Educational Communications and Technology: Issues and Innovations

Linda Daniela *Editor*

Inclusive Digital Education

ASSOCIATION FOR EDUCATIONAL COMMUNICATIONS & TECHNOLOGY

Springer

Educational Communications and Technology: Issues and Innovations

This book series, published collaboratively between the AECT (Association for Educational Communications and Technology) and Springer, represents the best and most cutting edge research in the field of educational communications and technology. The mission of the series is to document scholarship and best practices in the creation, use, and management of technologies for effective teaching and learning in a wide range of settings. The publication goal is the rapid dissemination of the latest and best research and development findings in the broad area of educational information science and technology. As such, the volumes will be representative of the latest research findings and developments in the field. Volumes will be published on a variety of topics, including:

- Learning Analytics
- Distance Education
- Mobile Learning Technologies
- Formative Feedback for Complex Learning
- Personalized Learning and Instruction
- Instructional Design
- Virtual tutoring

Additionally, the series will publish the bi-annual AECT symposium volumes, the Educational Media and Technology Yearbooks, and the extremely prestigious and well known, Handbook of Research on Educational Communications and Technology. Currently in its 4th volume, this large and well respected Handbook will serve as an anchor for the series and a completely updated version is anticipated to publish once every 5 years. The intended audience for Educational Communications and Technology: Issues and Innovations is researchers, graduate students and professional practitioners working in the general area of educational information science and technology; this includes but is not limited to academics in colleges of education and information studies, educational researchers, instructional designers, media specialists, teachers, technology coordinators and integrators, and training professionals.

Linda Daniela
Editor

Inclusive Digital Education

Springer

AECT
ASSOCIATION FOR
EDUCATIONAL
COMMUNICATIONS &
TECHNOLOGY

Editor
Linda Daniela
University of Latvia
Riga, Latvia

ISSN 2625-0004 ISSN 2625-0012 (electronic)
Educational Communications and Technology: Issues and Innovations
ISBN 978-3-031-14774-6 ISBN 978-3-031-14775-3 (eBook)
https://doi.org/10.1007/978-3-031-14775-3

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Looking Forward to Inclusive Digital Education

From the time when the first microprocessor was introduced by INTEL, different digital solutions, learning materials, and a variety of hardware, software, and digital content are now available on the market and can be used in educational settings. These technologies can be used as a support for inclusive education as can ensure access to education, access to different content, and can support assistive learning. But at the same time, we have to ensure that technologies also serve as support materials for an inclusive learning environment, we have to be aware about barriers which people have in digital space. We often use the term "digital divide" when talking about access to digital technologies, but in this book, we tried to analyse aspects of digital divide from inclusive education perspective because "digital divide" can be caused by barriers due to health condition, socioeconomical status, cultural background, gender differences, and military conflicts. Digital inclusion is an increasingly important social issue, reflecting imperatives, opportunities, and considerations about human rights, equity, issues of identity, language, social participation, community and civic engagement, and opportunities pertaining to the digital world. While the rate of use of different digital solutions keeps increasing, the digital divide persists, and the ability to access and use ICT effectively remains inequitable and can cause exclusion from education systems or from particular fields of education. It is therefore important to understand this phenomenon of digital inclusion as well as to develop strategies and tactics to promote and enhance digital inclusion so that disadvantaged individuals, groups, and communities can have better access to and the necessary skills to use ICT, digital tools, and digital learning materials. There are four main directions in reducing "digital divide" for inclusive digital education, and these are:

1. Provision of access to different digital technologies (hardware or software) and to assistive technologies as well to support students with special needs
2. Support for development of digital skills for everyone
3. Development of learning content by following principles of universal design to ensure that learning content is available to all people and their special needs to not cause barriers to the content

4. Development of different educational structure to remove barriers to education which exist for those who can't participate in face-to-face learning activities in particular time because of their family situation or their socioeconomical situation

These steps to close the "digital divide" can help remove barriers to education and also help reduce drop out rates from education.

Organization of the Book

The book consists of 19 chapters which all in different ways are looking for solutions to ensure inclusive digital education and to build ways to overcome "digital divide".

Linda Daniela in her chapter "Inclusive Technology-Enhanced Education" states that it is important to develop an understanding of opportunities to use digital technologies to support inclusive technology-enhanced education, close the digital divide that exists, and ensure that digital technologies are not supporting new risks of exclusion from the digital learning environment, thereby creating glass ceilings for students with diverse needs. In this chapter she summarizes the challenges and risks for inclusive education that may arise in the digital environment.

Jean Reale, Emma O'Brien, Cornelia Connolly, and TJ Ó Ceallaigh prepared the chapter "A Third Space: Infusing Open Educational Resources (OER) with Universal Design for Learning (UDL)", where they introduce the concept of open and participatory education which provides globally available equal access to collective knowledge. It is followed by an explanation of the transition from the passive consumption of technology to students as designers, ensuring understanding of the how, where, and why learning takes place through the effective use of learner-designed OER. The chapter views OER through the universal design for learning (UDL) lens to support the underpinning of inclusive and equitable design for all.

The chapter "Open Educational Resources for Inclusive Education: A Tangible Response for Italian School" prepared by Lucia Ferlino, Giovanni Caruso, and Vincenza Benigno examines the concept of disability in the light of the biopsychosocial model (WHO, 2002), the role of technologies, and open educational resources (OERs) in supporting inclusive processes. A definition of open educational resources (OERs) is provided, along with an associated set of dimensions as contents, instruments, and resources. Indications are provided on how and where OERs can be found, and the reasons that should guide their choice.

Teresa F. Blanco, Alejandro Gorgal-Romarís, Cristina Núñez-García, and Pablo G. Sequeiros in the chapter "Digital Education for Approaching the Affective Domain in Mathematics Learning" illustrate the role that educational technology can play in increasing students' interest in mathematics and mathematical learning. Results of an out-school socio-educational programme promoting the mathematical stimulus to adolescents at risk of social exclusion have been presented. The activities implemented in the programme, which are based on the STEM methodology, develop mathematical content from an interdisciplinary perspective with the help of different technological resources. Robots, 3D printing, math apps for learning, and software such as GeoGebra have been used, among others.

The chapter "Inquiry-Based Learning Focused on Inclusive Education in Programming of Robots: Challenges, Experience and Feedback of First Cycle Students" prepared by Rasa Bruzgiene, Lina Narbutaite, Tomas Adomkus, Jurate Pauliute, and Nadezhda Kunicina presents the state of the art in programming of robots using inquiry-based learning under inclusive education umbrella. Additionally, the study case with application of the inquiry-based teaching approaches for the first cycle students with focus on gifted students, their experience of learning, and feedback is described in particular sections of this chapter. The evaluation of changes in abilities of students, who learned programming of robots, in long-term period serves as numerical results, presented in this chapter as well.

Polyxeni Kaimara, Ioannis Deliyannis, and Andreas Oikonomou prepared the chapter "Content Design for Inclusive Educational Environments". They believe that educational equity is a key principle and an important prerequisite for inclusive societies without discrimination, and accommodations and adaptations of educational content, devices, and services should be personalized for students, based on their preferences and diverse learning needs. The purpose of this chapter is to present an innovative process of designing and developing inclusive transmedia educational materials. The authors recommend this innovative process to educators, therapists, developers, and education decision makers as a good practice guide for creating meaningful content.

In the chapter "Student-Centered Active Digital Technologies for High Abilities and Gifted Students", Scheila Aparecida Leal Dantas and Luciano F. de Medeiros analyse pedagogical aspects through the application of ludic workshops, using digital technologies like low-cost and sustainable robotics (Arduino) with recyclable waste. It was sought with such a project to develop computational thinking united with development of eco-consciousness, as well as amplifying alphabetization beyond traditional literacy, promoting, thus, digital inclusion and problem-solving abilities. It was looked to infer, through the use of said methodologies and conceptions, the educational epistemological foundation.

Soňa Kalenda, Alice Gojová, Ivana Kowaliková, and Antonio López Peláez prepared the chapter "Inclusive Digital Education of Vulnerable Children During Covid-19 Pandemic: The Role of Social Work". There they introduced a social innovation – the use of ICT in social work interventions. As part of this, 24 families and their 13 social workers were provided with 37 tablets with Internet access. The experimental validation lasted 20 months and still continues. Data to evaluate the impact of the implemented social innovation on the target group of vulnerable children were collected in two phases (after 6 and 18 months). The objective of the impact evaluation was to find out how the social innovation based on the support of digital education influenced the development of digital skills of vulnerable children and their families. The secondary objective was to find out what impact it had on the formation of a digital gap. The research results showed that the implemented social innovation contributed to mitigating e-exclusion.

The chapter "Digital Inclusion During the Covid-19 Pandemic: The Case of Austria" by Lisa-Katharina Moehlen and Seyda Subasi-Singh focuses on problems caused by the abrupt switch to digital solutions upon school shutdowns which put inclusive education in a very feeble situation. The authors believe that the digital learning tools, introduced as an alleviation of the severity of the situation, were proved not to be inclusive enough. The intersection of special education needs and the switch to digital learning indicated a need to focus on developing inclusive digital solutions for all, including students with special education needs.

This chapter reports on a study from the Austrian context. This study aimed to reveal how mechanisms of exclusion were visible during shifting educational processes to a digital mode.

Theodora Kouvara, Christoforos Karachristos, Stavroula Karasoula, Theofanis Orphanoudakis, Alexis Lacapele, Berenger Dupont, and Zoe Batsi prepared the chapter "Integrating Digital Pedagogies in the Era of the Inclusive Education: Needs Analysis and Use Cases from the Perspective of the 'Visitor' Project", where they provide insight on the needs analysis research which was conducted in a Greek primary school and lasted 4 months, involving two fifth grade classes and an integration class in which students with learning difficulties were provided with personalized training for a few hours every day and were separated from their classmates. The study's findings bring to light misconceptions in teaching methods and entrenched beliefs about the use of technology, highlighting issues related to the need for systematic training of teachers in inclusive digital education. To address these barriers, this work proposes a training plan based on an innovative scenario.

The chapter "Scales of Inclusion in a Vertically Integrated Program for a Community-Focused Interactive Experience" by Joshua A. Fisher and Lauren Liss explains vertically integrated programmes (VIPs) to enable students to pursue a public-facing project throughout their education. Students from different traditions combine their skills to produce a final deliverable in the form of research, an artifact, or an experience. VIPs allow for an inclusive approach to working in academia as professors direct students' strengths towards a collective good. When academic units direct VIP work outwards, the knowledge and skills of students and faculty become community service. The chapter presents tactics, lessons, and insights for achieving inclusion at all levels of the VIP curriculum to achieve constructive community work.

Marilene Santos Garcia and Andrea Filatro in their chapter "New Configurations of Inclusive Education: Contributions of Brazilian Edtechs to Accessibility and Inclusion" present an overview of the current panorama of technological innovations offered by Brazilian educational start-ups, the so-called edtechs. The focus is on discussing the innovative products and services of these edtechs to meet needs related to inclusion. The concept of inclusion itself is quite broad, so in the specific case of this survey, in the form of mapping, innovations were found that meet: (a) assistive technologies aimed at special needs, (b) technologies aimed at social groups at an educational disadvantage, (c) technologies aimed at education for ethnic and cultural diversity, and (d) technologies oriented towards the elderly.

Nur Samancioglu, Silvia Nuere, Laura de Miguel Álvarez, and Esperanza Macarena Ruiz Gómez prepared the chapter "A Step Further in Digital Divide: Information and Strategic Skills of the Academy". Inequalities observed in the digital divide can be based on physical access, social norms, infrastructure, and educational reasons. Recently, skills and competency, which are the sub-topics to be examined under education, have become one of the most prominent issues within the network and information society. Universities that were already in a slow adoption process had to come up with rapid and effective solutions because of the COVID-19 pandemic. Educators became capable to offer solutions in teaching and learning by using information and communication technology.

Dita Nīmante, Daiga Kalniņa, and Sanita Baranova in their chapter "Towards an Inclusive Digital Learning Environment in Higher Education: Opportunities and Limitations Gleaned from Working Students' Remote Learning Experiences During COVID-19" aim to investigate working students' experience of remote learning during COVID-19 as a possibility for the development of an inclusive digital environment at the University of Latvia (UL). This research reveals the experience of 742 students from 13 faculties of UL during the period of remote learning throughout the second outbreak of COVID-19 (Spring 2021). The findings of the study highlight that there are no significant differences in how students representing three different groups (full-time students, students working part-time, and students working full-time) assess the organization of remote studies in the context of the COVID-19 pandemic at UL. The study concludes that the remote learning experience was very helpful to students working part-time as they can participate in the online learning process almost as much as full-time students.

Sofia Pliasa, Lefkothea Kartasidou, and Nikolaos Fachantidis in the chapter "Higher Education Students' Training Towards Inclusion: Virtual Reality Introduces Socially Assistive Robots Technologies for Digital Inclusion" present the autism spectrum disorders (ASDs) aspects and inclusive techniques, and why Socially Assistive Robots is a powerful tool to deliver inclusive interventions to the ASD population, and subsequently they analyse the design and implementation of a virtual reality training scenario that utilizes the ARRoW (Assisting Relations Robotic Workfellow) method and the SAR Daisy towards inclusion. Then they discuss the implementation aspects of the training activities and higher education (HE) students' participation.

The chapter "Reconstruction of the Phenomenon of Social Inclusion Within ICT in Academia: Voices from Europe" by Joanna Leek and Anna Jarkiewicz introduces results of the study which purpose was to reconstruct the phenomenon of social inclusion within information communications technology (ICT) in higher education institution (HEI). The chapter starts with a review of ICT literature used in academia, which for us will serve as the theoretical context for social inclusion of students within academia. The study shows that digital tools have got potential to support students' educational experiences, and as discussed on the example of international mobility, ICTs in academia support social inclusion. Limited students' digital skills however may be conditioned by previous limited intentional experiences in this area, which can be understood as the effect of predispositions attributed to them by significant others as well as role expectations internalized in the socialization process, but also the internalized interpretive pattern.

Agnes Papadopoulou and Iakovos Panagopoulos in their chapter "Psychogeography and Digital Technologies: Inclusive Creative Experiences in an Academic Environment" give insight of an initiative to reduce dropout rate from university caused by Greek financial crises and the financial issues raised by the COVID-19 pandemic. The students had to create psychogeography maps of the location by searching traits of its previous use and recording these traits with their mobile phones. After that, they had to use this information in the creation of their own short stories based on this location. They also had to keep a video log of themselves sharing their thoughts and emotions from this whole experience. This experiment can be a first step of a more advanced approach of this methodology focused on attaching the university or school students with their environment.

The chapter "Breaking the Digital Gender Gap with Inclusive Digital Education" prepared by Gema de Pablo González and Mariano Sanz-Prieto discussed the gender perspective in STEAM disciplines which is essential to reduce the gender gap that has existed to date. The differentiation in STEAM career choice between men and women is based on gender construction. Gender socialization, and the narrative derived from it, makes women (or girls) feel less able to tackle science careers or professions. Authors believe that from this perspective, and taking into account that the future will be technological, failing to act within the framework of equitable and egalitarian education and socialization will result in a greater gender digital divide, thereby excluding girls from access to the digital world and the digital future. It is important to highlight the different initiatives carried out with the aim of reducing this gap, but perhaps we should think about intervening through educational inclusion to reduce this gap.

Patrick Camilleri believes that the facilitation of the soft-skills through video games and competitiveness can boost inclusion. Therefore, the perceptions and opinions portrayed by volunteering participants working at a Maltese esports company and competitive video game players are employed to discuss how instilled decision-making, strategic thinking, and personalized and community building traits that characterize competitive video game play in the esports industry can also define the discipline as an emergent platform where personalization of skills can be an attribute to inclusion. These ideas are discussed in the chapter "Esports: A New Frontier for Inclusion Through Competitive Game Engagement".

Riga, Latvia Linda Daniela

Contents

Inclusive Technology-Enhanced Education

Linda Daniela

Currently, we are no longer talking about the need to provide inclusive education (UNESCO, 2014) because such debates have been going on for decades. At first, these discussed what rights students with special needs have, whether students with special needs can study in school, whether they are provided with special support so that they can reach their highest potential, and so on. Later, these discussions became broader, and inclusive education was also discussed from the perspective of diversity: whether everyone has equal rights, regardless of their specific learning needs, which may have been caused by a health disorder, or whether people of different ages also have equal rights to education. Do individuals of different religious and cultural affiliations, genders, socioeconomic situations, and languages have equal rights? Is education available to new parents and single parents? Is it available to individuals with institutional care experience? Equal opportunities must be provided to everyone (Ainscow, 2020; Daniela & Lytras, 2018; Roche, 2016; Topping, 2012; UNESCO, 2009). The main challenges to providing inclusive education can be summarized as follows (see Fig. 1):

1. Students with special needs (Galkienė & Monkevičienė, 2021; Pulkkinen et al., 2019; Umbraško et al., 2018), which can either functionally impair a person from getting to an educational institution or hinder their perception of educational material due to significant visual or hearing impairments. These may include students with epilepsy or autism spectrum disorders. They can also include students with intellectual disabilities or learning disabilities. A list with all the possible health conditions that create barriers to education would go on, but the main idea is that every student, regardless of their specific health needs, should have access to education.

L. Daniela (✉)
University of Latvia, Riga, Latvia
e-mail: linda.daniela@lu.lv

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_1

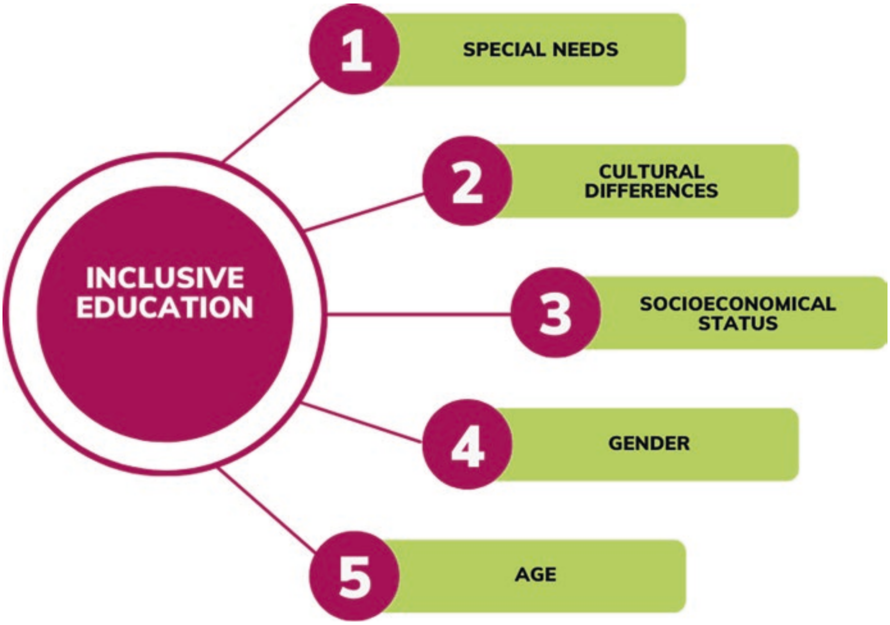


Fig. 1 Main challenges to inclusive education

2. Students with different cultural or language backgrounds (Civitillo et al., 2021; Herzog-Punzenberger et al., 2020; Skerrett, 2011). These may be students who live in a country where only the national language is used and are not provided with learning in other languages and thus cannot access learning materials that are available in, for example, English. They may also include higher education students for whom English (German, Spanish) is not their native language, and they thus find it more difficult to integrate into the international scientific environment than those who know this language.
3. Students who have a disadvantaged socioeconomic background (Cedeño et al., 2016; Gayton, 2010; Shifrer et al., 2011) and whose family members cannot provide them with access to quality education, the opportunity to attend educational classes of interest, or the materials needed to learn specific content. For example, during the pandemic caused by COVID-19, when learning took place remotely, it was not possible for these students to connect to the learning process because the appropriate technologies were not available. This group can also include single parents who have the desire to learn more on their own but cannot do so because they have to take responsibility for all the daily family duties by themselves. They can also be people with migration experience because they have had to relocate as refugees from countries affected by war or regime change. Currently, the most urgent situation in this regard affects refugees from Ukraine, but there are also refugees from other countries where people have had to leave their homes to survive. In most cases, these people do not have access to the

financial means to provide all their needs, so it is not possible for them to support their children in the process of getting an education either.

