case C and to some extent in Cases A and B. The most significant change was observed in the French class, where the students learned autonomously, they were motivated and recognized an authentic goal for their learning. The main characteristics of the French teacher are a realistic attitude towards the use of ICT in teaching and good ICT-competence with the ability to design meaningful tasks in an online environment.

The findings on the nature of the change in the teacher´s role will be discussed with regard to the initial five categories of change identified by Podgoršek (2016).

Extending approaches to teaching and methods of teaching: The methodological approach used was task-based language teaching. The most difficult goal for the teachers was to facilitate different paths to knowledge. Only in Case C this goal was achieved and also observed by the students. In Case A, the tasks were partly too challenging for the students, so it was hard to motivate them in their learning process.

Shifting the focus to student-centered instruction: The shift from teacher to student-centered instruction was the major change in all three case studies. The teachers tried to facilitate students' autonomous learning in an online environment. They had to trust students to work on their own, which proved to be a challenge for both students and teachers. The results show that the first steps in developing student autonomy were taken. Two groups of students were detected, one fond of their new, active and autonomous role, the other, bigger group, not approving. The distribution of students in the two groups should be interpreted with the knowledge of the limited duration of the study, in which radical development of autonomous learning was not possible, since such development takes more time and of course also depends on the individual's starting point. Two types of factors that inhibit the development of autonomy were identified: affective (the students did not feel secure) and metacognitive (it is easier to follow the teacher than to assume the responsibility for themselves).

A changed relationship between the teacher and the students: The relationship between the teachers and the students in class was very positive. The atmosphere was relaxed and the students asked for individual help, which was reported as very helpful and motivating. On the other hand, both the students and the teachers appreciated personal contact very highly and warned against too much technology in teaching.

Increased workload and preparation time for teachers using ICT: All three teachers reported that the workload and preparation time for teachers increased significantly. This was not only due to the technology but also to the fact that they had to deal with TBLT and ICT at the same time. The study also shows a necessity to test the assumption that the required infrastructure is readily available.

The need for new teacher competences: The teachers in our study needed additional training and constant support in their school environment. They adopted a teacher-learner role in the research process. This approach enabled an empirical insight into the reflective model of learning and teaching (Wallace, 1999), which seems to be a very fruitful model for integrating ICT into teaching. The teacher role is subject to permanent change and teachers should therefore be ready to learn and reflect on their own roles continually, as Krumm states (2003). In Slovenia, new technologies have not changed the teaching paradigm yet (Krašna, 2015). The findings of our study indicate some change in the paradigm of teaching, but there is still a lot of work to be done. This change can only be successful if teachers get active system support both on the school and state level. Their ICT-competence does not depend only on the individual teacher, their desire, readiness and ability to learn in this field. An enthusiastic teacher can give up if s/he does not have a supportive environment, the support of school management, a person to turn to in case of technical and methodological issues, and last but not least the possibility of continuing professional development at both the school and national level in the form of tailor-made trainings for FL teachers. The teachers in our study embraced the potentials of ICT on the one hand, but on the other hand they also discovered its limitations.

FUTURE RESEARCH DIRECTIONS

The multiple-case study focused on examining the role of teachers in mastering ICT in foreign language instruction in a micro environment of the grammar school. The limitation of this study is that only one research cycle in each class was conducted. As Van den Branden stresses (2016), implementation of a novelty is a process of learning. It would be therefore advisable for future research to conduct a long-term study with more focus on student learning. More research is also required regarding the approaches to in-service teacher training in ICT-supported FL instruction.

CONCLUSION

The study aimed to explore the categories of change of the teacher role identified by Podgoršek (2016). The results presented have shown that the teachers in our multiple-case study experienced similar changes, i.e. the focus shifted from teacher to student-centred instruction, the relationship between the teachers and the students was more relaxed than in a usual class, the teacher´s workload and preparation time increased and they needed to develop their ICT-competence. Different levels of learning effectiveness in the examined cases can be attributed to the factors connected to the teachers, students, and school environment.

Designing tasks in motivating online learning environments, with clear, authentic learning goals and at the appropriate level of students' language proficiency proved to be the most challenging role in our case studies.

The study also offers an insight into the students' perspectives on ICT-supported FL learning. It can be concluded that the majority of the students in Cases A and B preferred traditional to ICT-supported teaching. They were not used to taking responsibility for their learning and many of them did not really know how to use technology for learning. This does seem to be something that can be generalized to larger contexts, at least in Slovenia. However, in Case C the majority of the students enjoyed learning autonomously and quite some students expressed their satisfaction with having the chance to be in charge of their own learning.

The findings of the study can be summarized in the following recommendations for school authorities and policymakers concerning teachers and students: teachers should have access to continuing support in developing their ICT-competence as well as more time at the beginning of this process, and access to best practice. The infrastructure available should be adjusted to their needs and should be accessible. Students also need support in developing autonomous learning and in learning how to use ICT for FL.