4. The gender of students (Hui et al., 2018; Liasidou, 2012; Slee, 2018; Sundaram et al., 2014), which can act as a barrier to educational attainment. This may be a result of inappropriately organized pedagogical processes, such as when girls do not choose to study STEM subjects in depth as a result of various stereotypical views, or a result of ideas influenced by cultural and religious beliefs whereby women do not need to get an education, as is the case, for example, in Afghanistan (Gannon, 2022), South Sudan (Breidlid & Breidlid, 2013), and Niger (Greany, 2008). Other examples where girls' access to education is not ensured could probably be given.
5. The age of students, which relates to whether the instructional strategies used are appropriate for the age group, both from the perspective of their interests (Van Gerven et al., 2006) and from the perspective of their prior knowledge and acquired competencies (Hertzog et al., 2012), as well as whether the offered materials are appropriate for a specific age from the perspective of the social, cognitive, and physical development of learners (Salthouse, 1996). Age differences in the use of digital technologies can also be analyzed from the perspectives of different generations (Atwood & Schroer, 2018).

When providing inclusive education, it is essential to consider the differences between the stages of education (see Fig. 2). In the pre-school stage, it is essential to prepare children for learning and understand what support measures are needed (Halinen & Järvinen, 2008) either in general education to provide all children with

Fig. 2 Educational levels and domains of inclusive education

appropriate education for their specific needs so that everyone can realize their potential (Halinen & Järvinen, 2008; Lindsay, 2007; Miles & Singal, 2010) or in vocational education, where young people who do not choose to study in higher education or cannot continue their education at the higher level very often end up because, for example, they did not receive sufficient support during the compulsory education stage (Sonnenschein & Kamin, 2020). There are also other challenges in higher education, such as in creating a system where it is clear to students what kind of support they can receive, to educators what to do to help students, etc. (Hitch et al., 2015; Rubene et al., 2016). Also, there is the issue of opportunities for young researchers when thinking about issues such as the publication of their work if they do not know one of the languages that must be used to publish in respectable journals (English, German, etc.) to a level where they can prepare an article for publication. For example, this would apply to a student from Eastern Europe whose knowledge of English is at a sufficient level to communicate but not at a level to prepare a grammatically correct article, which thus affects their chances of being published and showing their scientific potential.

Inclusive education is full of various challenges, but the focus of this book is inclusive digital education, where one has to think about how to reduce the obstacles that may arise in the digital learning environment, so it is first important to understand what technology-enhanced learning (TEL) is. In this chapter, the term "technology" or "technologies" is used as a generic term for digital technologies and software that can be used in the learning process and digital learning materials that are prepared to support learning. I have previously indicated that TEL can focus on three directions (Daniela, 2020, 2021), and their characteristics may overlap (see Fig. 3). There can be a focus on technological solutions to provide remote or distance learning, where technologies are tools used to ensure that education can be accessed from a distance but where the learning process is quite traditional – students are provided with information, and they have to learn. Secondly, there can be a focus on specific technological skills that should be acquired for various reasons. For example, students have to learn how to use computers or how to use specific software. These can cover cases where we wish to ensure remote learning, but to do so, we have to teach particular skills, or, more specifically, we wish to use educational robotics to teach programming, but to do so, we need to ensure that students understand how these technologies work and we need to teach students to learn how to program, how to use sensors, how to connect cables etc. The third focus is on technology that complements learning. Here we have to think about pedagogical aspects to choose appropriate technologies that support learning (Daniela, 2019; Daniela & Rūdolfa, 2019; Rūdolfa & Daniela, 2021), such as applications that help students to understand geometrical figures, educational robotics that can help them to learn physics, or augmented reality, which provides them with the possibility to see the solar system.

These are only few examples of TEL, but from the perspective of inclusive digital education, we have to remember that there are several challenges. The first is the possibility of using digital technologies, and in the context of TEL, the term "digital divide" is sometimes used. This was introduced by the National Telecommunications

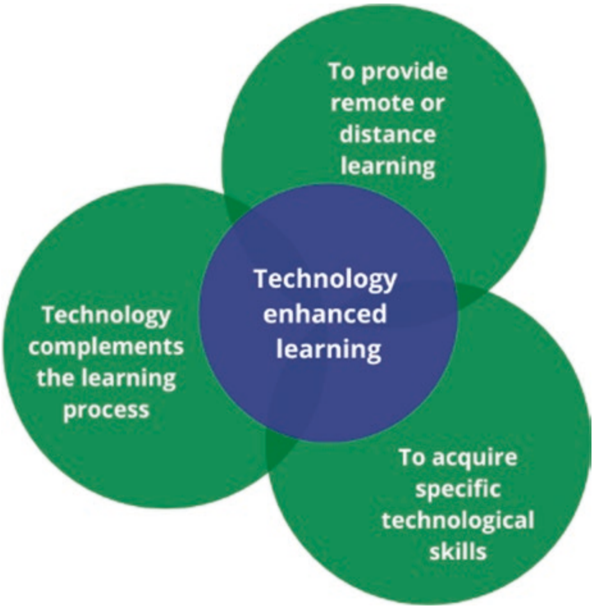


Fig. 3 Technology-enhanced learning

and Information Administration (NTIA) in the mid-1990s in the USA, where a divide was identified between those groups of society who have access to information and communication technologies (ICT) and those who do not. The term was initially used to characterize the situation regarding access to ICT (Rogers, 2001), but nowadays, we also have to discuss this digital divide from the perspective of inclusive education where access and technologies may be provided but do not support special needs, gender differences, cultural diversity, etc., creating barriers to the use of particular technologies or digital learning materials. Therefore, digital inclusion is an increasingly important social issue, reflecting imperatives, opportunities, and considerations about human rights, equity, issues of identity, language, social participation, community and civic engagement, and opportunities pertaining to the digital world. While the rate of use of different digital solutions keeps increasing, the digital divide persists and the ability to access and use ICT effectively remains inequitable and can cause exclusion from education systems or from particular fields of education.

To ensure inclusive technology-enhanced education, which includes not only TEL but also administrative and technological perspective we have to develop an understanding of how to provide remote or distance learning, how to teach technological skills, and how to ensure learning with technologies, bearing in mind all the possible challenges for inclusive education to reduce the digital divide (see Fig. 4).

Technology-enhanced education cannot happen without an understanding of the possible challenges, but it also cannot be realized if there is no administrative support, no technologies, and no appropriate pedagogical strategies used to support

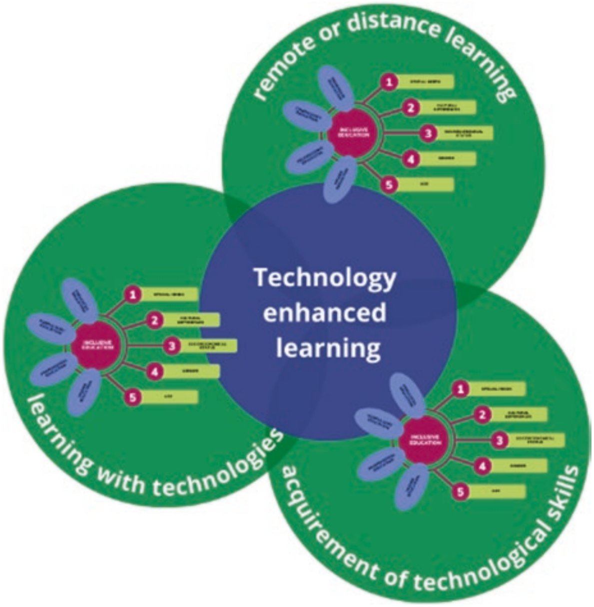


Fig. 4 Inclusive technology-enhanced education

learning in the digital environment (see Fig. 5). For example, support in the provision of technologies and decisions taken in times of crisis (Nīmante et al., 2021; Rubene et al., 2021). During the COVID-19 pandemic, there were a lot of examples around the world where countries tried to find a solution to continue educational processes but failed to support students with special needs, students from disadvantaged families, etc. Remote learning during the COVID-19 crisis seemed advantageous for those students who had to manage their family life and their studies because they did not have to go to their university to study, and education became accessible from every place where they could reach their learning materials. From the perspective of accessible education, this should be assumed as a positive outcome of remote and distance learning because students had a possibility to study, but from the gender perspective, it still caused risks of dropout because there are until now gender stereotypes about household chores and who is responsible for them. Research has already been done that found that women had more challenges to face during the COVID-19 crisis (Lewis, 2020; Möhring et al., 2020). If we are working to support the acquirement of specific technological skills, we also have to bear students' special needs and other challenges for inclusive education in mind. For example, if we wish to teach students how to use visual programming to program LEGO robots, we assume that all the students can recognize colours and work with tiny details. If we wish to teach students to find information online, then this might be hard for those who have visual impairments. Some web pages provide the possibility to change from a visual mode of information representation to an audial

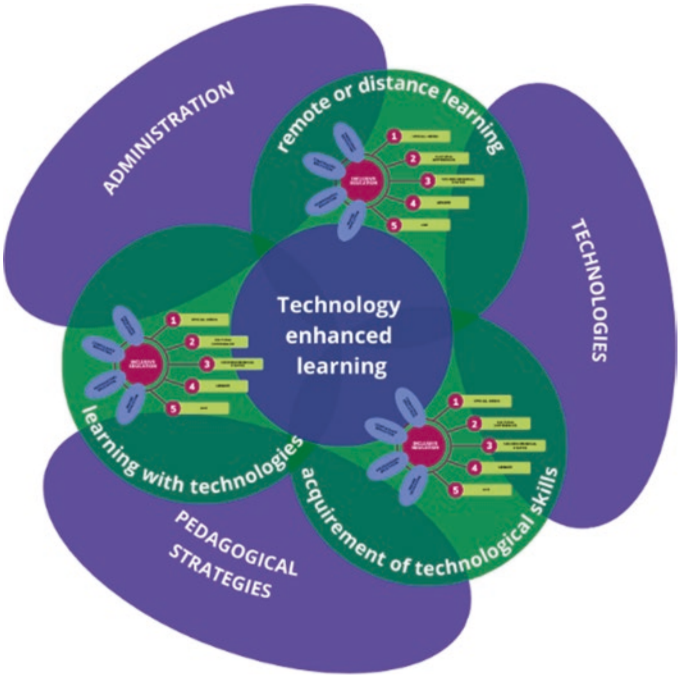


Fig. 5 An inclusive technology-enhanced education ecosystem

mode, but these are rare cases. The example of vision problems and how these can influence learning with technologies is given here, but similar examples can be provided with other special needs, and this influences not only the acquirement of specific technological skills but also learning processes from a wider perspective.

On the one hand, the digital learning space is open, and everyone can use the possibilities provided by technological progress, which supports access to knowledge, the possibility to find information in a few clicks, and the possibility to support students with diverse needs, but if we are not aware of different possible challenges in the digital environment, then there are still glass ceilings for students that prevent equal possibilities for everyone. Often, different learning materials that are appropriate for students with special needs are not available to them, or only at an extra cost, thus creating new risks of segregation because, in order for them to access information that is representative of their specific needs, they (or their families) have to pay for it. These are factors about which we have to think when providing technology-enhanced education to ensure that everyone can benefit.

Countries have attempted to provide inclusive education with varying degrees of success. In some, it has succeeded better, such as Finland (Jahnukainen, 2015), and there are countries where there is still room for improvement, such as Japan (Maeda et al., 2021). There are also countries where inclusive education is only at the beginning of its journey and where a lot of work still needs to be done to ensure equal opportunities for all, such as India, Bangladesh, etc. (Basant & Sen, 2014; Mizunoya et al., 2016; Mullick et al., 2014; Schiemer, 2017; Shankar & Adipudi, 2021; Shopland et al., 2022; Yang & Yorozu, 2015). But with regard to inclusive technology-enhanced learning, we have to put much more effort into ensuring that the digital learning space is inclusive to everyone and glass ceilings are removed.

References

Ainscow, M. (2020). Promoting inclusion and equity in education: Lessons from international experiences. *Nordic Journal of Studies in Educational Policy: A School for All, 6*(1), 7–16. https://doi.org/10.1080/20020317.2020.1729587

Atwood, D. R., & Schroer, S. E. (2018). "Just don't get too personal": Millennial students' perceptions of transformative teaching. In J. Keengwe (Ed.), *Handbook of research on pedagogical models for next-generation teaching and learning* (pp. 249–264). IGI Global. https://doi.org/10.4018/978-1-5225-3873-8.ch014

Basant, R., & Sen, G. D. (2014). Access to higher education in India: An exploration of its antecedents. *SSRN*. https://doi.org/10.2139/ssrn.2535644

Breidlid, A., & Breidlid, H. (2013). Women in South Sudan: Education, empowerment and identity construction. In H. B. Holmarsdottir, V. Nomlomo, A. I. Farag, & Z. Desai (Eds.), *Gendered voices: Reflections on gender and education in South Africa and Sudan* (pp. 99–115). Brill.

Cedeño, L. F., Martínez-Arias, R., & Bueno, J. A. (2016). Implications of socioeconomic status on academic competence: A perspective for teachers. *International Education Studies, 9*(4), 257–267. https://doi.org/10.5539/ies.v9n4p257

Civitillo, S., Juang, L. P., & Schachner, M. K. (2021). Stressing similarities or ignoring differences? Shedding light into different forms of color-evasive ideology with pre- and in-service teachers. *Zeitschrift für Erziehungswissenschaft, 24*, 135–153. https://doi.org/10.1007/s11618-021-00995-9

Daniela, L. (2019). Smart pedagogy for technology enhanced learning. In L. Daniela (Ed.), *Didactics of Smart Pedagogy: Smart Pedagogy for Technology Enhanced Learning* (pp. 3–22). Springer. ISBN 978-3-030-01550-3.

Daniela, L. (2020). The concept of smart pedagogy for learning in the digital world. In L. Daniela (Ed.), *Epistemological approaches to digital learning in educational contexts* (pp. 1–16). Taylor & Francis. ISBN 9780367333799.

Daniela, L. (2021). Smart pedagogy as a driving wheel for technology-enhanced learning. *Technology, Knowledge and Learning, 26*, 711–718. https://doi.org/10.1007/s10758-021-09536-z

Daniela, L., & Lytras, M. D. (2018). Educational robotics for inclusive education. *Technology, Knowledge and Learning, 24*, 219–225. https://doi.org/10.1007/s10758-018-9397-5

Daniela, L., & Rūdolfa, A. (2019). Learning platforms: How to make the right choice. In L. Daniela (Ed.), *Didactics of smart pedagogy: Smart pedagogy for technology enhanced learning* (pp. 191–209). Springer.

Galkienė, A., & Monkevičienė, O. (2021). Preconditions of transforming the educational process by applying inclusive education strategies: Theoretical background. In A. Galkiene & O. Monkevičienė (Eds.), *Improving inclusive education through universal design for learning* (pp. 1–21). Springer.

Gannon, K. (2022, March 24). *Taliban break promise on higher education for Afghan girls*. The Diplomat. https://thediplomat.com/2022/03/taliban-break-promise-on-higher-education-for-afghan-girls/

Gayton, A. (2010). Socioeconomic status and language-learning motivation: To what extent does the former influence the latter. *Scottish Languages Review, 22*(1), 17–28.

Greany, K. (2008). Rhetoric versus reality: Exploring the rights-based approach to girls' education in rural Niger. *Compare, 38*(5), 555–568. https://doi.org/10.1080/03057920802351317

Halinen, I., & Järvinen, R. (2008). Towards inclusive education: The case of Finland. *Prospects, 38*(1), 77–97. https://doi.org/10.1007/s11125-008-9061-2

Hertzog, C., Price, J., & Dunlosky, J. (2012). Age differences in the effects of experimenter-instructed versus self-generated strategy use. *Experimental Aging Research, 38*(1), 42–62. https://doi.org/10.1080/0361073x.2012.637005

Herzog-Punzenberger, B., Altrichter, H., Brown, M., Burns, D., Nortvedt, G. A., Skedsmo, G., Wiese, E., Nayir, F., Fellner, M., McNamara, G., & O'Hara, J. (2020). Teachers responding to cultural diversity: Case studies on assessment practices, challenges and experiences in secondary schools in Austria, Ireland, Norway and Turkey. *Educational Assessment, Evaluation and Accountability, 32*, 395–424. https://doi.org/10.1007/s11092-020-09330-y

Hitch, D., Macfarlane, S., & Nihill, C. (2015). Inclusive pedagogy in Australian universities: A review of current policies and professional development activities. *International Journal of the First Year in Higher Education, 6*(1), 135–145. https://doi.org/10.5204/intjfyhe.v6i1.254

Hui, N., Vickery, E., Njelesani, J., & Cameron, D. (2018). Gendered experiences of inclusive education for children with disabilities in West and East Africa. *International Journal of Inclusive Education, 22*(5), 457–474. https://doi.org/10.1080/13603116.2017.1370740

Jahnukainen, M. (2015). Inclusion, integration, or what? A comparative study of the school principals' perceptions of inclusive and special education in Finland and in Alberta, Canada. *Disability & Society, 30*(1), 59–72. https://doi.org/10.1080/09687599.2014.982788

Lewis, H. (2020, March 19). *The Coronavirus is a disaster for feminism*. The Atlantic. https://www.theatlantic.com/international/archive/2020/03/feminism-womens-rights-coronavirus-covid19/608302/

Liasidou, A. (2012). Inclusive education and critical pedagogy at the intersections of disability, race, gender and class. *Journal for Critical Education Policy Studies, 10*(1), 168–184. http://www.jceps.com/wp-content/uploads/PDFs/10-1-12.pdf

Lindsay, G. (2007). Educational psychology and the effectiveness of inclusive education/mainstreaming. *British Journal of Educational Psychology, 77*(1), 1–24. https://doi.org/10.1348/000709906x156881

Maeda, K., Hashimoto, H., & Sato, K. (2021). Creating a positive perception toward inclusive education with future-oriented thinking. *BMC Research Notes, 14*, 467. https://doi.org/10.1186/s13104-021-05882-4

Miles, S., & Singal, N. (2010). The education for all and inclusive education debate: Conflict, contradiction or opportunity? *International Journal of Inclusive Education, 14*(1), 1–15. https://doi.org/10.1080/13603110802265125

Mizunoya, S., Mitra, S., & Yamasaki, I. (2016). *Towards inclusive education: The impact of disability on school attendance in developing countries*. Innocenti Working Paper WP 2016-03. UNICEF.