Good teaching is not only about technology nor the teacher´s role. As seen in the three cases, the shift in the teaching as well as in the learning paradigm is a gradual and challenging process that should be carefully planed and supported over a longer period of time.

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ENDNOTE

[1] The evaluation of the teachers' ICT-competences consisted of 17 items rated on a four-point scale ranging as follows: 1 (no competence), 2 (satisfactory), 3 (good), and 4 (very good competence) (Podgoršek 2016, p. 96).

Chapter 19
Teacher Technology Education for Spatial Learning in Digital Immersive Virtual Environments

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ABSTRACT

The aim of this research is to deepen how teacher technology education can be designed to enhance spatial education, which is intertwined with digital education. The evolution of technology resources can actually sustain spatial learning. In the last years, the user experience has been improved by open-source, collaborative user-generated, and immersive content of synthetic learning environments. This research analyses which spatial design principles have influenced the virtual worlds of digital immersive virtual learning environments. In 3D virtual learning environments spatial interaction is really developed and may open full accessibility to further studies on digital and spatial education. In the joined field of learning and ICT, the main scope of digital technology knowledge sharing, and re-shaping, is the enhancement of digital skills based on experiences in educational activities and the re-thinking of the nature and the format of educational curriculum to implement more experiences in the digital—and, possibly, spatial—fields.

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"*Those who would like to see ICT transform the nature of education are still waiting for the long-promised radical shift."*— Roschelle Means

INTRODUCTION

Pedagogical information and communication technology (ICT) competence – the teachers' ability to appropriately use technological tools in related curriculum contexts – is nowadays crucial to support educational change by leveraging ICT as a developmental booster for students' cognitive systems. Teachers' knowledge and skills are required according to the learning goals foreseen by different curricula, which may vary from just using technology to enhance students' learning to the idea of starting up advanced models of ICT integration. The main shift is represented by providing customized and personalized learning for students through technological approaches and, at the same time, setting up communities of learners involved in knowledge building processes to face with real-world problems (Law, 2010).

Teachers' knowledge, related to technology resources, has been categorized in different kinds (Hinostroza, Labbé, López, 2010) (see Table 1):

- kind *know-what* – which refers to content matter knowledge, pedagogical knowledge and methodologies, knowledge of curriculum, learners' characteristics, educational contexts, and knowledge of educational purposes;
- nature *what-knowledge* – which can be divided in formal and informal knowledge, respectively gained by university studies and by learning from personal and shared experience;
- level *know-how* – which focuses on teachers' expertise development in coping with practical situations, skill acquisition in facing up under pressure routine procedures, and competence to plan ahead;
- in practice *how-to* – which means learning to carry on management and support routines, and exchange routines with colleagues.

For each one of these types of knowledge, a specific foreseen technological approach is suggested (Hinostroza, Labbé, López, 2010):

Table 1. Taxonomy of teachers' knowledge (Hinostroza, Labbé, López, 2010: 223).

Kind (know-what)	*Nature (what knowledge)*	*Level (know-how)*	*Practice (how-to)*
Content	Formal vs. Informal	Novice	Management routines
Pedagogical content	Intuitive vs. analytical	Advanced beginner	Support routines
Curriculum		Competent	Exchange routines
Pedagogy		Proficient	
Learners		Expert	
Educational contexts			
Educational aims, purposes, and values			

- kind *know-what* – useful ICT may be productivity tools and digital content resources to support teachers' knowledge building;
- nature *what-knowledge* – needed ICT are intended to enhance shared and distributed cognition, such as wikis, blogs, and social bookmarking;
- level *know-how* – basic ICT should sustain communication throughout teachers' learning community, co-creating virtual learning communities, using learning management systems, and sharing information through social networks, immediate response systems, and image sites;
- in practice *how-to* – interactive ICT for exploring can be considered virtual learning environments (VLE) and virtual worlds.

Technology resources, in themselves, cannot be seen as a booster of change, just because each technological approach could collaborate to update traditional didactics. The difference between only using technology and vice versa innovating by technology is given by the educational design underlying any learning environment. Indeed, only a specific pedagogical approach may really support a dynamic process of change.

Educational technological change should then imply the re-shaping and/or the co-construction of learning models, from a theoretical and methodological point of view; the analysis of teachers' and students' learning needs; and the specific role played by ICT in situation, in continuous interaction with teachers' competences in narrowing students to innovation.