Möhring, K., Naumann, E., Reifenscheid, M., Blom, A. G., Wenz, A., Rettig, T., Lehrer, R., Krieger, U., Juhl, S., Friedel, S., Fikel, M., & Cornesse, C. (2020). *Die Mannheimer Corona-Studie: Schwerpunktbericht zu Erwerbstätigkeit und Kinderbetreuung* [The Mannheim Corona Report: Focus on employment and childcare]. https://www.uni-mannheim.de/gip/corona-studie/

Mullick, J., Ahmmed, M., & Sharma, U. (2014). Prospects and challenges in implementing inclusive education reform in SAARC countries. In H. Zhang, P. W. K. Chan, & C. Boyle (Eds.), *Equality in education: Fairness and inclusion* (pp. 95–105). Springer.

Nīmante, D., Baranova, S., & Stramkale, L. (2021). The university administrative staff perception of inclusion in higher education. *Acta Paedagogica Vilnensia, 46*, 90–104. https://doi.org/10.15388/ActPaed.2021.46.6

Pulkkinen, J., Räikkönen, E., Pirttimaa, R., & Jahnukainen, M. (2019). Principals' views on changes in the provision of support for learning and schooling in Finland after educational reform. *Journal of Educational Change, 20*, 137–163. https://doi.org/10.1007/s10833-018-9334-3

Roche, S. (2016). Education for all: Exploring the principle and process of inclusive education. *International Review of Education, 62*, 131–137. https://doi.org/10.1007/s11159-016-9556-7

Rogers, E. M. (2001). The digital divide. *Convergence, 7*(4), 96–111. https://doi.org/10.1177/135485650100700406

Rubene, Z., Daniela, L., Nīmante, D., & Kraģe, G. (2016). Harmonization of the tertiary education program through the principles of inclusive education: The case of Latvia. In L. Daniela & L. Rutka (Eds.), *Selected papers of the association for teacher education in Europe spring conference 2015* (pp. 1–16). Cambridge Scholars Publishing.

Rubene, Z., Daniela, L., Sarva, E., & Rūdolfa, A. (2021). Digital transformation of education: Envisioning post-Covid education in Latvia. In L. Daniela (Ed.), *Human, technologies and quality of education, 2021 = Cilvēks, tehnoloģijas un izglītības kvalitāte, 2021* (pp. 180–196). University of Latvia Press. https://doi.org/10.22364/htqe.2021.13

Rūdolfa, A., & Daniela, L. (2021). Learning platforms in the context of the digitization of education: A strong methodological innovation. The experience of Latvia. In D. Scaradozzi, L. Guasti, M. Di Stasio, B. Miotti, A. Monteriù, & P. Blikstein (Eds.), *Makers at school, educational robotics and innovative learning environments: Research and experiences from FabLearn Italy 2019* (pp. 213–221). Springer. https://doi.org/10.1007/978-3-030-77040-2_28

Salthouse, T. A. (1996). The processing-speed theory of adult age differences in cognition. *Psychological Review, 103*(3), 403–428. https://doi.org/10.1037/0033-295x.103.3.403

Schiemer, M. (2017). Education for children with disabilities in Addis Ababa, Ethiopia: Developing a sense of belonging. Cham: Springer International. https://doi.org/10.1007/978-3-319-60768-9

Shankar, U., & Adipudi, A. V. (2021). Specific learning disabilities and higher education: The Indian scenario and a comparative analysis. *Jindal Global Law Review, 12*, 395–415. https://doi.org/10.1007/s41020-021-00155-4

Shifrer, D., Muller, C., & Callahan, R. (2011). Disproportionality and learning disabilities: Parsing apart race, socioeconomic status, and language. *Journal of Learning Disabilities, 44*(3), 246–257. https://doi.org/10.1177/0022219410374236

Shopland, N., Brown, D. J., Daniela, L., Rūdolfa, A., Rūdolfa, A., Rahman, M. A., Burton, A., Mahmud, M., & van Isacker, K. (2022). Improving accessibility and personalisation for HE students with disabilities in two countries in the Indian subcontinent – Initial findings. In M. Antona & C. Stephanidis (Eds.), *Universal access in human-computer interaction: User and context diversity* (pp. 110–122). Springer. https://doi.org/10.1007/978-3-031-05039-8_8

Skerrett, A. (2011). On identity, diversity, and educational change. *Journal of Educational Change, 12*, 211–220. https://doi.org/10.1007/s10833-011-9153-2

Slee, R. (2018). Inclusive education: From policy to school implementation. In C. Clark, A. Dyson, & A. Millward (Eds.), *Towards inclusive schools?* (pp. 30–41). Routledge.

Sonnenschein, N., & Kamin, A. M. (2020). Digitally-supported inclusive vocational education: Conceptual considerations for the hotel and restaurant industry. In *Universal access in human-computer interaction: User and context diversity* (pp. 291–303). Springer.

Sundaram, M. S., Sekar, M., & Subburaj, A. (2014). Women empowerment: Role of education. *International Journal in Management & Social Science, 2*(12), 76–85.

Topping, K. (2012). Conceptions of inclusion: Widening ideas. In C. Boyle & K. Topping (Eds.), *What works in inclusion?* (pp. 9–19). Open University Press.

Umbraško, S., Raščevska, M., Nīmante, D., & Šūmane I. (2018). Support measures for children with special needs in mainstream school in Latvia: Implementation and evaluation. *EDULEARN18 Proceedings* (p. 7831). IATED.

UNESCO. (2009). *Policy guidelines on inclusion for education*. http://unesdoc.unesco.org/images/0017/001778/177849e.pdf

UNESCO. (2014). Constitution of the United Nations Educational, Scientific and Cultural Organization. In UNESCO (Ed.), *Basic texts* (pp. 5–18). UNESCO. http://unesdoc.unesco.org/images/0022/002269/226924e.pdf

Van Gerven, P. W., Paas, F., & Tabbers, H. K. (2006). Cognitive aging and computer-based instructional design: Where do we go from here? *Educational Psychology Review, 18*(2), 141. https://doi.org/10.1007/s10648-006-9005-4

Yang, J., & Yorozu, R. (2015). *Building a learning society in Japan, the Republic of Korea and Singapore*. UNESCO Institute for Lifelong Learning.

A Third Space: Infusing Open Educational Resources (OER) with Universal Design for Learning (UDL)

Jean Reale, Emma O'Brien, T. J. Ó. Ceallaigh, and Cornelia Connolly

Introduction

Education can be defined as the 'process by which people deliberately support learning, including not only traditional formal primary, secondary, and tertiary schooling, but also activities such as workplace training, self-study, apprenticeship, informal learning environments' (Hoadley & Uttamchandani, 2021).

The potential of OER in education is globally recognised (Educause, 2020; European Commission, 2013). Highlighting the merit of open access, the Open Access 2020 initiative champions open access being available to the global community for the betterment of society and the benefit of all citizens (Connolly et al., 2020). The 2012 OER Paris Declaration makes recommendations to government and international institutions on the merit of OER. Open education and OER affects and assists educational stakeholders, within the educational ecosystem, such as teachers, school leaders, researchers, support services, policy makers and government. OER fosters inclusive education through facilitating accessible, affordable, flexible, sharing and ensuring the availability of intellectual capital for users in the education ecosystem.

'Open educational practices' is a broad term for the adoption of open approaches to teaching and learning, encompassing the use and sharing of OER, adopting open pedagogies in which students collaborate in a democratic manner with other students, teachers and the wider community (Cronin, 2017). Key to this is participatory pedagogy and students as partners and co-creators of their learning. Open education

J. Reale · E. O'Brien · T. J. Ó. Ceallaigh
Mary Immaculate College, Limerick, Ireland

C. Connolly (✉)
School of Education, National University of Ireland, Galway, Ireland
e-mail: cornelia.connolly@nuigalway.ie

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_2

and collaborative pedagogies are closely interlinked (Cronin, 2017; Nascimbeni & Burgos, 2019). Such approaches are key to inclusive teaching and learning which encourages marginalised voices to be amplified and heard in the learning process (Hays & Mallon, 2021), theme wish is explored further in this chapter.

Open Education Resources (OER)

Open education can incorporate policy, practices, resources, curricula and pedagogy and the relationship between these entities. Defined broadly, open education encompasses resources, tools and practices to improve educational access, effectiveness, and equality worldwide (Lane, 2009). Open educational resources (OER) contribute to this process. OER are described as 'teaching, learning and research materials in any medium, digital or otherwise, that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions' (Pawlowski & Hoel, 2012). These openly licensed learning materials are published on the Internet by the copyright-holder under a Creative Commons (CC) license that allows others to retain, reuse, revise, remix or redistribute (the 5Rs) these materials (Wiley & Hilton, 2018). All of the CC licenses require those who use the resources to credit the original work by providing attribution (Wiley & Hilton, 2018) and the licenses delineate how that work can be used.

The major benefits of OER, namely, cost and access, appear as the leading factors that significantly influence instructors' and students' interest and motivation for using OER (Luo et al., 2020; Hurley & Hallmark, 2020). By providing globally available equal access to collective knowledge through open and participatory education, OER has potential to address the achievement gap (William and Flora Hewlett Foundation, 2013) and improve learning experiences (Katz & Brandle, 2020). Additionally, OER designation enables users to customise and personalise resources, allowing for greater cultural inclusivity (Van Allen & Katz, 2020) and tailored student materials (Blomgren, 2018). While numerous advantages of OER use have been reported, a supportive policy to nurture the creation of OER sustainability models and to address OER in terms of universal quality standards is critical (Wiley & Hilton, 2018). Wiley and Hilton (2018) also argue that the perceived benefits of OER might differ due to contextual variables and call for additional research aimed at identifying criteria on OER context and design to promote and invigorate innovative pedagogical OER practices.

The global COVID-19 pandemic interrupted 'norm' which was applied to the education system worldwide. The extensive closure of school buildings and the move to online education, remote 'emergency' education, resulted in teachers and students establishing new pedagogical models and the sharing of information. This rapid digital pivot has led to the adoption of more online resources than ever before (Schaffhauser, 2020). The compatibility of OER with online environments and its instant access makes OER even more attractive during a pandemic. For example, in

2020, the Open Schools for Open Societies (OSOS) project made up of 1169 schools (https://www.openschools.eu portal), enabled educators to share innovations quickly with this community. In addition, during the COVID-19 pandemic, the sharing of information was illustrated by leading journal publications and publishing houses as research became freely available to help create solutions solving the global pandemic. Now is the time to raise awareness of OER in all educational contexts to provide more equitable and culturally relevant and sustaining educational experiences for all learners. The potential of OER to improve equity in learning beyond the pandemic is compelling. However, traditionally the creation and use of OERs has largely been educator driven. There is significant potential to explore the student's role in OER development and use, particularly in the context of the media rich world in which learners socialise and participate in today.

Students as Co-Creators of OERs

User Generated Content: Its Role in Education and OER Development

User generated content is exponentially increasing. Platforms such as TikTok, Instagram and Pinterest all provide spaces for learners to create and share content. Many users of these platforms are those from younger age groups with 24% of those aged 15–25 having a TikTok account compared with 2% over the age of 56 (Statista, 2022a). User generated content attract far more 'views' or hits than commercial content. It is evident that there is a growing level of interest in peer learning and knowledge exchange. This has a number of advantages. Marginalised groups and voices can share experiences, the wider population can gain a broader perspective of society and we can learn more about those in a variety of cultures and contexts. However, much of the content that is shared can be skewed towards a particular bias and lack factual or evidence-based thinking. To date, much of the user generated content is focused on product usage, entertainment, political opinion and health (Naab & Sehl, 2017), with 41% of users sharing a picture or video (Statista, 2022b). However, this figure may be significantly higher as in many cases those who create video or content often do not share this (Loftus et al., 2014). It is evident that there is very little educational content creation and usage. Myers (2018) highlights that young peoples' social experiences in the online spaces are very different to that in their educational contexts. A more critical approach to digital content creation and use is required. By providing educational opportunities for learners to create and develop user generated content in a 'safe' and scaffolded space, critical literacies and digital skills in multimodal content creation can be developed promoting access for all users (Myers, 2018; Loftus et al., 2014). Many educators are broadening their modes of learning beyond the traditional reproduction of texts to encourage students to create and construct their learning in a variety of modalities. This provides a number of advantages; it shifts the focus to student-centred approaches and constructivist pedagogies (Tiernan & Gurrin, 2012), learners simultaneously develop digital skills in addition to discipline-specific skills, learners develop critical literacy skills that can potentially influence their usage and sharing of user generated content on public platforms (Littlejohn et al., 2012). However, to support users to share generated educational content a number of barriers need to be overcome. -concerns about privacy, quality assurance and intended use (Loftus et al., 2014) are also echoed by higher education teachers (Cronin, 2018).

To address such issues, we need to consider widening research in the adoption of OERs to explore how we can support marginalised students to develop and share generated educational content. This requires educators to situate student generated OERs in the context of open pedagogical practices which support the development of a learning community to enable collaborative approaches to producing and developing learning (Couros, 2010). To date, much of the research has been focused on teacher adoption and creation of OERs, little research has focused on supporting students in the creation and sharing of educational content.

Open Education Practices (OEP)

The adoption of OERs provide opportunities in terms of co-creation and for students to co-create learning materials, assessment and learning activities. Cook-Sather (2018) highlights the importance of inviting marginalised students into the learning environment and providing them with opportunities to explore their identity in terms of how they fit into social structures and empower them to advocate for inclusive learning practices. OEPs provide a space in which all learners can contribute equally to a learning environment in different modes (Cook-Sather et al., 2014). This enriches the learning experience for all, as learners are provided with various lens' to view the curriculum. Hays and Mallon (2021) developed a framework for adopting OERs as a model for promoting inclusivity. They explored how supporting students to use and adapt OERs using the 5 R OER licensing model - (Reuse, Retain, Revise, Remix, Redistribute) could support the development of skills mapped in the Inclusive Pedagogy Framework, particularly interpersonal skills, intrapersonal awareness, fostering an inclusive and welcoming learning environment and offering multiple ways for students to demonstrate their knowledge (Centre for the Integration of Research, Teaching and Learning, 2017). The framework enables students to reuse learning material generated by other students, update OERs and redistribute these. These activities urge students to understand various perspectives, critically build upon these and share new perspectives. This encourages students to actively engage with OERs (Hays & Mallon, 2021).

However, OEPs are complex consisting of a myriad of individual and cultural barriers that are 'continuously negotiated' at nano, micro, meso and macro levels (Cronin, 2018). The next section will explore some of these challenges and how we can address such.

Supporting Students as Co-Creators and Consumers and Users of OERs

We have already seen that students often share personal information and user generated content on social platforms such as social media. However, this does not translate to the educational context. When exploring students as partners and co-creators, factors such as student identity (their perceived role in the learning environment), power balance, trust, community, reciprocity and digital literacy skills (O'Shea, 2018; Cook-Sather et al., 2014) can limit engagement in co-creation and the sharing and distribution of user-generated educational content.

Particularly, students' identities can limit students. Within an educational environment students' often see their role as passive spectators rather than active participants who make decisions and shape their learning. When a student is asked to play a more active role in their learning, they can often struggle as their identity has changed, they often find it difficult to understand where they fit into new educational structures and systems, particularly where power dynamics remain and they are graded and assessed by teachers. When they are invited to participate, they strive to understand what this means and how it impacts their learning and assessment. Furthermore, where learners are asked to share and collaborate without consideration for fostering community, it can create even more challenges. If individuals spend time creating high quality learning resources but those shared with them are poor, the lack of reciprocity can undermine a student's sense of belonging and identity. Having a common goal and expectations is key as well as a critical framework for self and peer assessments of OERs to ensure quality and reciprocity.

Brown et al. (2021) developed an open learning framework for students that focused on learner identity and role, fostering community and building relationships through four pillars:

- Clarifying the co-design process and negotiating each learner's personal learning pathway
- Building and sharing knowledge through learners choosing how to communicate their learning and make thinking visible
- Building learning relationships
- Sustaining the learning

However, in any framework learners require critical digital skills and literacies, to develop quality OERs. They need to understand the need to source information from reputable sources and express this information in a modality and format that is respectful and culturally aware of diverse students. To support students to adopt critical digital literacies, it is important that they not only have the digital skills to represent information in different ways but the media literacy skills to critically evaluate information sources through a variety of lens' and represent knowledge in a sensitive way. Given that as producers of digital content we often do not 'see' the reaction of our consumers, it can be difficult for learners to understand the potential impact of their OER.

Furthermore, the act of creating and sharing OERs learning is situated and community based. It can be argued that as learners engage in situated learning, they gain confidence and more from the community peripheries into the centre. Nurturing such efficacy is key to inclusive design. To develop learner agency, Lave and Wenger (1991) argue that Social practice, the Person and the Social World are key elements to supporting learners to shift from the peripheries of communities (in which marginalised people are often situated) into the centre. They particularly acknowledge 'the relational interdependency of agent and world, activity, meaning, cognition, learning, and knowing' (Lave & Wenger, 1991). Therefore, the individual must realise how they can influence the learning environment through the act of generating an OER that illustrates their interpretation and knowledge.

However, the power dynamic and balance that takes place within a learning environment are still prevalent. This is difficult to address given the structural limitations of the educational resource and the emphasis on assessment and quantifying engagement and performance. The development of a third space (or an informal space) to support students to contribute and share OERs is key. Although these spaces already exist, there is little integration into formal education. Integrating these spaces into formal education by encouraging students to identify and critique relevant OERs, and revise and remix resources is critical. However, we need to consider how these fit in with the overall context of the current educational system and provide recognition frameworks for students who engage in informal learning activities. Universal design for learning provides opportunities to empower students to critically develop and exploit OERs relevant to their individual learning pathways.

UDL Underpinning Inclusive Equitable Design

Universal Design for Learning (UDL) is a set of principles for curriculum development that gives all individuals equal opportunities to learn, including Students with Disabilities AHEAD (2017). UDL aims to improve the educational experience of all learners by introducing more flexible methods of teaching, assessment and service provision to cater for the diversity of learners across primary, post primary and tertiary education. This approach is underpinned by research in the field of neuroscience and is designed to improve the learning experience and outcomes for all learners.

UDL is not a new concept. It provides a framework for educators at all educational levels to map their inclusive practice and in doing so, highlights areas where potential access issues or barriers may occur for learners. A fundamental concept behind UDL is to design flexibility into the resources and methods used in the learning environment through the principles of multiple means of engagement, representation, action and expression. Rose and Meyer (2002) report that by using the UDL framework, educators can accept learner variability as a strength to be leveraged rather than a challenge to be overcome. Capp (2017) identifies that there is a disconnect between an increasingly diverse student population and a one-size-fits-all curriculum. UDL has been defined as a framework that 'proactively builds in features to accommodate the range of human diversity' (Mcguire et al., 2006:173), and encourages teachers to anticipate a variety of students' needs at the beginning of the lesson instead of modifying materials as an afterthought (Hitchcock, 2001).

In addition to providing a design frame, UDL also contributes to the construct of student-centrism by emphasising the role of UDL in the development of 'expert learners', that is, learners who are purposeful and motivated, knowledgeable and resourceful, strategic and goal directed (Meyer et al., 2014). UDL assumes that barriers to learning lie within the curriculum and not within the learner and that by designing out these barriers, we automatically open up learning opportunities for a greater number of learners. By acknowledging that authentic learning only takes place when a learner connects in a meaningful way with the learning experience, can we truly engage all learners.

In the development of accessible authentic learning environments, we need to design with our learners. Novak (2016) suggests that we need to give our learners voice and choice. While UDL does not solely depend on the use of technology, it does strongly recognise the potential of learning technologies to widen access and support inclusion and to build opportunities for learners to take ownership of their learning environments and interactions. Educators have the opportunity with the development of technology for learning to design OERs that are not just affordable and accessible but are accessible for all students spanning the full spectrum of human ability (SPARC, 2017).

UDL encourages learners to be co-creators in their learning environments and to take responsibility for their learning. The advancement in technology in the last 10 years means that once a competitive edge, customisation has become an expectation; Everyone wants a hand at designing their experience (Cadone, 2018).

Edyburn and Edyburn (2015) have argued that Goldilocks is an apt metaphor for describing learners experiencing UDL. That is, creation of environments that proactively support a continuum of needs (i.e., nourishment, support, rest) through the active engagement in making choices to determine what is 'just right'. However, the question is who is in charge of designing the bear's home (e.g., classroom) to ensure that all that is needed is in place for all who may enter? For education to be truly meaningful, it needs to be co-designed by the main stakeholders, i.e. the learners. McClaskey (2016) states there is a significant and growing demand for learners to be able to do more than receive instruction, follow a learning path designed by educators and complete problems and assignments presented to them by an adult. Learners need to develop the capacity to shape and manage their learning without over-reliance on the direction and control of others. The learners need opportunities within their learning to develop expert learning skills and become experts in their own abilities to learn to be able to identify and manipulate resources to support them where they are in their continuum of learning.

UDL inspires students to become architects of their own learning (Posey & Novak, 2020). This choice empowers learners but choice without capacity is not choice. Learners need to be supported to develop the necessary digital skill sets to engage in purposeful and meaningful ways with digital resources (Ó Ceallaigh, 2021). The current unprecedented access to technology for living has led to the perception that all young people have technological expertise. This myth is perpetuated by the continuous and all-consuming use of social media and by the ability of the user to create content. However, there is no adequate measure in place to determine the quality of the interactions and outputs. The persistent lack of technological integration in our classrooms has led to a disconnection between technology for personal use and technology for learning. COVID-19 has given rise to the prolific use of technology across all learning environments. However, the need for an unplanned and untested pivot to fully online learning environments has further perpetuated the argument that technology is an integrated part of all learning environments. We need to capitalise on the opportunities afforded by this new integration of technology in our classrooms, but we need to take stock and analyse the skill sets needed by all stakeholders to effectively use technology to design and develop meaningful and accessible scholarly learning experiences for all going forward. Boyer et al. (2016) talks about the scholarship of integration as being the means by which people bring together ideas and concepts from a range of different sources in new and creative ways. It is within these exciting shifting spaces, using a diversity of new and traditional tools, that students integrate. This exciting space referred to in this chapter as the third space is a realm, if resourced properly, that will give access to learners to develop as co-creator and architects of their own learning. This third space enables the teacher to move from the role of teaching information to teaching how to learn. Allowing the opportunity to design with and not for learners enhances both the teaching and learning experience for all. Open pedagogy is one such practice that allows the engagement of learners as creators of information rather than simply consumers of it. It is a form of experiential learning in which learners demonstrate understanding through the act of creation which fits with the three main principles of UDL. Bovill et al. (2011) having the opportunity to collaborate with academic staff in developing pedagogical approaches inspired students to experience an increased sense of engagement, motivation, and enthusiasm. Having an opportunity to design and develop OER gives the learning community the opportunity to hear the voices of the wider community which inevitably result in the development of resources which more accurately reflect the users by being more linguistically and culturally appropriate. Perhaps now more than at any other time we are in a position to realise the potential of OERs by championing our newfound readiness to embrace technology as a result of the worldwide pandemic, coupled with the rising understanding of the growing diversity of our student population and the need for equitable access to learning for all. We can work together in this dynamic and invigorating third space to create an equitable digital learning ecosystem that views learners as partners.

A Third Space Infusing Open Educational Resources (OER) with Universal Design for Learning (UDL)

We can see that OERs provide significant potential to support inclusive and accessible learning and teaching. However, there are a number of barriers to the adoption and development of OERs. Students are often largely reliant on teachers to direct them towards relevant OERs. As adult learners it is important that they develop their identity as architects of their own learning. UDL can be leveraged to encourage learners to become self-aware of their own learning needs in terms of modality and content and provide them with the agency to shape such. OERs provide significant opportunities for learners to go outside formal education to learn from other voices and students have a wider choice as they can select learning material that meet their needs in a medium that aligns to their preferred mode of learning. However, quality and criticality can remain an issue. Therefore, students need to be provided with critical literacy skills to support them in identifying evidence-based OERs (Myers, 2018; Loftus et al., 2014). Furthermore, OERs can provide capacity for students to make themselves heard and amplify their voices. There are a number of challenges that arise for students, particularly their privacy and concerns about the intended use of the content they generate (Loftus et al., 2014). For digital education to be truly open and inclusive, we need to meet students where they are and address these concerns. A third space that provides opportunity to build community, trust and facilitate reciprocity is key- a place where learners explore their identity and how they are situated in their educational contexts and how they can influence such to make learning more inclusive.

Bhabha (2007) defines the third space as a hybrid place which encourages individuals to explore how they are uniquely situated in a social space. He argues that the third space is an

> overlap and displacement of domains of difference-that the intersubjective and collective experiences of nationness, community interest, or cultural value are negotiated (Bhabha, 2007 p. 38).

The third space is defined differently in a variety of contexts, Bahaba first adopted the term to offer a lens in which to inquiry into post-colonial cultures. In Higher Education many teaching and learning professionals that neither have an academic nor administrative role identify themselves as being in a 'third space'.

In the context of OER and inclusive education, the third space (Fig. 1) argues for a place in the curriculum that combines formal and informal learning worlds with a view to providing opportunities for learners to explore their identity in the context of education and how they can influence inclusive approaches to learning and teaching by adopting OEPs.

In the first space is associated with one's beliefs (Soja, 1998). In the context of this chapter, this is within informal learning through the leans of UDL. In this space learners build self-awareness of their learning needs and formulate their individual learning identity as active participants in the construction of an inclusive learning environment in line with Lave and Wengers theory of Legitimate Peripheral participation (1991). In the second space are social norms that are constructed (Soja, 1998). This is the informal learning space where OERs provide social perspectives and knowledge. These offer significant opportunities for choice in terms of modality of learning (multiple means of representation) and content. For example, once learners are aware of what and how they wish to learn, the third space provides them with the skills to support them to identify and critically evaluate the relevant OERs

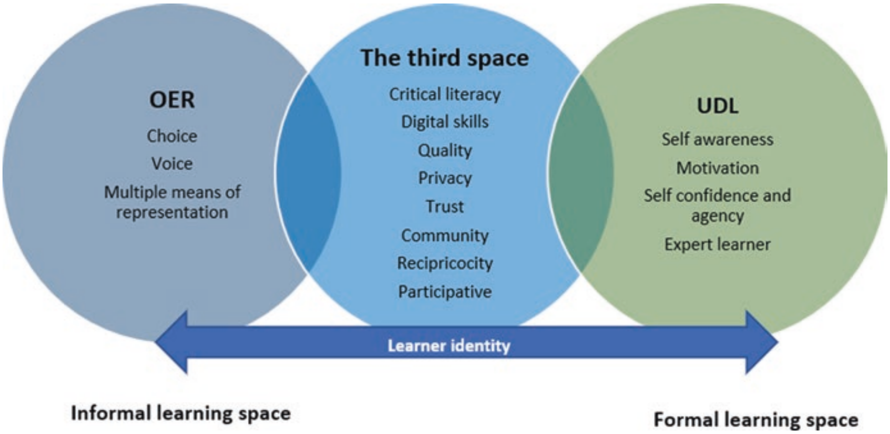


Fig. 1 Third space infusing OER with UDL

(in the informal world) that meet their needs. Furthermore, it provides opportunity for new and multiple student voices by empowering students to reuse, revise and remix existing OERs (Wiley & Hilton, 2018). Alternatively, students are encouraged to develop their own OERs and license these appropriately using the OER framework. The third space is the living space (Soja, 1998). It provides a place in the curriculum to bridge formal and informal learning worlds. It facilitates the development of digital skills to support learners to adapt and develop OERs and critical literacies to recognise quality OERs. In a safe space in the curriculum, students work together, build trust and a community of open learning in which they actively participate in the development and revision of OERs. They peer review and provide critical feedback through co-generated interpersonal norms (Woolf, 2020) which enables self-confidence and efficacy in the development and sharing of OERs and the development of their identity as 'expert learners'. Finally, students are encouraged to share their revised and user generated content with the wider OER community.

Conclusion

Open education and OER drives innovation and transformative approaches to teaching and learning (Nascimbeni & Burgos, 2019). Particularly, open education and the adoption of OERs encourages educators to 'let go' of the traditional view of the teacher as the creator and distributor of learning and knowledge and support learners to explore a variety of voices in the learning context through various modalities. This enables spaces for marginalised and multiple perspectives, providing a more inclusive learning environment. However, these practices are reliant on the educator providing opportunities for collaborating, co-creation and sharing which are often not mainstream practices.

Furthermore, students as partners or participatory pedagogical approaches can vary significantly along a continuum from providing limited choices to students in terms of material, assessment and engagement, to co-creation of such learning activities and finally joint decision making and partnership (Bovill, 2020). Open education and OER have the potential to support the principles of UDL in developing expert learners who are resourceful and knowledgeable, strategic and goal-directed, purposeful and motivated. It is only by having opportunities to capture the voice of all stakeholders, we can truly design fully inclusive learning environments for all and thus ensure success for all.

References

AHEAD, Universal Design for learning. (2017). https://www.ahead.ie/udl

Bhabha, B. (2007). *The location of culture* (rev ed., p. 2007). Routledge Classics.

Blomgren, C. (2018). OER awareness and use: The affinity between higher education and K-12. *The International Review of Research in Open and Distributed Learning, 19*(2). https://doi.org/10.19173/irrodl.v19i2.3431

Bovill, C. (2020). *Co-creating learning and teaching: Towards relational pedagogy in higher education*. Critical Publishing.

Bovill, C., Cook-Sather, A., & Felten, P. (2011). Students as co-creators of teaching approaches, course design, and curricula: Implications for academic developers. *International Journal for Academic Development, 16*(2), 133–145.

Boyer, R. H., Peterson, N. D., Arora, P., & Caldwell, K. (2016). Five approaches to social sustainability and an integrated way forward. *Sustainability, 8*(9), 878. https://doi.org/10.3390/su8090878

Brown, B., Roberts, V., Jacobsen, M., Hurrell, C., Neutzling, N., & Travers-Hayward, M. (2021). Introduction: Creating an OER using an open learning design framework. In *Ethical use of technology in digital learning environments: Graduate student perspectives, volume 2*. PRISM, https://prism.ucalgary.ca/handle/1880/112963

Cadone, T. (2018). Embracing customization in higher education: Leveraging personal learning design to promote design thinking and self-authorship. *About Campus, 23*(4), 11–18. https://doi.org/10.1177/1086482218817533

Capp, M. J. (2017). The effectiveness of universal design for learning: A meta-analysis of literature between 2013 and 2016. *International Journal of Inclusive Education, 21*(8), 791–807. https://doi.org/10.1080/13603116.2017.1325074

Centre for the Integration of Research, Teaching and Learning. (2017). Inclusive pedagogy framework. https://cirtlincludes.net/wp-content/uploads/2018/03/Inclusive-Pedagogy-Framework.pdf

Connolly, C., Hall, T., Jones, S., & Procter, R. (2020). Research informed teaching in a global pandemic: Opening up schools to research. In R. E. Ferdig, E. Baumgartner, R. Hartshorne, R. Kaplan-Rakowski, & C. Mouza (Eds.), *Teaching, technology, and teacher education during the COVID-19 pandemic: Stories from the field*. Association for the Advancement of Computing in Education (AACE). https://www.learntechlib.org/p/216903/

Cook-Sather, A. (2018). Developing "Students as Learners and Teachers": Lessons from ten years of pedagogical partnership that strives to foster inclusive and responsive practice. *The Journal of Educational Innovation, Partnership and Change, 4*(1), 1–7.

Cook-Sather, A., Bovill, C., & Felten, P. (2014). *Engaging students as partners in learning and teaching: A guide for faculty*. Jossey-Bass.

Couros, A. (2010). Developing personal learning networks for open and social learning. In *Emerging technologies in distance education* (pp. 109–127). Athabasca University Press, Edmonton, Canada. http://www.aupress.ca/books/120177/ebook/06_Veletsianos_2010-Emerging_Technologies_in_Distance_Education.pdf

Cronin, C. (2017). Openness and praxis: Exploring the use of open educational practices in higher education. *International Review of Research in Open and Distributed Learning: IRRODL, 18*(5), 15–34.

Cronin, C. (2018). *Openness and praxis: A situated study of academic staff meaning-making and decision-making with respect to openness and use of open educational practices in higher education*. Available at https://aran.library.nuigalway.ie/handle/10379/7276?show=full

Educause. (2020). *2020 Educause horizon report: Teaching and learning edition*. https://library.educause.edu/resources/2020/3/2020-educause-horizon-report-teaching-and-learning-edition

Edyburn, D. L., & Edyburn, K. D. (2015). Design for more types: Designing text to support the access, engagement, and success of diverse learners. In *Accessible instructional design*. Emerald Group Publishing Limited.

European Commission. (2013). *Communication from the Commission to the European Parliament. Opening up education: Innovative teaching and learning for all through new technologies and open educational resources*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013DC0654

Hays, L., & Mallon, M. N. (2021). Using OER to promote inclusion in higher education institutions. *Currents in Teaching & Learning, 12*(2), 20–33.

Hitchcock, C. (2001). Balanced instructional support and challenge in universally designed learning environments. *Journal of Special Education Technology, 16*(4), 23–30.

Hoadley, C., & Uttamchandani, S. (2021). *Current and future issues in learning, technology, and education research*. Spencer Foundation.

Hurley, T. A., & Hallmark, J. R. (2020). Inclusive access and open educational resource programs: A system perspective. In T. A. Hurley (Ed.), *Inclusive access and open educational resources: E-text programs in higher education* (pp. 3–14). Springer Nature. https://doi.org/10.1007/978-3-030-45730-3

Katz, S., & Brandle, S. M. (2020). Why do CUNY faculty adopt OER: A qualitative inquiry [O-013]. OER20 The Care in Openness Conference. https://oer20.oerconf.org/sessions/o-013/members/

Lane, A. (2009). The impact of openness on bridging educational digital divides. *The International Review of Research in Open and Distance Learning, 10*(5), 1–12, https://doi.org/10.19173/irrodl.v10i5.637

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.

Littlejohn, A., Beetham, H., & McGill, L. (2012). Learning at the digital frontier: A review of digital literacies in theory and practice. *Journal of Computer Assisted Learning, 28*(6), 547–556.

Loftus, M., Tiernan, P., & Cherian, S. (2014). Students' readiness to move from consumers to producers of digital video content: A cross-cultural analysis of Irish and Indian students. *Education and Information Technologies, 19*(3), 569–582.

Luo, T., Hostetler, K., Freeman, C., & Stefaniak, J. (2020). The power of open: Benefits, barriers, and strategies for integration of open educational resources. *Open Learning: The Journal of Open, Distance and e-Learning, 35*(2), 140–158. https://doi.org/10.1080/02680513.2019.1677222

McClaskey, K. (2016). *Developing the expert learner through the stages of personalized learning*. https://www.learningdesigned.org/sites/default/files/McClaskey_2017.pdf

Mcguire, J. M., Scott, S. S., & Shaw, S. F. (2006). Universal design and its applications in educational environments. *Remedial and Special Education, 27*(3), 166–175.

Meyer, A., Rose, D. H., & Gordon, D. T. (2014). *Universal design for learning: Theory and practice*. CAST Professional Publishing.

Myers, A. (2018). *Developing critical consumers and creators: Merging critical literacy with digital tools*. Texas Forum of Teacher Education. https://txate.org/resources/Documents/2018-myers.pdf

Naab, T. K., & Sehl, A. (2017). Studies of user-generated content: A systematic review. *Journalism, 18*(10), 1256–1273.
Nascimbeni, F., & Burgos, D. (2019). Unveiling the relationship between the use of open educational resources and the adoption of open teaching practices in higher education. *Sustainability, 11*(20), 5637.
Novak. (2016). *UDL now! : A Teacher's guide to applying universal design for learning in today's classrooms*. CAST Professional Publishing.
Ó Ceallaigh, T. J. (2021). Teacher educators and teaching presence in the asynchronous learning environment: Emerging issues and future priorities. In R. E. Ferdig & K. E. Pytash (Eds.), *What teacher educators should have learned from 2020* (pp. 125–143). AACE2021. Available at https://www.learntechlib.org/p/219088/
O'Shea, S. (2018). Equity and students as partners: The importance of inclusive relationships. *International Journal for Students as Partners, 2*(2), 16–20.
Pawlowski, J. M., & Hoel, T. (2012). Towards a global policy for open educational resources: The Paris OER declaration and its Implications. *White Paper, Version 0.2, Jyväskylä, Finland*.
Posey, A., & Novak, K. (2020). *Unlearning: Changing your beliefs and your classroom with UDL*. CAST Professional Publishing.
Rose, D. H., & Meyer, A. (2002). *Teaching every student in the digital age: Universal design for learning*. Association for Supervision and Curriculum Development.
Schaffhauser, D. (2020). OER commons launches authoring tool. *THE Journal*. Accessed 6 Apr 2022 at https://thejournal.com/Articles/2020/01/06/OER-Commons-Intros-Authoring-Tool.aspx?p=1
Soja, E. W. (1998). Thirdspace: Journeys to Los Angeles and other real-and-imagined places. *Capital & Class, 22*(1), 137–139.
SPARC Open Education Leadership Program. (2017). https://sparcopen.org/our-work/open-education-leadership-program/
Statista. (2022a). *Percentage of internet users who use TikTok in the United Kingdom (UK) as of 3rd quarter 2020, by age group*. https://www.statista.com/statistics/1184043/tiktok-user-demographics/
Statista. (2022b). User-generated content - Statistics & Facts. https://www.statista.com/topics/1716/user-generated-content/#dossierContents__outerWrapper
Tiernan, P., & Gurrin, C. (2012, April). Towards developing a collaborative video platform for learning. In *Proceedings of the Ireland International Conference on Education (IICE)* (Vol. 1618, pp. 277–281), Dublin.
Van Allen, J., & Katz, S. (2020). Teaching with OER during pandemics and beyond. *Journal for Multicultural Education, 14*(3/4), 209–218. https://doi.org/10.1108/JME-04-2020-0027
Wiley, D., & Hilton, J. (2018). Defining OER-enabled pedagogy. *The International Review of Research in Open and Distributed Learning, 19*(4). https://doi.org/10.19173/irrodl.v19i4.3601
William and Flora Hewlett Foundation. (2013). Open educational resources. White Paper, William and Flora Hewlett Foundation. Available at: https://hewlett.org/wp-content/uploads/2016/08/OER%20White%20Paper%20Nov%2022%202013%20Final_0.pdf
Woolf, S. B. (2020). Exploring pedagogies to elevate inquiry: Teaching action research in the third space. *Educational Action Research, 28*(4), 579–596. https://doi.org/10.1080/09650792.2019.1629975

Open Educational Resources for Inclusive Education: A Tangible Response for Italian School

Lucia Ferlino, Giovanni Caruso, and Vincenza Benigno

The ICF and the Use of Technologies

According to World Health Organization (WHO, 2002), disability is considered as a consequence of an interaction between the person's health condition and the environment where s/he lives, defining the so-called biopsychosocial model of disability.