The Technological Pedagogical Content Knowledge (TPCK) approach (Mishra, Koehler, 2006) focuses for instance on teachers' knowledge required to teach with technology. Teachers need to master how technology, pedagogic, and content knowledge interact with one another and how these aspects develop a kind of knowledge which goes beyond three separate knowledge bases. Technological Knowledge (TK) involves learning how to use technologies in educational contexts, while Content Knowledge (CK) refers to the different subject matter of the various disciplines. Pedagogical Knowledge (PK) implies the management of teaching methodologies based on educational views.

Melting together these three kinds of knowledge, Technological Content Knowledge (TCK) emerges linking technology and content, Technological Pedagogical Knowledge (TPK) focuses on the relationship between technology and pedagogy, and finally Technological Pedagogical Content Knowledge (TPACK) synthesizes how technology can be applied to teach specific disciplinary content through educational approaches. The intertwined relationship between technology, content, and pedagogy can leverage – as a holistic result – innovative and cohesive solutions to teaching and learning, so encouraging teachers to be designers of their own learning environments (Koehler, Mishra, 2008).

In this paper, innovation within teacher technology education is seen in relation to students' digital education intertwined with spatial education. The evolution of educational technology resources has indeed developed ground-breaking shifts in the joined field of learning and ICT, but it needs to be oriented by educational design to produce relevant changes in learning. Research on implementation of ICT in schools has indeed found that teachers' training on specific learning activities – about open-source and collaborative, user-generated content; in immersive, multi-user environments – may enhance the development of meaningful learning activities sustained by technology (Means, Roschelle, 2010).

Actual and Experimental Teaching and Learning Models Meet Spatial Education

According to the recent 'spatial turn' (Warf, Arias, 2008; Newcombe, Frick, 2010; Montello, Grossner, Janelle, 2014), digital education has met the neglected area of spatial thinking (Hawes, LeFevre, Xu, Bruce, 2015) through spatial education for teaching and learning (Boniello, Paris, Santoianni, 2017; Santoianni, Ciasullo, 2018a, 2018b) to empower spatial learning and spatial skills[1], as spatial perception, mental rotation, and spatial visualization (Toptaş, Çelik, Karaca, 2012), and to enhance the intertwining of logical reasoning and spatial and verbal skills (Santoianni, 2016a).

In the last years, the user experience has been improved in educational settings starting from open-source, collaborative user-generated, multimedia/hypermedia architectures to immersive synthetic learning environments. How digital education has been intertwined with spatial education throughout the evolution of technology resources and which spatial design principles have influenced the synthetic environments of virtual worlds is to be focused.

3D virtual learning environments contribute to reduce environmental complexity by immersing the learner within the overall elements of the surrounding web-based reality through interactivity levels of spatial simulation which involve and support the learner (Ranchhod, Gurău, Loukis, Trivedi, 2014). The organizational development of a 3D virtual learning environment simulates indeed interactions between users and environment. Even if 3D virtual learning environments can also be accessed with a conventional workstation and may be literally non-immersive – that is, "a computer-based environment that can simulate places in the real or imagined worlds" and do not necessarily give to the user the perception of being really physically present in a non-physical world (Freina, Ott, 2015) – we can refer, anyway, to a broader interpretation of the concept of immersion.

In a more general sense, immersion means in fact to be involved in an environment and this implies lack of awareness of time and of the real world (Jennett, Cox, Cairns, Dhoparee, Epps, Tijs, Walton, 2008). Anyway, any virtual learning environment which may sustain "structural coupling" (Riegler, 2002) – the process through which adaptation is bilateral, implying restructuring actions from both sides, the flexibility of the user's approach and the intentional self-modifiability of the educational environment – may be considered immersive. This is because the reciprocal adaptation between the user and the environment can be seen as immersive in itself, since it implies a holistic understanding of the human system, which allows the mental, organismic, and environmental intertwining (Gottlieb, 1996; Lerner, 1998). The three basic principles of virtual reality are in fact immersion, interaction, and user involvement.

In 3D virtual learning environments, knowledge structures development is enhanced by experiential simulation in immersive contexts. Experiential simulations range from real phenomena simplified to enhance understanding[2] – virtual reality gives users the chance to experiment situations otherwise bounded by limits of time, physical inaccessibility, danger, or ethic (Freina, Ott, 2015) – to synthetic environments with immersion interfaces in virtual worlds, which may allow both a single learning experience or a multiple interaction in a distributed virtual environment (Dede, 1996). Although post-cognitivist models have been basilar for updating digital education through virtual learning communities, 3D virtual learning environments may represent a way to rethink education through advanced experimental methods of teaching and learning, mainly based on distributed, situated, and embodied knowledge.

Knowledge construction in multimedia/hypermedia is mainly empowered by constructivist and learning-by-doing pedagogical approaches, while computer-supported collaborative learning is enhanced by virtual communities, in which "groupware" tools encourage group dialogue and team performance (Dede, 1996). Web 2.0[3] educational approaches allow users' collective activities of interaction in social media dialogue, close cooperation and shared responsibility. Knowledge is distributed and situated according to the post-cognitivist framework (Lave, Wenger, 1991; Olson, Torrance, 1996; Kirshner, Whitson, 1997; Clancey, 1997; Wenger, McDermott, Snyder, 2002), in which each learner co-constructs and negotiates user-generated content within the virtual learning community through peer tutoring and teachers as facilitators, as in the Knowledge Forum software environment, designed for knowledge building and theories development (Scardamalia, Bereiter, 2006).

Collaborative learning is a term that identifies any kind of group learning in which exist meaningful horizontal learning interactions; if it mainly takes place in a virtual environment, it is named 'collaborative e-learning' (Bouras, Triantafillou, Tsiatsos, 2002). Web based collaborative learning approach implies significant advantages in terms of students' collective participation and individual involvement, interaction, motivation, and self-reflection. Collaborative e-learning develops a sense of belonging to a learning community which is missing in individual on-line learning methods and can be experienced at different levels of interaction.

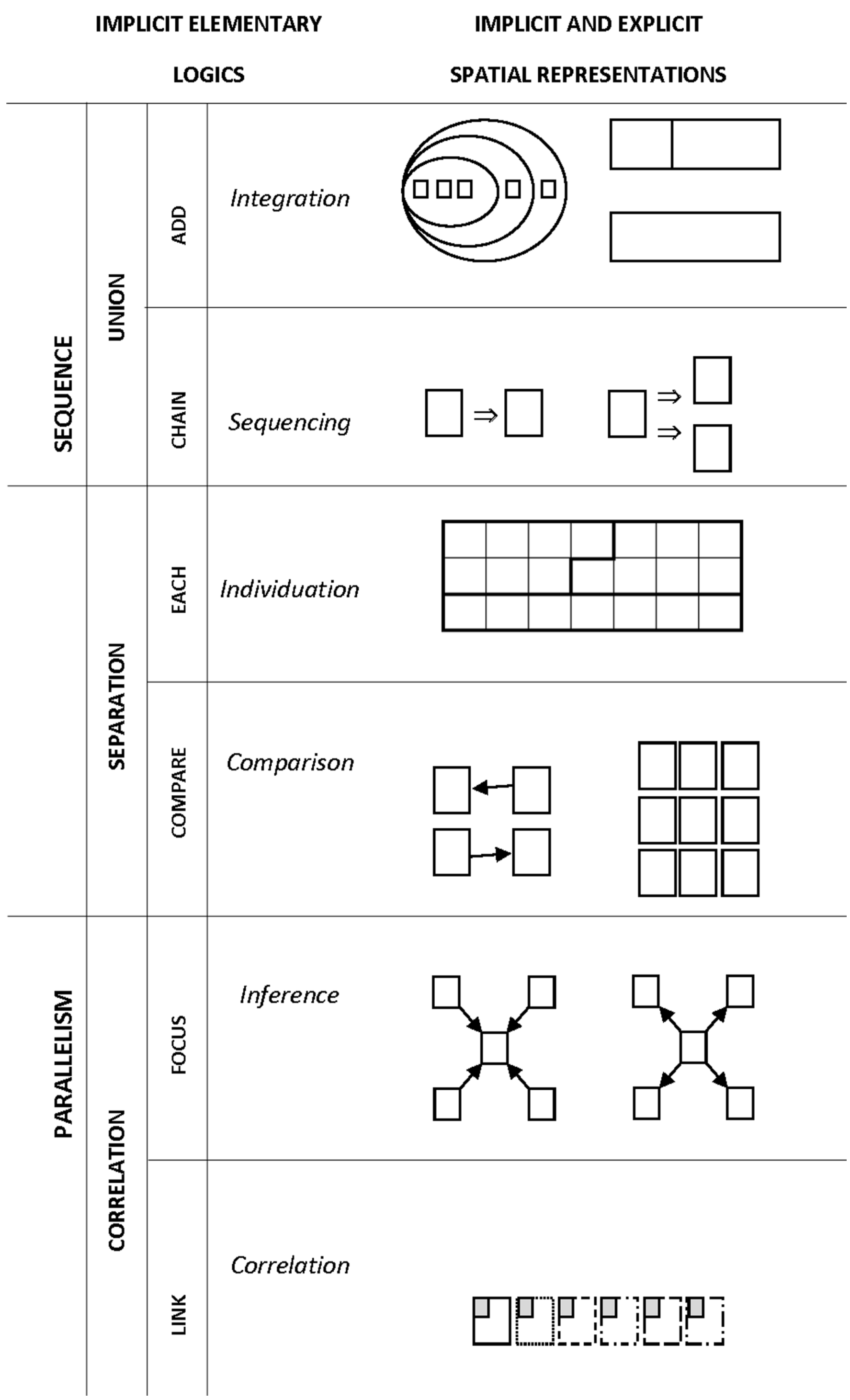
In virtual knowledge communities any collaborative learning is enhanced by implicitly/explicitly related design architectures of virtual knowledge spaces. Educational challenge lives nowadays on the re-thinking of learning as an adaptive process (Santoianni, 2007) in spatial environments, which educational design can be thought both for learners and spaces modifiability (Barajas, Owen 2000; Bates, 2005; Dobre, Haiaianu, 2016). Spatial interaction is better developed in immersive 3D virtual learning environments, which offer a joining of the web's fragmentation through a three-dimensional spatial organization of content, while various websites are instead bi-dimensional and not always in connection with each other (Sidorko, 2009; Chen, Cheng, Chew, 2016).