The International Classification of Functioning (ICF; WHO, 2002) provides a broad analysis of the state of health of individuals considering the relation between health and the environment, and defining disability as a health condition in an unfavourable environment (Leonardi, 2005). WHO, through the ICF, promotes and disseminates the following definition of disability:

> disability is defined as the consequence of factors or the result of a complex relationship between an individual's health condition and personal factors, and environmental which represent the circumstances in which the individual lives (WHO, 2002).

The analysis of the different existential dimensions of the individual brings to light not only how people live their difficulties, but also what can be done to improve the quality of their life. When the environmental and social conditions do not consider the functional limits of the person, and the social context does not adapt to them, barriers arise that hinder social participation, not allowing true inclusion.

The ICF, by correlating health condition and the environment, promotes a method for measuring health, skills, and difficulties in carrying out the various activities, which makes it possible to identify the obstacles to be removed or the interventions to be carried out to allow the individual to maximize his personal satisfaction.

L. Ferlino · G. Caruso · V. Benigno (✉)
Institute for Educational Technologies of the National Research Council in Genoa (ITD-CNR), Genoa, Italy
e-mail: ferlino@itd.cnr.it; caruso@itd.cnr.it; benigno@itd.cnr.it

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_3

Environmental factors interact, in particular circumstances, with all dimensions of the individual's functioning and can act as barriers or as facilitators, thus having a positive or negative effect on his performance and therefore on the active participation of each individual. In this framework, the technologies, which ICF classifies as environmental factors, are effective tools to support the independence and autonomy of the person, favouring both activities and participation.

Technologies can facilitate the inclusion in the educational context as well as the active participation in the social and working life of those in difficult situations (WHO, 2002; ISTAT, 2019), by taking different roles that correspond to different ways of approaching educational actions oriented to the Special Normality.

In this sense, technologies can play a compensatory/enabling role, by making "able" those students who cannot perform a specific function due to various difficulties, as well as a participatory support by guaranteeing participation in a social learning context (also remotely). Technologies should be considered as mediators between the person and the environment and, to foster inclusion, they can range of cases (UNESCO, 2015).

Technologies should be considered as mediators between the person and the environment and, to foster inclusion. Table 1 shows an example of some disabilities/difficulties and how technological resources, in their compensatory/enabling and participatory role, can foster the involvement of students in difficulty into normal school life, allowing them to express themselves based on their potential. Technologies can take on distinct roles to:

- *compensate*, allowing to carry out and make normal activities otherwise precluded;
- *develop disciplinary skills and competences* in learning contexts that respond to the training needs of the involved students;
- *learn knowledge and contents* in compliance with the methods of accessing the most appropriate information for the students involved in their use (Chiappini et al., 2004).

Table 1 Types of difficulty and purposes in the use of technology

Type of difficulty	Purpose in the use of technology
Motor-sensory disabilities	Overcoming disability to enter into communication with others (compensatory action) to encourage participation in the teaching-learning process (participatory action)
Cognitive disabilities	Enhance cognitive processes (rehabilitative action) and support the active and participatory learning path (participatory action)
Other SEN Special educational needs (learning disabilities, social hardship, etc.)	Facilitate the personalization of the learning path (compensatory action) and/or favour the sharing of the same didactic path (participatory action)
Health problems that prevent normal school attendance	Participate remotely, actively, and collaboratively in the class activities

These roles sometimes intersect and have the common goal of promoting autonomy, learning and building meaningful relationships for the students, achieving the best didactic-educational objectives appropriate for them. Nevertheless, when considering the use of technological resources to support the processes of educational and/or socio-educational inclusion for students in situations of hardship, a very wide range of cases has to be considered.

Particularly, ICT and web 2.0 technologies are contributing to the transformation of educational models thanks to the introduction of software tools that allow participation, the production of user-generated content, collaborative tagging, the expression of preferences, the personalization of content with respect to the profile user, the aggregation of content through the mashup. Learning becomes more dynamic, interactive, and social. The Web is not only the place where information can be found, but it becomes the place where new contents are created, or existing ones are improved. The status of the students with disabilities changes: from passive consumers of contents to active producers, able to add value to their courses.

In this context, educational and assistive technologies, particularly OERs, play a crucial role in creating learning contexts according to an approach universally recognized as accessible for all (WHO, 2002).

Open Educational Resources (OER)

For some years now, the European Union has been carrying out the "Open Education" action, with the objective of promoting the adoption of an open approach to teaching, shared and adaptable to individual contexts and specific needs[1] (Orr et al., 2015; Banzato, 2012; Ferrari, 2021). Within this context, OERs are of great interest.

Focusing on each single word, it is possible to outline the value of the OERs in the production and sharing of knowledge:

- *Open*: an educational content (of any kind) is open when the author shares it freely and it can be reused according to one of the copyleft licenses.
- *Educational*: any resource that has an educational goal is educational, whether it is designed for the teacher (transmission of knowledge) or the student (exercise to gain knowledge or skills).
- *Resource*: any tool that allows to create texts, videos, multimedia elements, structured as didactic units, academic articles, courses.[2]

OERs contribute to the development and dissemination of educational resources, and, by guaranteeing free access, they promote training (Nascimbeni, 2020).

[1] https://ec.europa.eu/jrc/en/open-education

[2] https://www.epict.it/content/oer-open-educational-resource

In addition to supporting students, they play an important role for teachers who can reuse them, modify them, or use them as ideas for new productions (Orr et al., 2015).

These resources are free of charge and access barriers, and grant legal permission (issued by the authors) for open use (mainly reuse and modify), such as, for example, Creative Commons (CC) licenses. This type of rights, which allow anyone to use, adapt, and share resources anytime and anywhere, are generally defined in terms of "5R"[3] (Wiley, 2014; Scheunemann et al., 2018):

- *Retain*, make, own, and control a copy of the resource;
- *Revise*, edit, adapt, adjust, modify, or alter the content itself (e.g., translate the content into another language);
- *Remix*, combine the original or revised content with other open content to create something new (e.g., incorporate the content into a mashup);
- *Reuse*, use the original, revised, or remixed copy of the resource publicly in a wide range of ways (e.g., in a class, in a study group, on a website, in a video);
- *Redistribute*, share copies of the original, revised, or remixed copy of the resource with others (e.g., give a copy of the content to a friend).

Types of OERs and Where to Find Them

OERs are usually divided into different types:

- *Courses*, open and free courses that can be attended by anyone interested;
- *Textbooks/Lesson Plans*, books and teaching units;
- *Multimedia/Software*, software for creating, distributing, using and modifying open educational contents, including the research and organization of contents, content and learning management systems, content development tools and online learning communities;
- *Simulations/Games*, online and offline games and simulations;
- *Assessment*, online and offline assessment tests
- *Scientific Research*, scientific works and publications

Some websites collect multimedia and text resources under a CC license, such as:

- *Europeana*: which promotes the European cultural heritage through both textual and multimedia documents (https://www.europeana.eu/);
- *OER Commons*: a public digital library of open educational resources (https://www.oercommons.org/);
- *OpenStreetMap*: free alternative to Google Maps, maps that can be used without restrictions (https://www.openstreetmap.org/);
- *Openverse*: over 600 million articles that can be freely reused (https://wordpress.org/openverse/?referrer=creativecommons.org);

[3] This material is based on the original writing by David Wiley.

- *Arasaac pictograms*: can be used to create free augmentative and alternative communication tables, with the only limitation that they cannot be used for commercial purposes (https://arasaac.org/pictograms/search);
- *Search Creative Commons*: a search engine addressing over 500,000 resources (https://oldsearch.creativecommons.org/);
- *Wikibooks*: a set of books in different languages, including Italian (https://it.wikibooks.org/wiki/Wikibooks:Bibiverso);
- *Wikimedia Commons*: a repository of images, sounds, and videos released under CC licenses (https://commons.wikimedia.org/wiki/Main_Page), a lot of which are also present in Wikipedia.

In addition to using search engines and repositories to find and locate OERs, systems such as Flickr, Google or YouTube offer specific advanced features.

Available Licences for the Creation of Open Multimedia Resources

There are mainly three different types of use licenses for OERs:

- *Public domain*: resources are not subject to copyright (e.g., literary or musical works of the past, where the author is not known or is uncertain, produced several decades ago). The concept of "public domain" is subject to interpretation and its meaning (as well as related rights and duties) can change from country to country.
- *Creative Commons*: resources are subject to copyright which grants the right to use or modify a work with very limited restrictions.
- *GFDL* (Gnu Free Documentation License): the contents of the resources can be reused and modified without limitations (while acknowledging the authors for the original work).

Among these, CC are the most complex; they are copyright licenses whose main purpose is to protect the author of the work while, at the same time, allowing users to use, reuse and share. In fact, a CC license grants both the right to share (copy, distribute, transmit) and modify (change, adapt) the original works, while defining four possible conditions (or clauses) for its use:[4]

- *BY* – Attribution: it is possible to copy, distribute, show, and make copies of the original work and the works derived from it, as long as the original author is mentioned as indicated by him.
- *NC* – Non-commercial: it is possible to copy, distribute, show, and make copies of the original work and the works derived from it, only for non-commercial purposes.

[4] Source: Wikipedia https://it.wikipedia.org/wiki/Creative_Commons#Le_quattro_clausole

- *ND* – Non derivative works: it is possible to copy, distribute, show, and make identical copies (verbatim) of the original work, but any derived work or re-elaboration is not allowed.
- *SA* – Share alike: it is possible to distribute works derived from the original one only under a license that is identical (not more restrictive) or compatible with the original one (see also copyleft).

By combining the two rights (share and modify) with the four conditions of use, the CC organization defined six licenses, among which the author can choose to best protects his work while allowing its sharing. Table 2 summarized the six licences showing permissions and limitations. The CC-BY license is the one that guarantees a greater degree of freedom, while the presence of the ND clause, which prevents derived works, implies greater limitations. The CC-BY-NC-ND is the most restrictive license and is therefore considered as a non-free culture license. In all cases, the author of the work must be mentioned and the link or the license text must be reported.

The Advantages of OERs[5]

Allowing to reuse, adapt, remix, and redistribute teaching materials in a flexible and customizable way can be beneficial for both teachers and students.

Table 2 Licenses and freedom of use

Allow/ license	Share	Modify	Derivative works	Commercial use	License change	Conditions
CC BY	Y	Y	Y	Y	Y	It is mandatory to indicate any changes
CC BY-SA	Y	Y	Y	Y	N	License change not allowed
CC BY-NC	Y	Y	Y	N	Y	Commercial use not allowed
CC BY-NC-SA	Y	Y	Y	N	N	License change not allowed/Commercial use not allowed
CC BY-ND	Y	N	N	Y	N	License change and content modification not allowed
CC BY-NC-ND	Y	N	N	N	N	License change and content modification not allowed/Commercial use not allowed

[5] Freely taken from: https://guides.library.queensu.ca/oer/about

OERs offer teachers the possibility to spend more time on other aspects of the teaching and learning process. Furthermore, reusing existing OERs can foster new and creative learning approaches by increasing the availability of usable resources.

OERs can be integrated both in face to face and remote teaching, in a flexible and adaptable manner,[6] and can contribute to an increase of a global common knowledge supporting international development. Moreover, the resulting savings from the use of OERs can result in a greater number of licensed resources, both in a printed or digital format.

Using OER also has benefits for students. Limiting economic and technological barriers creates greater accessibility to education. Furthermore, learning materials that are more accessible and adapted to specific needs can create a positive learning experience based on flexibility.

OERs for Inclusive Education

To promote a really inclusive teaching environment, the use of tools that can be adapted to the specific needs of their users is fundamental. These needs can be of various kinds, and it is difficult to find resources designed, right from the beginning, to be used by everyone. Needs change over time and an innovative resource can become obsolete in a short time. To meet the needs and have long lasting renewable resources, a significative intervention is often needed, and the limitations imposed by proprietary licenses and/or high costs may be a serious limit for the most fragile users with greater needs. Since OERs promote reuse and adaptation, they can enhance and support inclusive education (Watkins et al., 2020).

In the Italian research and education context, the creation of open resources of various kinds (software, teaching units, multimedia contents, etc.) has been encouraged in the last decades, with the aim of spreading their use and promoting social and educational inclusion for all students.

The Contribution of Research for the Italian School

Among other OERs, the Free/Libre and Open Source Software (FLOSS) plays a significant role, as it provides a large number of educational software for different school levels and disciplines. Nevertheless, the FLOSS environment is very dynamic and finding the needed resources is not easy as methodological skills, resources and time are needed to identify, evaluate, and catalogue existing software.

The Institute for Educational Technologies of the National Research Council in Genoa (ITD-CNR) carries out this activity by cataloguing the existing educational

[6] https://unesdoc.unesco.org/ark:/48223/pf0000215804

software. The Library of Educational Software was established in 1985, and access to it is provided through the Essediquadro database which can be freely consulted online (since 1999). The FLOSS for teaching are constantly analyzed and catalogued, while their use among teachers is promoted (since 2003). Moreover, other types of resources that can be used in the educational context are also added to the database (since 2014).

Since 2003, ITD-CNR has been carrying the So.Di.Linux[7] project (Educational Software for Linux, a free operating system, FLOSS). The research project was launched in the context of a collaboration with AICA[8] from 2003 to 2008 with the aim of carrying out a survey of the educational software, an experimentation in the classroom and a dissemination of the results and of the created software (CD and DVD). The project was extended and is still ongoing. Over the years, several versions of So.Di.Linux have been released, and since 2006 particular attention has been paid to accessibility issues and the principles of universal design. Furthermore, a close collaboration and synergy between professionals directly involved in the school and those who study education was created, allowing for the last versions to be the result of a common work between researchers and teachers.

The So.Di.Linux project started with the aim of creating and disseminating Open Source teaching tools in the school environment; over time it has maintained the interest in education, innovation, and school, but focused more on free software as a central element for inclusion of students with disabilities.

The software selected in So.Di.Linux aims at addressing educational issues in schools, and not technical ones, while providing assistive technologies and accessibility functions. Actually, the main objective is to create the conditions for open, inclusive, and personalized teaching, in which everyone can learn "in their own way," according to their needs, with their limits and with their potential (Caruso et al., 2016).

The latest version is "So.Di.Linux Horizons 2025," published in February 2021, which offers an opportunity to learn about software suitable for promoting inclusion processes that are often unknown and that work on multiple platforms, to have a robust and stable system for classrooms and laboratories that contains maintained and updated software (guaranteed until 2025) chosen, validated, documented and integrated by ITD-CNR (one of the main Italian points of reference on the topic of inclusion and educational software).

So.Di.Linux is based on GNU/Linux, an open source operating system that can be optimized to make the best use of the (limited) resources of a wide range of electronic devices. Customizing the operating system also makes it possible to use hardware that is not of the latest generation, making it more durable and thus combating the phenomenon of planned obsolescence.

[7] https://sodilinux.itd.cnr.it/

[8] Associazione Italiana per il Calcolo Automatico – Italian Association for Automatic Calculation.

GNU/Linux with no license costs allows removing the barriers created by licensing and maintenance costs and to reuse computers whose operating system can no longer be updated (e.g., Windows 7, Mac Os High Sierra, etc.) because they do not have enough hardware resources for the new versions.

The choice of this operating system has therefore proved to be a winning one for introducing open source educational software to Italian schools, which do not always have modern computers for use in the classroom or at home.

The selection of the software to be included into So.Di.Linux is driven by a series of criteria identified together by teachers and researchers who collaborate in the project. All software is updated to the current Linux Mint/Ubuntu Linux distribution, interoperable, available for multiple operating systems and compatible with them (Windows and Mac OS). They all have an Italian interface and (some of them) also in a foreign language. They are intuitive, easy to use, but also documented with tutorials and online manuals.

The software that was selected for educational and inclusive use, is organized in the menu (Fig. 1) according to its purpose, in particular to:

- Compensate for difficulties
- Communicate with symbols
- Create audio/video lessons
- Create maps, flowcharts, and timelines
- Teaching with the network
- Manage and manipulate texts
- Manage images

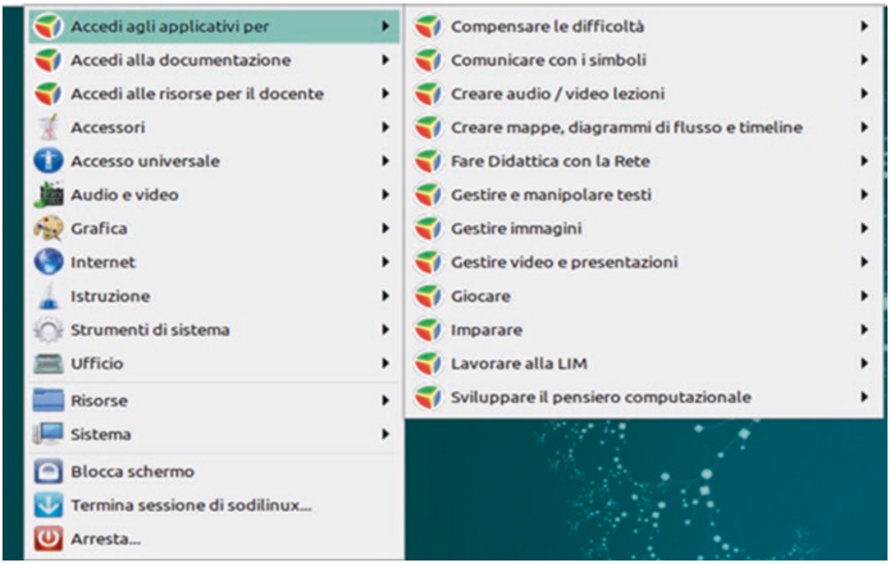


Fig. 1 Access menu for the selection of educational software

- Manage videos and presentations
- Play
- Learn
- Work with the Interactive Whiteboard
- Develop computational thinking

Furthermore, So.Di.Linux also offers some tools for universal access, such as the magnifying glass, the on-screen keyboard, as well as functions to activate assistive technologies in a personalized manner (support for the Braille bar, speech synthesis management, keyboard shortcuts, etc.).