Spatial Design of a 3D Virtual Learning Environment: Federico 3DSU

Experimental models of education (Santoianni, 2010) address 3D virtual learning environments design, as in the case of Federico 3DSU (Santoianni, Ciasullo, De Paolis, Nunziante, Romano, 2018), a multi-user virtual environment which implement the Department of Humanities of the University of Naples Federico II as a 3D University model. The main characteristic of this innovative virtual environment is that it is spatially designed with the Elementary Logic theory (Santoianni, 2011, 2014a, 2014b). According to this theory, spatial knowledge plays a key role in the possible hypothesized relationship between implicit and explicit levels. The implicit may indeed operate as a default level to be activated on demand in a continuous cognitive collaboration with the explicit. Elementary logics are interpreted as patterns of connection between these two levels, which can be expressed by spatial representations.

The spatial relational organization of concepts – developed in 2D research on how space may influence concepts comprehension and conceptual reasoning (Santoianni, 2016a, 2016b) – is based here on the main idea that knowledge prototypes of spatial processing may be systematized in three classes – union, separation, and correlation. In the figure below (Figure. 1), differences among the three classes are shown.

Figure 1. Spatial representations of elementary logics (Santoianni, 2016a).



The class of union is subdivided in two functions: integration and sequencing. The primary implicit logical relationships which underlie this class are the integration and sequencing of conceptual units. The class of separation is instead subdivided in other two functions: individuation and comparison. The primary implicit logical relationships which underlie this class are the identification and the comparison of conceptual units. At last, the class of correlation is subdivided in two functions: inference and correlation. The primary implicit logical relationships which underlie this class are the derivation of conceptual units from each other and the correlation between several conceptual units (Santoianni, 2011, 2014b).

Federico 3DSU is based on the idea that the spatial structure of a learning environment may influence students' performance (Belingard, Péruch, 2000). Its spaces of exploration are indeed mainly structured following a specific architectural design which reflects the inference logic model of the Elementary Logic theory (Fig. 2). As can be seen in Figure 2, the architectural design of Federico 3DSU is based on a simple inferential scheme which focuses on four key points – the corners (A, B, C, D) of the squared shape of the central courtyard of Department of Humanities of the University of Naples Federico II – which all converge towards a central meeting point. Each corner hosts a related building: Welcome Area, Adaptive Teaching and Learning Area, Digital Humanities Project Area, and Campus Meeting Area.

Other elementary logics are introduced and implemented in the 3D virtual learning environment (Figure. 3), so triggering cognitive flexibility (Barak, Levenberg, 2016) of students, which interact with the digital learning environment in relation to both personal patterns and the structure of the environment itself.

Figure 2. Federico 3DSU spatial structure of inference elementary logic

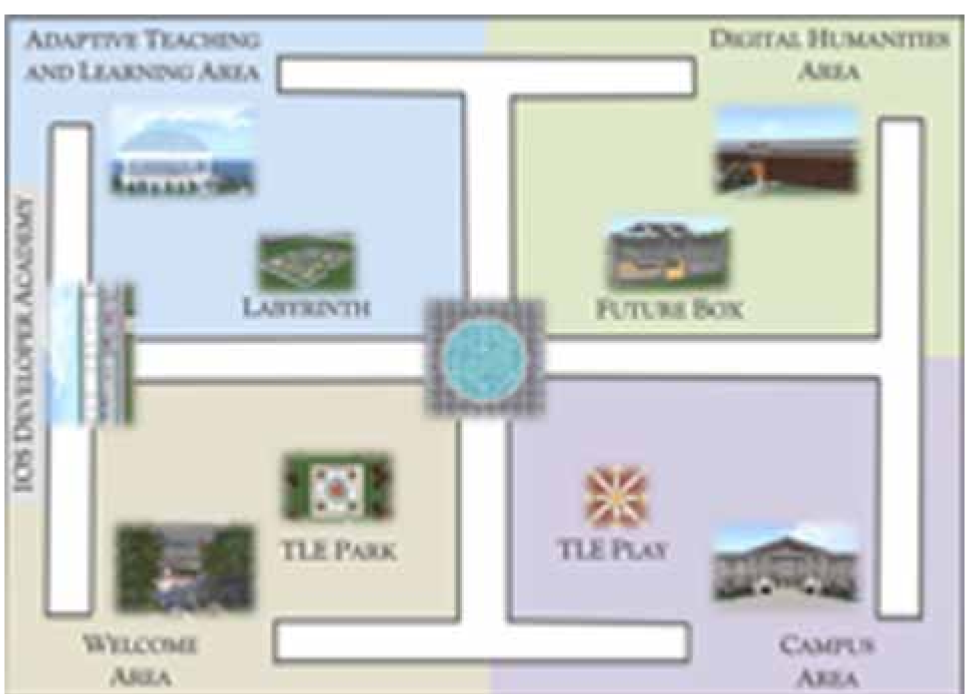


Figure 3. Elementary logics park in Federico 3DSU.

According to Elementary Logic theory, spatial knowledge has been also used for information content organization in Federico 3DSU design. Finding specific objects within a rich environment is usually guided by the features of the objects and by our memory of the visual environment characteristics. But the spatial organization of objects in a visual environment, if held constant, may guide visual attention – according to a recognized effect called "contextual cueing" (Chun, Jiang, 1998). Contextual cueing effect may anyway be influenced by active search strategies, which can interfere with the guidance mechanisms (LLeras, Von Mühlenen, 2004), so it is important to notice that implicitly learned contextual information may not always automatically guide spatial attention.

Moreover, according to research on spatial navigation (McNamara, Sluzenski, Rump, 2008), the environmental shape is highly significant for space exploration (Cheng, Newcombe, 2005) and there is experimental evidence that learners are sensitive to environmental geometry in new learning contexts (Shelton, McNamara, 2001; Schmidt, Lee, 2006).

Spatial Navigation in 3D Virtual Learning Environments

Spatial navigation is influenced by micro-genesis of spatial knowledge, that is the process of the acquisition of spatial knowledge in a new environment (McNamara, Sluzenski, Rump, 2008). Spatial navigation research should be taken into consideration in 3D virtual learning environments design because it is of great interest for their own digital organization and, as a consequence, for digital and spatial intertwining in education.

The theory of Micro-genesis of Spatial Knowledge (Siegel, White, 1975) states that the learner acquires first the acknowledgment of landmarks and then the routes between landmarks. Landmark knowledge is a declarative form of spatial knowledge, akin to topological concepts, which associates knowledge of discrete places/objects to the linked information (Santoianni, 2016a; Boniello, Paris, Santoianni, 2017). Spatial development consists of decisions and actions related to sequences of landmarks, as the computation of the steps needed to reach the next landmark on a route, without necessarily acknowledge distance, timing, and path variations as turning corners, which will be gradually acquired by experience (Siegel, White, 1975). Even if the procedural processing of route knowledge is initially nonmetric in early acquisition of landmarks, through experience route knowledge can acquire spatial properties.

Route knowledge consists of discrete chunks of procedural descriptions related to sequential records of landmarks (McNamara, Sluzenski, Rump, 2008). To get from one point to another (Thorndyke, Hayes-Roth, 1982; Taylor, Tversky, 1992), the learner represents, in a projective way, sequential itineraries of locations (Hirtle, Hudson, 1991) – so creating a kind of personal spatial knowledge which allows the development of internal cognitive maps of exploration, as a first-person, embodied, terrain level perspective, mental tour (Hund, 2014). Route knowledge is indeed acquired through direct navigation; it can be defined with the term ‘featural’ and relies more on verbal/propositional knowledge (Fiore, Schooler, 2002) than survey knowledge.

Route knowledge represents sequential locations rather than to determine the locations of objects within a general common frame of reference. Survey knowledge is instead the overall configuration of an environment (Siegel, White, 1975) and it gives a holistic representation of the location of objects (Taylor, Tversky, 1992), which has been indeed termed ‘configural’. In survey knowledge, the reference system of spatial relations is developed even if the learner has never visited the locations (McNamara, Sluzenski, Rump, 2008). It resembles then a cognitive map (Tolman, 1948), a “map in the head” (Kuipers, 1982), because it consists of global map-like representations of the location of discrete or linked objects within a fixed coordinate system (Tversky, 1991).

Survey knowledge is considered less verbal than route knowledge (Fiore, Schooler, 2002); it is composed of both declarative and procedural knowledge and it is more closely associated with abstract frames of reference (Boniello, Paris, Santoianni, 2017), as a disembodied, third-person view from the environment (Hund, 2014). While route perspective may link the events of visiting sequential locations in time – so imposing a temporal order to stationary spatial relations (Tversky, 2004) – in survey perspective links between locations are only spatial and not temporal. Survey perspective requires complex frames of reference to be developed – it is seen as derived from accumulated route knowledge (Thorndyke, Hayes-Roth, 1982) – and it needs a great deal of experience to be implemented.