The So.Di.Linux Characteristics

So.Di.Linux has a number of educational features that have made it a very popular resource among teachers who have chosen it for their inclusive teaching actions. It is easy to use, thanks to an intuitive interface and accessible contents. Facilitated access functions and native assistive technologies allow users with disabilities to directly use the system and its software. Teachers can renew their teaching by easily create video lessons, make screencasts or podcasts. So.Di.Linux also offers inclusive educational opportunities, providing teachers and students with software for the creation of mental and conceptual maps, for reading digital texts in PDF, for reading written texts.

From a methodological point of view, all the educational software present in the system is documented in Essediquadro, the Documentation Service on Educational Software and other digital resources;[9] moreover, from the So.Di.Linux website it is possible to download the documentation of all the applications present in "So. Di.Linux Horizons 2025."[10]

From a technical point of view, So.Di.Linux is based on the GNU/Linux operating system which is known for its stability, thanks to its design and to the work of its development community that constantly improves it, solves compatibility issues and/or software bugs. The result is a tested and updated product, which provides the user with an environment with a low risk of malfunctioning. Furthermore, the system allows the use of the older computers, optimizing the exploitation of the available resources, thanks to its ability to adapt to the underlying hardware. This feature, combined with the available software (educational and non-educational), allows to minimize the costs and time required for setting up a lab or digital classroom.

So.Di.Linux, by providing educational and non-educational programs that run on multiple operating systems (multiplatform), allows to use the same software without depending on a specific operating system.

[9] https://www.essediquadro.it

[10] https://sodilinux.itd.cnr.it/mod/resource/view.php?id=169&redirect=1

Finally, a community of people supports and guarantees the longevity and stability of So.Di.Linux, by providing technical and methodological support through a series of channels, such as the mailing list,[11] the dedicated Facebook page[12] and its website.[13]

In the following parts of this work, some applications for inclusion, communication and access to contents are presented, referring to specific disabilities.

So.Di.Linux for the Inclusion of Specific Disabilities

In the case of motor or sensory disabilities, technology is used to facilitate communication with others (compensatory action) to foster participation in the teaching-learning process (participatory action). It is therefore important to provide the most suitable tools to allow performing activities that would otherwise be precluded and to make inclusion possible on an operational level. This is the case in which technologies mainly have an enabling role. So.Di.Linux offers, as an example, an on-screen virtual keyboard that can be used with the mouse or its emulator. The system allows also to set the preferences for the use of assistive technologies, customizing its use according to the needs. For more severe motor disabilities, when the use of a keyboard is not possible, the system offers "Dasher," an interface for entering text, that is based on word prediction and is driven by natural pointing movements.

Also in the presence of visual impairments, technologies take on mostly an enabling role. Interaction with the computer through specific input and output peripherals, as well as special programs, can facilitate the learning process of the students with visual disabilities, acting directly on self-perception and potential recognition. So.Di.Linux offers specific tools as: a magnifying glass to enlarge part of the screen (Virtual Magnifying Glass – VMG or KMagnifier), a screen reader (Orca Screen Reader – Orca) that provides access to applications and toolkits and a character recognition software (gImageReader) used by the screen reader.

In case of hearing disabilities, in most cases, there is no need to use assistive technologies, however the use of multimedia elements may facilitate learning without a specific adaptation of the used hardware or software. People with hearing difficulties tend to have problems in deciding and understanding contents. In these cases, the use of learning environments (that can be also shared) offered by So.Di. Linux can create interesting learning opportunities, such as:

- Cooperative editing of a text in a virtual classroom using, for example, Gobby;
- Storytelling through the creation of e-books using, for example, LibreOffice Writer or Sigil;

[11] https://sodilinux.itd.cnr.it/index.php/subscribe

[12] https://www.facebook.com/sodilinux/

[13] https://sodilinux.itd.cnr.it

- The adaptation of the texts through the use and construction of mental and conceptual maps (Dia, Diagramo, Freeplane, Wiki 2 map).

In the presence of cognitive disabilities, the purpose of the technologies is to enhance cognitive processes (rehabilitative action) and to support an active and participatory learning path (participatory action). To enhance cognitive processes, within So.Di.Linux, two suites of various activities for the development of basic skills are available: GCompris and Omnitux.

Since technologies can play an important role in inclusion by supporting communication through, for example, the use of symbols, some tools have been included within So.Di.Linux that can be used for this purpose, such as Araword supporting Augmentative and Alternative Communication (AAC), SIMCAA to create AAC texts, and "Sussidiario" for images, an online library of school texts adapted to AAC.

With respect to other Special Educational Needs (SEN), such as Specific Learning Disorders, social discomfort, etc., the purpose of the technologies is to facilitate the personalization of the learning path (compensatory action) and/or facilitate sharing of the same educational path (participatory action). Technologies, in these cases, offer both rehabilitation tools and tools to assist in the deficient function. When faced with these difficulties, the relevant educational software presents specific educational objectives focused on structuring those skills that the particular type of difficulty does not allow to acquire completely by following the normal course of study and/or traditional teaching techniques.

So.Di.Linux offers support applications for reading text in multiple languages such as GSpeech, that can read parts of text and the contents of the clipboard, and LibreOffice Writer which, thanks to the addition of the Voxvox plugin for text reading, provides users with text reading in real time; both software can work without an active Internet connection. Furthermore, some software allowing the construction of mental and conceptual maps is also provided (Dia, Diagramo, Freeplane, Wiki 2 map) to graphically represent knowledge.

Finally, there are some pathologies that prevent normal school attendance, creating SEN, and that deserve attention. In these contexts, the main purpose of technologies is to allow the student to participate remotely, actively, and collaboratively in the life of the class (Benigno et al., 2019). Most software used for remote control or video calling rely on "proprietary" cloud services, but there are some alternative solutions based on FLOSS software. Unfortunately, these usually require technical skills to be installed and managed, which hinders their diffusion. In 2020, the COVID-19 emergency offered an opportunity to encourage the use of these tools by end users and schools; particularly in Italy, the "Iorestoacasa" initiative collected on a web site a set of freely accessible servers managed both by private individuals and by Italian institutions (including some CNR institutes and Italian universities) based on free software (particularly Jitsi, Edumeeting, BigBlueButton). Through So.Di. Linux the web site "iorestoacasa.work" can still be accessed freely by anyone.

Essediquadro

Essediquadro[14] is an online Documentation Service on Educational Software set up in 1999 as part of a collaboration between the Italian Ministry of Public Education (MPI) and the National Research Council (CNR). CNR had a previous experience in the creation and management of an Educational Software Library, which lasted more than 15 years, offering in service teachers and trainees constantly updated information on multimedia products available on the national and international market, on their use in the context of the various disciplines and on the use experiences made with them in particular learning situations. Since its establishment, Essediquadro has always been active and constantly updated based on the still ongoing collaboration between MPI and CNR. In 2014, a complete restyling of the website and its contents was carried out, opening it to all types of digital educational resources and no longer limiting them to educational software only. Essediquadro offered both information about the existing resources (through the database) and orientation for its use in different contexts (through insights). Starting from 2016, a new teacher training service was added.

Referring to the concept of Open Education, Essediquadro offers an even more flexible interpretation, where "open" can refer to all the available educational experiences, accessible at no cost, including training courses based on proprietary content (Nascimbeni, 2020).

According to this approach, the contents of the information service (database and insights), while maintaining intellectual property, are open to all those who want to be informed on digital educational resources, and the training contents are available and usable by anyone. In the last years, the available training proposals have been used as in-depth studies also in university courses and post-graduate training courses.

The Database

The Essediquadro database contains about 1400 digital educational resources catalogued through descriptive cards and can be searched both in a free or structured manner. There is a wide number of different resource types: software tutorials, exercises and explanations on specific topics, in-depth sectoral insights and monographs on issues related to the curriculum, products for the autonomous construction of knowledge, reference works. To these, two new types were added: apps and online resources (video lessons, social media, simulations, portals, learning environments, software collections). The number of cards obviously varies according to the school levels and disciplines covered. A part of the catalogued resources is related to school inclusion (disabilities, disadvantaged situations and learning difficulties); for these, the descriptive cards have some additional specific information.

[14] https://sd2.itd.cnr.it

Fig. 2 The Database section

The database section shows all the cards of the catalogued resources, ordered starting from the most recently added (Fig. 2).

In the list of available resources (from which the detailed file can be accesses), in addition to the title, a short description and an image, some icons (fixed or variables) provide information on the type of resource, the license, the type of device needed for its use, the availability of related insights, etc.

The long list can be filtered, using two search methods:

- *free search*: by typing a word to be searched in the descriptive cards;
- *structured search*: using (and/or combining) different search criteria (by subject, by school level, by language, by type of resource, by hardware required, etc.).

The descriptive cards aim to highlight the most significant aspects of the available resources. The card contains a longer description, a summary, the educational characteristics (subject, topic, teaching strategy, school level, prerequisites), the system requirements (operating system, type of needed device), information for finding the resource (publisher and distributor, author and, if available, where to consult it). Each descriptive card also has two significant images of the resource that can be enlarged.

All the cards that describe a resource that was created for inclusion are enriched by indications on the target users' functional limitations addressed, and the specific devices that are needed or optional for the best use of the resource.

There is also information that highlights the software produced by schools, the free and opensource ones, making them more easily identifiable.

Insights

The insights (Fig. 3) offer either an overview of some disciplinary sectors (or some themes), or focus on specific resources. In both cases, they offer information needed for an informed choice of resources involved. From the insights, the files of the resources mentioned can be accessed.

In particular, they report:

- Use experience: knowing the use experiences others with the involved resource is a valuable opportunity to share, as it offers the possibility to learn about original solutions to problems frequently found in daily work;
- Sector analysis, or systematic overviews of the educational software for a specific area;
- Educational paths, or educational units centred on the use of specific digital resources designed according to objectives that are consistent with ministerial guidelines (working hypotheses, methodological indications functional to curricular planning, etc.);
- Food for thought, or ideas to stimulate a critical vision, highlighting strengths and weaknesses.

As for the Database section, the Insights section provides a list of all the available titles, starting from the most recent one. In the list of resources gives access to the detailed insight, and contains the title, the subject area, and the school level to which the insight refers, along with an icon showing the type of resource. The list

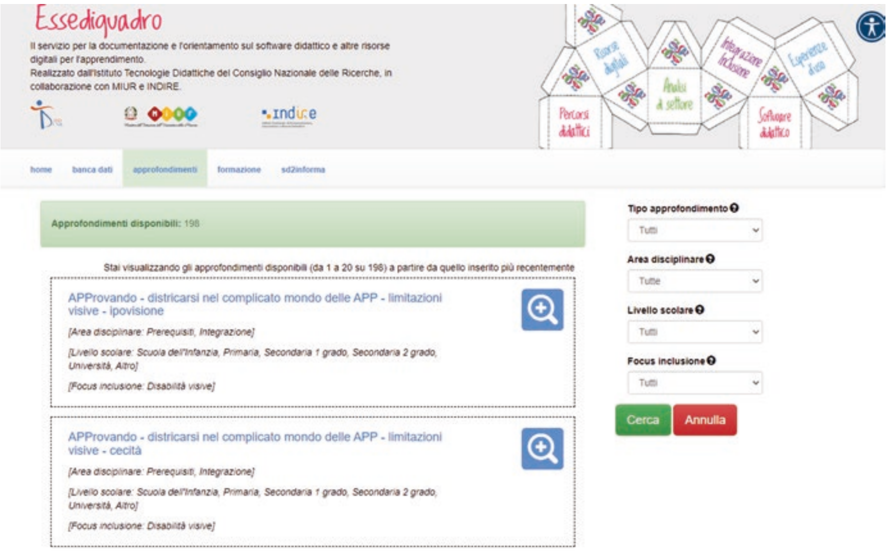


Fig. 3 The Insights section

can be filtered with a structured search including different possible search criteria (by subject area, by school level, by type of study, Focus inclusion, etc.).

Essediquadro Training

In January 2016, the new Essediquadro Training platform was released (https://sd2.itd.cnr.it/corsiformazione), with the specific aim of offering teachers on the "Technologies, teaching and inclusion" theme (Fig. 4).

The purpose of the platform is to contribute, in the broader scenario of teacher training, to a growth in knowledge, skills and applications on the educational use of digital technologies aimed at school inclusion. The platform stems from over 30 years of experience of ITD-CNR in this specific educational area, guaranteeing a highly qualified training offer, unique of its kind.

Target Users

The target users are in service teachers (disciplinary and non) working in the Italian schools, as well as trainee teachers. There are no specific requirements for the use of the service, it can be accessed free of charge from any device connected to the

Fig. 4 The Training section

Internet, after a short registration. Due to the very specific theme addressed by the platform, over time it has become a national reference point. Between 2016 and 2022, 25,000 users (mainly teachers) have registered and followed some courses.

Contents and Methods of Use

The platform offers online courses organized into several modules (the specific number depends on the single course). For each module, 2 hours of training are formally recognized to teachers.

Course attendance is free and autonomously managed by the user since there are no predefined time frames. The platform offers both open courses, accessible to anyone, and reserved courses, specially designed for a specific circumstance or group of users. Most open courses are based on the contents of webinar cycles carried out as part of training proposals for disciplinary and support teachers, organized by ITD-CNR (or in collaboration with) in several projects approved by MIUR. Reserved courses are usually organized by single schools or school networks, as part of MIUR projects, under the supervision of ITD-CNR. These courses can only be accessed by teachers from the schools participating in the projects.

Between 2016 and 2022, 13 open courses were created and made available for a total of 310 hours of assisted teaching and 12 reserved courses (created in collaboration with the beneficiary institutions) for a total of 643 hours of assisted teaching.

The service is freely used, free of charge and, at the end of the course, issues a training certificate that is officially recognized by MIUR, through certificates and open badges. The training initiatives present on the platform are included in SOFIA (the Operating System for Training and Professional Development Initiatives for teachers) in the online catalogue, among the initiatives proposed by the schools and by MIUR accredited/qualified bodies according to Directive 170/2016.

Overall, 124 speakers lectured in the courses, including CNR researchers and technologists, university professors, schoolteachers of all levels, operators of the Territorial Centres of Support for the use of technologies of the Ministry of Education, psychologists, psychomotricists, pedagogists, assistive technology experts, trainers.

As a consequence of the direct contact with the teachers following the courses, researchers were pushed to investigate some research topics related to aspects highlighted by the participants through questionnaires and comments. In some cases, new research lines were activated in the context of inclusive teaching. Essediquadro Training also contributed to consolidating collaborative relationships with the University of Genoa (which entrusted ITD-CNR the teaching of some ordinary courses and in some the specialization course for support teachers), with USR[15] Liguria and with several schools (through agreements for ad hoc training courses).

[15] Ufficio Scolastico Regionale – Regional School Office.

The project, which started as an experimental activity, has become a permanent training service offered by the institute, used by many schools throughout the country, as well as school networks. Furthermore, it is recognized and used in external training courses organized by other institutions. Collaboration agreements with some institutions were started, leading to the design and use of new training initiatives within the platform, such as the MI Territorial Support Centres, schools, school networks.

Conclusions

Inclusion in the educational context is an international priority and, as stated in the 2030 agenda, the goal is to provide quality, equitable and inclusive education, and a learning opportunity for all (Objective 4).

Nevertheless, the objective is not easy to reach, the obstacles to inclusive processes in the presence of disabilities are many, and of different natures. The adoption of the biopsychosocial model according to the ICF helps to understand how environmental factors can be considered among the main causes that determine a person's disability.

Technologies, particularly OERs as discussed in the present work, are resources that can facilitate participation in the social and educational context of each individual, provided they are used and managed in a competent manner. In doing so, they can avoid physical, psychological, or sensory difficulties to turn into a real disability.

So.Di.Linux and Essediquadro, thanks to the availability of a considerable variety of resources, are configured as two services that can respond effectively and punctually to the different needs of inclusion in the Italian school.

They support users (students, families, and teachers) by offering tools with compensatory, rehabilitative, and participatory purposes and accompanying them in the acquisition of technical and methodological skills oriented towards a school where no one should be left behind, everyone must have the opportunity to access Education (UNESCO, 2020; Bucholz & Sheffler, 2009).

References

Banzato, M. (2012). Open Learning. Il caso dei MOOC tra luci e ombre [The case of MOOCs between lights and shadows]. *Formazione & Insegnamento, 3*, 11–33.

Benigno, V., Ferlino, L., & Trentin, G. (2019). Tecnologie abilitanti. Un nuovo paradigma per l'inclusione [Enabling technologies. A new paradigm for inclusion]. *Inclusione a 360°. Equità e valorizzazione dei talenti,* Pearson, Milano.

Bucholz, J. L., & Sheffler, J. L. (2009). Creating a warm and inclusive classroom environment: Planning for all children to feel welcome. *Electronic Journal for Inclusive Education, 2*(4). Retrieved at: https://corescholar.libraries.wright.edu/ejie/vol2/iss4/4/

Caruso, G., Ferlino, L., & Fusillo, F. (2016). SoDiLinux@cts-2015: uno strumento per una didattica sostenibile [SoDiLinux @ cts-2015: A tool for sustainable teaching]. *Nea Science - Giornale Italiano di neuroscienze, psicologia e riabilitazione, 3*(10), 148–152.

Chiappini, G., Dini, S., & Ferlino, L. (2004). Tecnologie didattiche e disabilità [Educational technologies and disabilities], D. Parmigiani (a cura di), *Tecnologie per la didattica*, Franco Angeli, Milano.

Ferrari, L. (2021). Risorse Educative Aperte e Massive Open Online Courses. Opportunità, limiti e sfide nel campo dell'educazione formale [Open educational resources and massive open online courses. Opportunities, limits and challenges in the field of formal education]. In *La responsabilità della pedagogia nelle trasformazioni dei rapporti sociali. Storia, linee di ricerca e prospettive* (pp. 1120–1127). Pensa Multimedia.

ISTAT. (2019). *Report sull'inclusione scolastica: accessibilità, qualità dell'offerta e caratteristiche degli alunni con sostegno, Anno scolastico 2017–2018* [Report on school inclusion: Accessibility, quality of the offer and characteristics of pupils with support, School year 2017–2018]. Retrieved at: https://www.istat.it/it/files//2019/01/Alunni-con-sostegno-as-2017_18.pdf

Leonardi, M. (2005). Salute, Disabilità, ICF e Politiche Sociosanitarie [Health, disability, ICF and health and social policies]. *In Sociologia e Politiche Sociali* (vol. 8, n.3, pp. 73–95). Franco Angeli Editore.

Nascimbeni, F. (2020). *Open Education. OER, MOOC e pratiche didattiche aperte verso l'inclusione digitale educativa* [Open Education. OER, MOOC and open teaching practices towards educational digital inclusion]. Franco Angeli, Milano.

Orr, D., Rimini, M., & Van Damme, D. (2015). Open educational resources: A catalyst for innovation. In *Educational research and innovation*. OECD Publishing. https://doi.org/10.1787/9789264247543-en

Scheunemann, S., Brandão, A., & Brauner, D. (2018). *Rethinking the 5 R's in open educational resources: A reuse perspective*. 1729. https://doi.org/10.5753/cbie.sbie.2018.1729

UNESCO. (2015). *Embracing diversity: Toolkit for creating inclusive, learning-friendly environments*. Retrieved at: http://unesdoc.unesco.org/images/0013/001375/137522e.pdf

UNESCO. (2020). *Global education monitoring report 2020: Inclusion and education-All means all*. 92310038. Retrieved at: https://en.unesco.org/gem-report/report/2020/inclusion

Watkins, C., Treviranus, J., & Roberts, V. (2020). Inclusive design for learning: Creating flexible and adaptable content with learners. *Commonwealth of Learning*. Retrieved at: https://snow.idrc.ocadu.ca/articles/inclusive-design-for-learning-creating-flexible-and-adaptable-content-with-learners/

WHO. (2002). *International classification of functioning, disability and health*. Children & Youth (ICF-CY). Retrieved at: http://www.who.int/classifications/icf/en/ (trad. it. ICF. Classificazione Internazionale del Funzionamento, della Disabilità e della Salute, Erickson, Trento).

Wiley, D. (2014). *The access compromise and the 5th R – Iterating toward openness*. Retrieved at: https://opencontent.org/blog/archives/3221

Digital Education to Approach the Affective Domain in Mathematics Learning

Teresa F. Blanco, Alejandro Gorgal-Romarís, Cristina Núñez-García, and Pablo G. Sequeiros

Introduction

The last decades have been very productive with respect to innovation processes and advances in educational technology (Daniela, 2019). Progressively, different active methodologies capable of positively influencing the motivation and academic performance of students have emerged (Mosley et al., 2016; Rodríguez-García & Arias-Gago, 2022). An example of this is the STEM (Science, Technology, Engineering and Mathematics) approach, which starts from real problems that involve integrated work, providing an interdisciplinary vision of teaching and where technology acquires an important weight.

If we focus on the relationship that exists between the disciplines of technology and mathematics, within this STEM approach, it can be said that it is reciprocal (Hansson, 2020). Modern technology is inconceivable without mathematics, but mathematics also uses technology to carry out many tasks. As Hansson (2020) points out, within mathematics, technology is not used exclusively to perform calculations, but is also used to seek proofs, validations or counterexamples and to understand concepts. In addition to providing benefits at a cognitive level, the introduction of technology in the classroom has positive effects on the affective dimension (García et al., 2021; Vankúš, 2021; Zetriuslita et al., 2020). Technological resources to work on solving contextualized mathematical problems help to improve

T. F. Blanco (✉) · A. Gorgal-Romarís · C. Núñez-García
University of Santiago de Compostela, Faculty of Science Education, Santiago de Compostela, Spain
e-mail: teref.blanco@usc.es; alejandro.gorgal@rai.usc.es; cristina.nunez.garcia@usc.es

P. G. Sequeiros
University of Santiago de Compostela, Faculty of Teacher Training, Lugo, Spain
e-mail: pablo.gonzalez.sequeiros@usc.es

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_4

students' attitudes towards mathematics (Brad & Tangney, 2017; Diego-Mantecón et al., 2019; García & Romero, 2009; García et al., 2021) and, in addition, promote self-efficacy, which reinforces the interest of students (Mosley et al., 2016).

In this chapter, we first present the affective domain in mathematics as a domain strongly linked to the cognitive domain, which acquires a special aspect in contexts of inclusion. Secondly, some educational technologies used in mathematics, as well as their contributions to the two previous domains, are shown. Thirdly we present and analyze math activities supported by digital educational technology that have been implemented within the framework of a socio-educational program with students at risk of exclusion. The aim is to evaluate the affective suitability of these activities and provide a possible framework that helps to reduce the digital gap derived from disadvantaged contexts.

Affective Domain in Mathematics

Even if it is true that mathematics presents an intrinsic difficulty due to its abstract nature, the stereotypes created around it do not help to promote a positive and attractive vision favoring its teaching-learning processes. The growing interest in the last three decades towards the affective domain in mathematics education is due, among other things, to the acceptance that a deep understanding of school mathematics is not limited to a solid conceptual understanding of elementary mathematics, but rather the awareness of the conceptual structure and the basic attitudes of mathematics inherent in it (Gómez-Chacón & Marbán, 2019). The affective domain is strongly related to the cognitive domain, forming a system that is difficult to separate, and its impact on it is decisive in the learning process (Beltrán-Pellicer & Godino, 2020; DeBellis & Goldin, 2006; Goldin, 2009; Gómez-Chacón, 2000). Research on mathematics performance (Cueli et al., 2014; Gómez-Chacón, 2000; Kalloo & Mohan, 2012; Lamana-Selva & De la Peña, 2018; Lomibao et al., 2016; Maree et al., 2013) points out that many of the problems related to failure in this subject are due to the lack of encouragement and motivation of students, who do not perceive mathematical tasks as pleasant or stimulating.

There is some consensus regarding the basic partitioning of the affective domain into *beliefs*, *attitudes*, and *emotions* from McLeod (1992), although research on emotions has received less attention, probably due to the lack of adequate instruments for diagnosis and measurement, among other reasons. Other facets to provide more suitable models to different research aims have been added. Regarding the theoretical framework that has modeled the experience that we will present, Beltrán-Pellicer and Godino (2020) consider *values*, following DeBellis and Goldin (2006).

Although a comprehensive evaluation of the effectiveness of instruction regarding the affective domain requires intervention studies, those specifically designed for mathematics have been neglected (Schukajlow et al., 2017). It has been suggested that open tasks would provide opportunities to meet student needs of autonomy, competence and belonging, thanks to their different levels of complexity and the number of emotions that they can generate (Hannula, 2015). Students learn mathematics best when engaged in building connections between mathematical ideas for themselves at the start of a sequence of learning, prior to instruction from the teacher (Ingram et al., 2020) and solving multiple solution problems provides positive experiences of autonomy and competence and increases students' interest in mathematics (Schukajlow & Krug, 2014). A little further, teaching of mathematics within the framework of a well-structured STEM (Bennison & Bielinski, 2018) or Service-Learning (SL) program (Wilkerson, 2021) is proving useful in helping students begin to perceive mathematics as more useful, as a worthwhile science. However, in any case, we must pay special attention to students who do not come out of the zone of confusion, which could imply their overall perception of themselves as "not good" at mathematics, by comparing themselves with other students experiencing more success (Ingram et al., 2020).

Mathematics, Technology, and Affect

Nowadays, the need and benefits of including technology in twenty-first century education are no longer questioned (Budhwar, 2017; Daniela, 2019; Ferraguti et al., 2020). Technology-rich classrooms help students understand conceptual ideas and apply these concepts and skills to real life (Brad & Tangney, 2017; Kwon, 2017; Radović et al., 2019). In the case of mathematics, so marked by school failure and low academic performance, technology is especially relevant because, in addition to the benefits at a cognitive level, it helps to foster positive attitudes towards the subject by emphasizing its practical applications (Brad & Tangney, 2017; De Witte & Rogge, 2014; Diego-Mantecón et al., 2019; García & Romero, 2009; García et al., 2021).

Gómez-Chacón (2011) and Gómez-Chacón et al. (2016) highlight the positive results of using technologies that promote visualization and exploration to develop perseverance, autonomy, critical thinking, precision and rigor, and an inductive attitude in students. Along these lines, the potential of the GeoGebra dynamic geometry software has been corroborated in numerous investigations, especially in the formulation of conjectures, arguments, proofs, and problem solving (García et al., 2021; Gómez-Chacón et al., 2016; Granberg & Olsson, 2015). Research by Wassie and Zergaw (2018), Yoganci (2018), Zetriuslita et al. (2020) and García and Romero (2009) especially highlight the significant effect that this software provides in the affective domain, promoting increased confidence, self-esteem, interest, and motivation in students. Among the GeoGebra attributes that most contribute to the development of student confidence, constructiveness stands out, as well as interactivity, which helps to overcome blocking situations.

In addition, the great variety of applications existing today is a favorable point for the introduction of mobile devices as a didactical tool in teaching processes, which allow addressing numerous contents of any area of mathematics (Aryasa et al., 2021; Bouck et al., 2018; Verzosa et al., 2021). Studies such as those by Blanco and

Ares-Méndez (2021), Papadakis et al. (2018), Larkin and Milford (2018) and Dubé et al. (2020) try to analyze the quality of the multiple mobile applications that exist in iTunes or Google Play. Mobile technology can provide a potential alternative solution to memoristic mathematical learning, especially when the application design is based on solid pedagogical principles and gamification elements (Verzosa et al., 2021; Blanco & Ares-Méndez, 2021). Furthermore, Aryasa et al. (2021) and Hsu et al. (2021) suggest that the use of applications in the classroom makes learning mathematics more attractive, motivating and interesting.

On the other hand, introducing technology as an isolated science in the educational system would reduce its usefulness, because reality problems appear as a result of the intersection of different disciplines. In this sense, various works highlight the educational benefits of introducing robotics in the classroom to improve the interest, participation and academic performance of students in the disciplines that make up STEM (Anwar et al., 2019; Bellas et al., 2019; Daniela, 2019; Shankar et al., 2013; Stergiopoulou et al., 2017). According to Mosley et al. (2016), a cooperative learning environment using robotics promotes self-efficacy, which serves as a stimulus to generate a positive attitude towards STEM disciplines. The research by Shankar et al. (2013) shows how learning math with robots helps students visualize real-world applications as well as support multiple representations of a problem. Furthermore, it allows students to develop lasting practical experience in a social context and improve their attitude towards mathematics education.

Another technology with great potential to improve STEM education and favor interdisciplinary connections is 3D design and printing, which is beginning to occupy an important place in the educational field, postulating itself as a very useful resource for working with mathematics (Beltrán-Pellicer, 2017; Beltrán-Pellicer & Rodríguez-Jaso, 2017; Blanco & Fernández-López, 2021; Lieban & Lavicza, 2019; Segerman, 2012). The Tinkercad design program, much simpler than other existing ones and free, makes this environment accessible in any educational setting (Beltrán-Pellicer, 2017; Beltrán-Pellicer & Muñoz-Escolano, 2021; McGahern et al., 2015). In addition, this simple software offers students valuable skills and a solid understanding of the aspects covered (McGahern et al., 2015). Thus, Kwon (2017) shows in his study that 3D printing, and three-dimensional design software provide positive effects on students' motivation, as well as on their interests and abilities, both mathematical and real life.

The effect of these technologies on the teaching and learning of mathematics has also been analyzed in inclusion contexts (Bennison & Bielinski, 2018; Cárdenas et al., 2020). Mobile devices have been one of the great allies to favor the teaching and learning processes of mathematics in students with educational needs. Studies such as the one by Tangarife (2018) and the one by Bouck et al. (2017) show its effects on mathematical performance in students with down's syndrome and in students with learning difficulties in basic operations, respectively. The study by Cárdenas et al. (2020) presents robotics as an escape route for students with a lack of motivation for learning. However, Daniela et al. (2017) draw attention to the little research on the use of this technology involving students at risk of early school leaving.

Methodology

The activities we present in this chapter are part of a socio-educational program called "Anaquiños Matemáticos" (Mathematical Bits). The program was carried out fortnightly after school hours in secondary schools on the surroundings of the city of Santiago de Compostela (A Coruña, Spain). It consists of 14 activities that have a maximum duration of 1 hour and in which the STEM methodology is applied (Blanco et al., 2018). A brief presentation of the activities can be found on the program's website (http://gidem-tesela.es/anaquinos/). All the participants are students in the first year of Spanish Compulsory Secondary Education (from 12 to 16 years old) and share the common characteristic of being students at risk of social exclusion due to their family conditions. These students show disturbing behaviors in the classroom and lack of interest in academic explanations and finishing tasks or doing homework. In addition, other conditioning factors are added, such as the lack of empathy. This situation of social vulnerability influences their educational process and their poor academic performance. A total of 68 high school adolescents participated in the program during three editions. The selection of the students was carried out jointly by the researchers, the mathematics teachers, and the orientation staff of the educational centers. Informed consent was obtained from all subjects involved in the study, as well as permission to use photographs of participants during the sessions.

The data collection was done by recording the activities on video, the field diary, and a satisfaction questionnaire for each activity, where they were asked in relation to interest, difficulty, liking and perceived learning. As an analysis instrument, the affective suitability indicators of Beltrán-Pellicer and Godino (2020) detailed in Table 1 have been taken and adapted.

The following sections will briefly describe the different activities that were carried out with the following digital educational resources: apps, robots, 3D design

Table 1 Components and criteria of affective suitability

Components	Criteria
Languages	L1. Attention is paid to non-verbal language to foster immediacy
Emotions	E1. Qualities of aesthetics and precision of mathematics are highlighted E2. Specific moments along the activities are scheduled so that students can express their emotions towards the proposed situations
Attitudes	A1. Self-esteem is promoted, avoiding rejection, phobia, fear of mathematics A2. Participation in activities, perseverance, responsibility, etc. is promoted to foster a mathematical attitude A3. Argumentation is favored in situations of equality. The value of an argument does not depend on who says it
Beliefs	B1. The beliefs about mathematics, about the meta-cognition of students, about the teaching of mathematics and about the social context in which they develop learning are explored and considered
Values	V1. The value and usefulness of mathematics attributed by students in daily and professional life are explored and considered

and printing, and GeoGebra software. Apps have been introduced to work from a playful approach, robots and 3D design and printing from a STEM educational perspective and GeoGebra as a tool specifically focused on geometry and measurement. Activities were designed according to the characteristics of these students, mentioned above. This means that to keep their attention, the resources are varied, and different activities are proposed for the same resource with different objectives, both in relation to affective aspects and mathematical content. In addition, to encourage empathy, individual participation is combined with group dynamics and static work with dynamic one.

Mobile Apps

To favor inclusion, it was considered that part of these students did not have access to a Smartphone or Tablet, so they were all provided with the same devices to avoid differences. It was decided that this would be the first activity due to its playful nature and because it was the most familiar resource for the students, so it was assumed that this would imply greater confidence in its use. To begin to create a climate of trust, the students were allowed to choose to do the activity in pairs or individually, depending on whether they felt more comfortable. This resource also helps create that climate of trust by allowing students to feel free to manipulate it both standing and sitting, an important feature given the restless nature of these students. In addition, the approach of the activity encourages collaboration since the objective was for everyone to reach the highest level possible without rewarding the first one achieving it.

Two games were presented to maintain the interest of the students. The Block Puzzle and Math Stick games of the Brain Training-Logic Puzzles game application (https://play.google.com/store/apps/details?id=com.psp.brainmindgames&gl=US) were chosen, through which arithmetic and geometry contents are worked with a strong support in spatial visualization. The objective proposed with this activity is to reach the highest level in a maximum time of 10 minutes.

The Block Puzzle (Fig. 1) is a game whose objective is to fill a shaded figure with an indicated number of pieces, where each piece is formed by joining two or more squares. The geometry area is worked on indirectly, developing spatial vision and rigid movements in the plane (symmetries, translations and turns). In the first levels the pieces that cover the figure are placed in the position in which they appear, in higher levels it is necessary to mentally apply rotations and symmetries to be able to fit the pieces. On the screen of the Math Stick (Fig. 2) and equality appears where both the numbers and the operators are built by sticks. The objective of the game is to move as many sticks as the current level indicates so that equality is true. The level of difficulty increases when the number of sticks that need to be moved increases and when the field of action is extended to the other side of the equality or to the operators themselves. This game works mental agility linked to arithmetic calculation and visualization.

Fig. 1 Student trying to solve level 4 (Block Puzzle)

Fig. 2 Student trying to solve level 4 (Math Stick)

Robotics

Robotics activities were presented as an opportunity for these at-risk students to use this resource outside of the classroom. They were raised to work in pairs, designing and developing the steps to be executed and distributing the work in a coordinated manner. In the three activities proposed, the components of each pair have a role that they must exchange. This favors dialogue between them and an increase in their self-efficacy.

It has been used the mBot model (https://www.makeblock.com/mbot-3), which has a simple and small physical design (Fig. 3). This networkable educational robot is designed for student interaction with content applications in the real world. The movements of the robot are controlled through the mBlock program, which is a graphical programming environment based on the Scratch 2.0 editor . This program

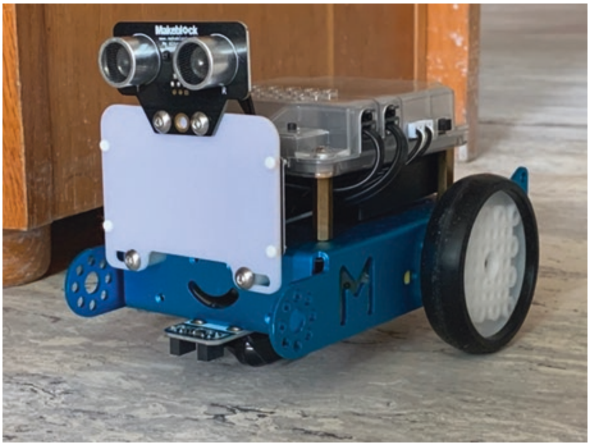


Fig. 3 mBot robot

presents an interface aimed at introducing robotics in a simple and intuitive way, with a programming language based on connecting predefined blocks that issue orders to the robot and thus direct its movement. A brief instruction in the programming language was therefore necessary at the beginning, so special care was taken to avoid blocking situations because of novelty.

Three activities were carried out, which are detailed below: Learning to drive, Polygonal routes and Arithmetic at a line. The mathematical content involved focuses on angles, polygons and perimeter.

Learning to Drive

The first introductory activity is carried out so that the students become familiar with the robot and with the mBlock program. The students, in pairs, must program the devices to be able to control their movement through the arrow keys on the computer keyboard (Fig. 4). They are asked to make basic movements with the robot (Fig. 5): go forward, stop, go backward, turn right, turn left. The goal is to perform a combination of this type of movements.

Next, among all the groups, a circuit, which has as many curves as the number of groups of students, is built on a piece of paper on the ground. To create the curves, each group selects an angle and builds it on the floor using the protractor (Fig. 6). Finally, all the angles are joined creating a double parallel line that will shape the circuit, becoming the lanes along which the robots move (Fig. 7).

Once the circuit is created, the students program their robot to go through it, adjusting in terms of time, speed, and distance, and they also carry out simulations as a test. The objective is to travel the circuit in the shortest time without leaving the lane and making the turns only once. The components of each team are distributed in such a way that one of them is the pilot and the other the co-pilot. The pilot controls the robot's movements via the computer and the co-pilot records the time it

Fig. 4 Robot programming

Fig. 5 Initial movements of the robot

takes to complete the route, the number of times the robot goes outside the marked lines and the number of turns it makes. Then the roles are exchanged. Finally, the times of each team are compared, and the best driver is chosen (Fig. 8).

Polygonal Routes

Each group of students builds a regular polygon on the floor The goal is to program the robot to walk the perimeter of its polygon automatically. Figure 9 shows students building regular pentagons. The students carry out several tests until they discover that they must carry out a repetitive programming that only implies paying attention to the direction and the advance time. Once these two parameters have been set, the students must adjust them to determine the precision of the robot's movement and that it travels around the perimeter (Fig. 10).