Although the theory of Micro-genesis of Spatial Knowledge (Siegel, White, 1975) is still highly influential, it has been discussed by empirical studies (Ishikawa, Montello, 2006), which validated the theoretical distinction between route and survey knowledge but noticed that landmark and route knowledge were acquired almost at the same time and few participants gained survey knowledge. Moreover, unexplained individual differences were observed. According to Montello’s theoretical framework (Montello, 1998), the process of acquiring spatial knowledge is not qualitatively distinct but instead it is due to incremental accumulation of metric knowledge.

The theory of Montello (1998) acknowledges the significance of knowledge integration in spatial knowledge acquisition. Moreover, Taylor and Tversky (1996) evidenced that learners use mixed perspectives as a natural way of interacting with an environment and they showed that gaze, route, and survey perspectives may respectively correspond to prototypic relative, intrinsic, and extrinsic frames of reference. Gaze perspective is considered a hybrid because spatial relations are both related to a viewer – as in route perspective – and to a static position, which generates a constant point of view – as in survey perspective. Gaze perspective describe landmarks from the stationary spatial orientation of the viewer (Tversky, 2004).

Configuration of an environment affects perspective choice (Taylor, Tversky, 1996) and – even if isomorphisms between physical and mental dimension are not to be pursued (McNamara, Sluzenski, Rump, 2008) – it is to be highlighted that spatial knowledge may play a significant role in knowledge management (Santoianni, 2016a). This could be particularly true as concerns knowledge management and information organization in digital education, in particular in 3D virtual learning environments design, which may infer significant design criteria from spatial knowledge research about learners' perspectives of space interaction. The design key of *immersion* of virtual reality implies indeed to focus attention on spatial knowledge research to infer methodological criteria of content fruition for spatial education and it may instead sustain a sort of isomorphisms between geographical and virtual explorations.

The evolution of technology resources supports then the hypothesis of a continuous intertwining between digital and spatial education. In collaborative user-generated content technology, visual presentation facilitates learning co-construction and spaces are intended as synchronous and asynchronous virtual knowledge spaces of communication. Actual research focuses on spatial knowledge and interaction in 3D virtual learning environments, which may open full accessibility to further studies.

Digital and Spatial Interactive and Interaction Skills

All these intertwined research trends in digital and spatial education may be all seen as issues related to educational activities based on experiential learning. Experience is a basic interpretative key for enhancing digital and spatial skills in educational contexts. Digital experience is nowadays fully opened by low-cost digital tools and web worldwide access, which gives to everyone the chance to have customized experiences of expressing her/himself through personalized publishing and broadcasting. Moreover, computer-mediated communication allows a whole communication in synchronous or asynchronous ways and supports teacher-learners and learner-learner interactions through collaborative and cooperative learning.

In the joined field of learning and ICT, the main scope of digital technology knowledge sharing, and re-shaping, is the enhancement of digital skills based on experiences in educational activities and the re-thinking of the nature and the format of educational curriculum to implement more experiences in the digital – and, possibly, spatial[4] – fields.

Digital skills have been divided (Van Deursen, Van Dijk, 2014) in:

- *medium* related skills, i.e. 1. the operational technical skills which allow users to decode and cope with digital world, and 2. the formal skills which regulate the processing of browsing and navigating;
- *content* related skills, i.e. 1. the information skills needed for searching, selecting, and evaluating digital information, 2. the communication skills (mainly on the web), 3. the content creation skills which guide users in generating content, and 4. the strategic skills which are the competences of using digital for personal aims.

Skills development and individual motivation may influence digital usage in an active way. In particular, digital and spatial interaction may promote the gaining of experience in medium related skills as concerns the spatial processing of choices involved in browsing and navigating. It may also improve content related skills, mainly as regards the competencies – skills plus knowledge – of generating content and orienting it for individual purposes. Spatial experience is indeed a key factor in knowledge content creation and in the related processes of tailoring it – a hypothesis of its significance in knowledge creation may be related to spatial experience, which has a phylogenetic matrix fully involved in all prototypical processes of knowledge development (Santoianni, 2011).

The implementation of digital and spatial educational technology resources may sustain both core skills of learners and content *interactivity* and of interpersonal *interaction* in multimedia/hypermedia architectures and in virtual learning environments (Zhao, Zhang, Lai, 2010). While traditional curriculum is often pre-packaged and teacher-centered, through digital interactivity it's possible for students to customize curriculum through personal choices, so becoming co-designers of their own curriculum. Interactivity triggers the development of user-generated content – i.e., the choice of web links for learning support and the logical order through which the learner clicks and reads; the way in which students manage e-textbooks or carry on search engines and use databases to seek information, … – and encourage the empowerment of skills in digital and spatial fields, and in individual and collaborative contexts.

Interaction skills are instead mainly oriented to share knowledge within learning communities. Even if there are different interpretations of knowledge communities, they are characterized by several joining aspects which may affect their own technological shape and related skills development, as the fact that community members with different expertise can develop shared knowledge, can metaknowledge about learning and creation processes, and foster theories, ideas, and concepts improvement, in particular in Fostering Communities of Learners (FCL) and in Knowledge Building (KB) approaches (Slotta, Najafi, 2010).

According to the Digital Competence Framework 2.0 (Vuorikari, Punie, Carretero Gomez, Van Den Brande, 2016), the key components of digital competence are related to *Information and data literacy*, *Communication and collaboration*, *Digital content creation*, *Safety*, and *Problem solving*. In relation to spatial education, in particular the area of information and data literacy should be activated as concerns the competence of locate and retrieve digital data, information and content, and to store, manage, and organize them. The communication and collaboration area will be solicited by the increased possibility to achieve participatory citizenship through facilitated access to public and private digital services within spatially organized 3D virtual learning environments. Finally, the problem-solving area of competence could be enhanced by the chance to solve conceptual problems and problem situations in spatial digital environments. Spatiality may also contribute to the use of digital tools to innovate processes and products and to keep learners up-to-date with the digital evolution.

Digital and Spatial Educational Curriculum

Re-shaping curriculum means enriching it with various mixed resources, so empowering its flexibility and making new learning content always available for students; enhancing learners' control more than teachers' or developers' one.

Teachers – from a digital point of view – gain the possibility to easily consult online curriculum standards, to be assisted in planning lessons through digital templates, to refer to online exemplary lesson plans, to get involved in local events and to use more audio/visual and interactive learning materials (Zhao, Zhang, Lai, 2010). From a spatial point of view, it means first considering the spatial expression as an ineludible starting point in any situation which involves a learning activity of any kind. According to Elementary Logic theory, the spatial dimension may in fact represent a ubiquitous linking node between the continuous cognitively present implicit and explicit synergies (Santoianni, 2014b). Then, it should be taken into consideration the chance to re-formulate lesson plans by re-organizing them in relation to logical orders of content spatial disposition, as in Elementary Logic maps (Santoianni, 2014a, 2016b). More in general, the spatial dimension and its learning criteria – such as the ones explained in the theory of Micro-genesis of Spatial Knowledge (Siegel, White, 1975) but also in Elementary Logic theory – may guide the educational design of any learning environment, both in physical presence and in 2D/3D virtual dimensions.

In conclusion, technology education allows teachers to become competent users of ICTs, to make use of them as a tool for teaching, and to relate to them as an emerging mind tool (Kirschner, Davis, 2003; Davis, 2010).

For students, the re-shaping of curriculum means the challenge of digital content accessibility via electronic books instead than printed materials or supplementary digital materials linked to print-based books. E-textbooks so have become the more common digital resources for students' curriculum, which trigger various different levels and degrees of interactivity. Curriculum delivered with digital technology is moreover enhanced by productivity and presentation, drill and practice, tutorial and simulation educational software and educational games. Effectiveness of educational software is however controversial because it depends both on software design and users' characteristics (Zhao, Zhang, Lai, 2010). Students may also benefit from online learning systems and online courses as MOOCs or from 3D immersive online virtual learning environments. In all these cases, the spatial design which may underlie each of these digital resources and their related advanced organizers – e-textbooks, educational software, educational games, online learning systems and courses, 3D virtual learning environments – could effectively enhance their potential of knowledge expression, so representing a real chance of a ground-breaking pedagogical shifts in the joined field of learning and ICT, but more research is still needed in the innovative field of digital and spatial intertwining.

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ENDNOTES

1. Spatial skills imply the representation of space and the role of spatial-graphic representations in spatial thinking (Liben, 2005) and declarative/procedural knowledge of space (Liben, 2006).
2. 3D virtual learning environments sustain visual presentation by enhancing students' fruition of simulated 'what-if' scenarios to improve experience and learning in 3D visualizations. 3D visualizations involve three spatial abilities, that is spatial perception – i.e. the ability to individuate spatial relations referring to user's body; mental rotation – i.e. the two- and three-dimensional ability to imagine shapes rotated into a new orientation; and spatial visualization – i.e. the spatial tasks involved in strategy selection (Toptaş, Çelik, Karaca, 2012).
3. The term was coined to cover the second-generation of web sites, characterized by dynamic content shared and modifiable by multiple users.
4. Multimedia presentation of curriculum may redefine its content by introducing the use of nonverbal language through the chance visual expression of information, which contributes to support communication and social interaction.

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