Fig. 6 Angle construction

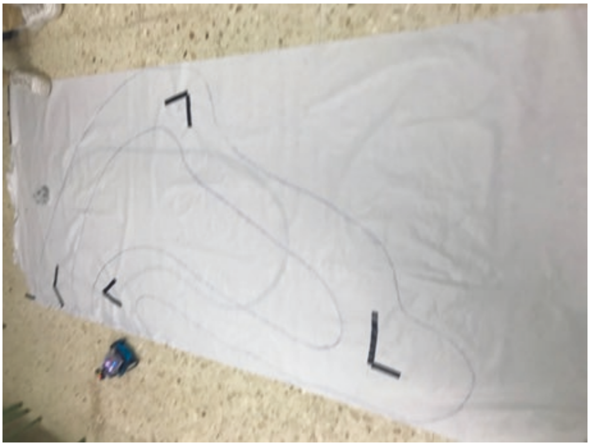


Fig. 7 Circuit construction

Arithmetic at a Line

This activity is based on the classic game of three in a row incorporating the basic operations in arithmetic (addition, subtraction, multiplication and division). The robot moves on a board of 9 squares with a number in each of them (Fig. 11). One of the students is the pilot and he controls the robot, and the other is the co-pilot and gives the indications of the position of the square to which the robot must move to place the card it is carrying (Fig. 12). These indications are given by means of an operation whose result is the number of that box. The pilot must solve this operation to program the robot and position itself in that box. In the next game, the roles of the team members are exchanged. The winning team is the one that puts all three cards in a row.

Fig. 8 Circuit route

Fig. 9 Construction of regular pentagons

GeoGebra

The proposal of this individual activity with mathematical software GeoGebra (https://www.geogebra.org/classic?lang=es) aimed to develop the mathematical competence of these students as well as improving their self-efficacy. It was about offering these students the opportunity to participate in guess and proof activities, normally aimed at students with higher academic performance, by making constructions on which variations can be made easily and quickly, which favors the establishment of relationships and mathematical properties. This activity, more

Fig. 10 Tour of the perimeter of the pentagons

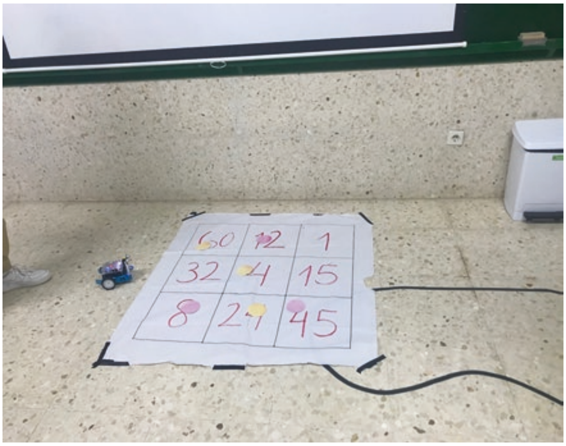


Fig. 11 Game board

static than the previous ones, provided a different situation for the students to also learn to focus their attention and control their impulses. In addition, although the recreational component is also less, the use of computer as specific work support favors the student being able to carry out the curricular activities in another way and see their direct application.

Two activities were held to establish conjectures about the area-perimeter relationship. It begins with a brief explanation of how the program works (Fig. 13). Students are asked to find out which is the figure with the largest area among those that have the same perimeter, or conversely, the smallest perimeter with the same area (isoperimetric problem). So they can elaborate their own conjectures, a series of intermediate questions are posed. As the question is general, it arises for the case

Fig. 12 Student giving instructions to his partner so that the robot takes the card to the corresponding box

Fig. 13 GeoGebra presentation

of triangles. Thus, for example, to find out which triangle has the smallest perimeter among those with the same area, students build a triangle with two vertices on a straight line and the other vertex on a parallel straight line. The variation of the position of this third point within the mentioned line will give rise to triangles with the same area, but different perimeter (Fig. 14).

Observing how the perimeter of the triangles varies depending on the place where that point is located will allow students to make their own conjecture. The students conclude that the triangle with the smallest perimeter is the isosceles triangle. In the next challenge the students must construct all isosceles triangles with a given perimeter and find out which one has the largest area.

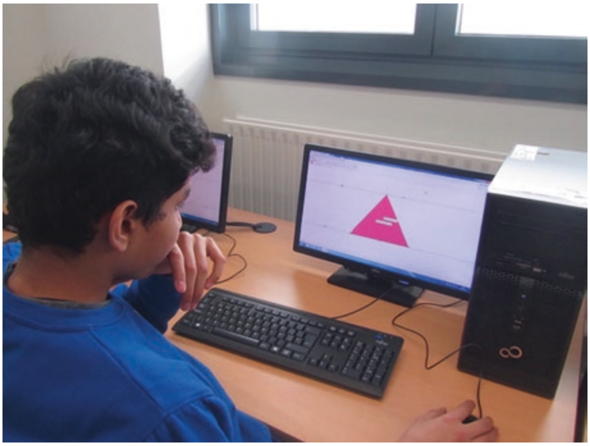


Fig. 14 Student building triangles

3D Design and Printing

The aim of this activity is that each student can create an original three-dimensional figure which will be printed later in 3D. The product of this activity will be something tangible that these students with few resources will be able to take home, as a result of their own work, which favors their motivation and interest. This initial motivation for the figure to be original and well-constructed translates into curiosity about handling the modeling program, which allows figures to be moved in space and their dimensions to be changed, which promotes the development of aesthetic issues in mathematics. Although activity is developed individually, its creative nature makes students interact to comment on the different productions as they progress.

The Ender 3D model of a 3D printer and Tinkercad as a 3D modeling program (https://www.tinkercad.com/) are used as a technological tool. The latter is a free easy-to-use web application that allows you to make basic designs by placing shapes on the plane to which you can add some pre-existing ones or create new ones by intersecting the existing ones. Spatial vision, geometric bodies, measurement, proportionality and orthogonal representation are worked on. First, a presentation of the features and instructions for using the Tinkercad program is made, and students are allowed to experiment with the color, size of the already predetermined shapes and with the different views of those shapes. Students are then asked to sketch their figure (Fig. 15) before building it on Tinkercad (Fig. 16).

The teachers review the figures before printing them and discuss with the students the details that can be corrected or improved (need for support, thickness of the layer, size of the figure, adjustment of the different pieces that make up the figure). Figures 17 and 18 show the beginning of the printing process and the result of some of the figures created by the students, respectively.

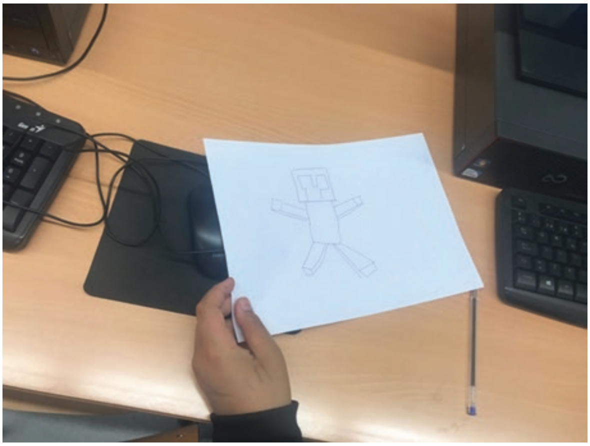


Fig. 15 Sketch

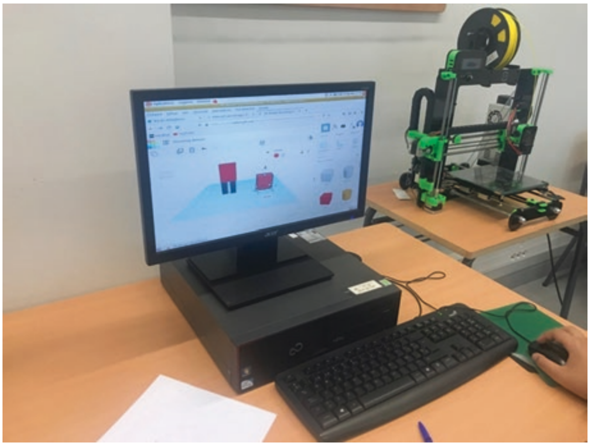


Fig. 16 Student building the sketch figure

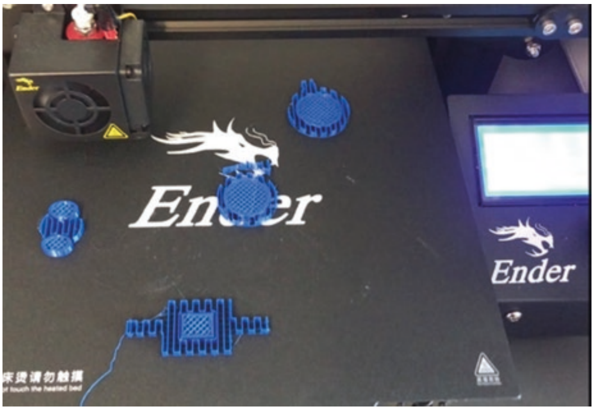


Fig. 17 Beginning of the 3D printing process

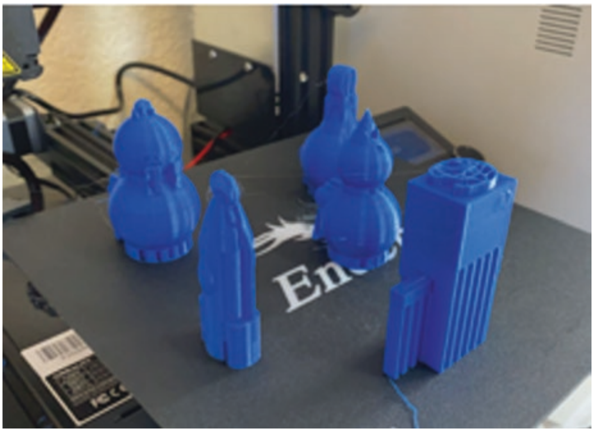


Fig. 18 Result of the 3D printing process

Analysis of Results

The affective suitability of the activities has been analyzed following the indicators from Beltrán-Pellicer and Godino (2020) that assess the components of this suitability: language (L), emotions I, attitudes (A), beliefs (B), and values (V). The data analysis has been supported by the video recordings of the implementation, the field diary, and the student satisfaction questionnaires. Two of the authors acted as participating researchers, conducting the sessions, and recording the field notes. The other two authors reviewed the recordings to collect the evidenced indicators. Finally, to complete the data triangulation, each one analyzed a satisfaction questionnaire.

Due to their characteristics, these adolescents do not usually express themselves much verbally. So, to assess the level of students' interest and attitude, attention has been paid to non-verbal language (L1). Despite this, with these activities we also saw how some of the most reticent begin to communicate. For example, facial expressions of joy and desire to continue playing to increase the level in each of the games can be perceived in the videos from the apps activities. A singular tone of voice can also be appreciated when they reach the next level. These manifestations of body language are also shown in Robotics activities, with specific gestures of care and protection when handling the robot. In the same way, gestures of surprise are observed in activities requiring greater concentration or implying more difficult, such as in the 3D Printing one, where they look surprised seeing from another position that the pieces of the figure are not joined. In GeoGebra activity, gestures of impatience are appreciated when they begin to use the program and their actions do not correspond to what they intend, as well as faces of satisfaction when they autonomously find the answer to the question about the perimeter of triangles with fixed area. As in García et al. (2021), it has been observed that the fact that students can test constructions and have activity continuously encouraged them to continue working on the tasks and perceiving that they were capable of solving them made them feel more secure.

As far as the emotional component is concerned, it is important to show students the mathematical content from a specific aesthetics and precision point of view (E1). In the 3D Printing activity, when using the 3D design program Tinkercad, students must be precise in terms of measurements and relative positions of the pieces so that they fit together and then be able to achieve the desired figure. They also need to manage proportions accurately to stick to their sketch. The students themselves perceive the aesthetics in their different creations, with statements such as the following: "all the pieces must fit well, otherwise the keychain will be amorphous." Likewise, in Robotics activities, place the sequence of blocks and the value of the angles with precision will allow the robot to carry out the polygonal paths correctly. On the other hand, moments are proposed during the activities for students to tell what they think of the activity or how they feel when doing it (E2). In most cases, students express acceptance and motivation. For example, in 3D Printing activity one student stated, "I am very happy to be able to use at class this material allowing us to build new things," and another one "Today for me is an opportunity to be able to use the 3D printer to make an object that is for me." In Robotics activities, another student said, "This is the first time I can use a robot in my life, and it may be the last." These expressions of happiness, as well as their low expectations for the future, reveal his risk situation. Students also sometimes expressed some aspect that they did not like, such as when a student protested "I don't like this practice because there are many steps to do" during the GeoGebra activity.

Promoting self-esteem is important to students do not show fear or rejection to work on the issues or to face difficulties arising (A1). It has been verified that the dynamics of the sessions and their management foster empathy and promote a sense of trust with the teacher. In the following conversation between two students, we show an example of a difficult situation in GeoGebra activity:

- *I made a mistake when marking the points on the lines and when I told the teacher, he told me that what I had done is another alternative way to do it.*
- *And?*
- *Well, instead of telling me it was wrong, he told me that and helped me with a new test.*
- *Imagine that this is in math class, the teacher rips the page out of your notebook...*
- *(Both laugh).*

There are other situations where students show their low self-esteem. For example, in Robotics activities a student tells his partner: "I don't want to be a pilot, because I don't know. If I don't handle the program well, the robot won't follow the route and my team will left behind'. At that moment, an intervention is necessary to encourage the student to program the robot, stating that the objective is for everyone to learn, and that a good group dynamic is based on that. In addition, positive emotions are enhanced whenever possible with the successful resolution of tasks. When students solve an activity, positive reinforcement is given so that they themselves see that they can overcome any task without difficulties. For example, during practice with apps a student who had shown difficulties following the activities passes the different levels of the Math Stick game and checks that he is the one who has reached the highest level: "It is the first time that I have finished an activity before anyone else and reached the top level." All students are encouraged to participate and is given individual help when needed (A2), promoting a climate of trust. In the case of 3D Printing activity, to make the students feel confident, they are shown models that they can reproduce with the Tinkercad program, or ideas for their individual design are provided. All students have a high level of participation, they are persevering in their actions and do not abandon any activity, creating a climate of trust when working. The relevance of producing contexts favoring argumentation (A3) is also considered. These situations occur, above all, when students are encouraged to help each other. An example of this can be found in 3D Printing activity when a student explains to another how to turn their creation into a keychain: "If you use this sphere to be the trunk, you must use the cylinder tool to make a hole so that it can become a keychain." Or when playing Logic Magic Puzzle one student comments to another: "To complete the cube you only have to fit the figure having two pentominoes, but you must turn it 90° to the right so that it fits."

Teaching and learning process that takes place during the activities is built considering the beliefs of students at risk of exclusion (B1), since these come into play regardless of whether a problematic situation occurs (Beltrán-Pellicer & Godino, 2020). The results from an earlier study (Blanco et al., 2021) have confirmed that the dimensions "pleasure" and "effort" make up a single factor for these students. Therefore, so as to the students try with the activities, they have to be pleasant for them. Also, activities have been found to offer an opportunity to improve self-efficacy and self-concept, as already noted, thanks both to the capacity for autonomy offered by the chosen resources and to the classroom climate that has been achieved.

Regarding the last component of the affective domain, the activities presented in this chapter are proposed in a contextual framework that allows assessing their usefulness for real life, making students aware of it (V1). In this sense, in 3D Printing they are the ones who highlight that "with the use of a 3D printer we can design and make parts that can be part of our mobiles or car engines." We have another example in the following comment: "The movement of the robot correctly programmed as we do in our practice is like that of a robot used to search for leaks in a water supply network."

Figure 19 shows the global results of the answers to the satisfaction questionnaire. It used a 4-point Likert scale, where 1 means not at all and 4 means a lot. It can be seen that, in general, the activities were not difficult for the students, being the GeoGebra activity valued as the most difficult one. Something very significant is the high score that the students gave to how interesting the activity was for them, being the mean value above 3 points in all cases. Also, the answers to question 4 reveal that students considered that they learned a lot (the mean for the four activities is above 3 again) despite that the mathematical contents were not especially new for them (question 2).

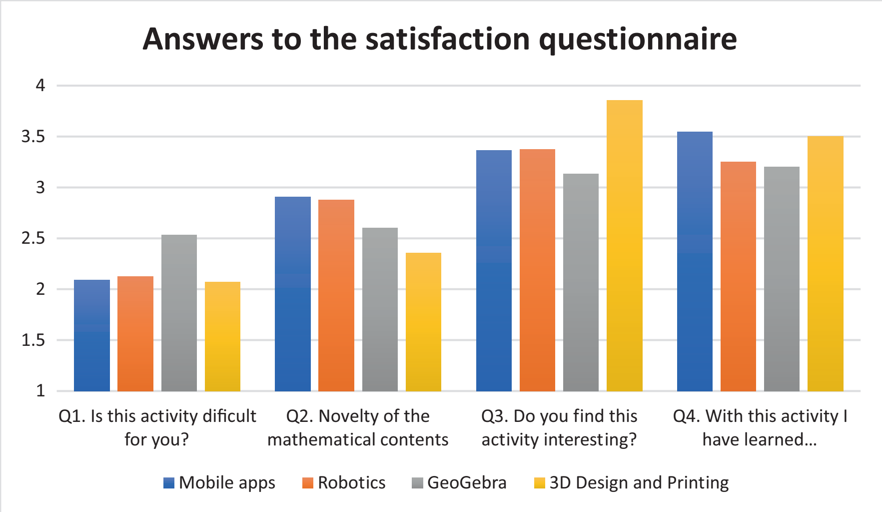


Fig. 19 Means of the answers per question and activity

Conclusion

In this chapter, we have presented an instructional process aimed at students at risk of social exclusion based on activities combining mathematics with technology. These activities specifically consider the affective dimension linked to the teaching-learning process, trying to increase the interest and motivation of students through technology as a tool for students to work on arithmetic, geometry, and computational thinking content in an applied way. They are designed to encourage student participation and create a climate of trust favoring argumentation.

The results obtained show high affective suitability, being evidenced all the indicators for each of this suitability components in each of the selected activities. Application of educational technology to resolution of real-life tasks has proven useful in encouraging students to understand the usefulness of mathematics and give it greater importance (Tangarife, 2018; Zhang et al., 2020). Students actively participate creating new situations of argumentation, collaborating with their classmates, and showing an attitude of responsibility by taking care of the material. The results from the satisfaction questionnaire show they liked the activities and considered that they learned a lot.

We have observed at the beginning of the instruction process the insecurity of these students when using technology. Indeed, throughout their arguments they have expressed low expectations of using technology in a near future. This highlights the digital gap derived from their risk situation. The activities carried out have provided an opportunity for these students to experiment with new and varied technologies within a STEM context, normally focused on other types of students, as indicated by Daniela et al. (2017).

Finally, there is a need to carry out programs like the one presented here, placed outside school hours, supported by educational technology, and focused on the affective domain of mathematics. It has been shown that they can be a specific measure to help students at risk of social exclusion and that they also conform to inclusive practices.

Acknowledgement Funded by: FEDER/Ministerio de Ciencia, Innovación y Universidades – Agencia Estatal de Investigación/ _Proyecto EDU2017-84979-R.

References

Anwar, S., Bascou, N. A., Menekse, M., & Kardgar, A. (2019). A systematic review of studies on educational robotics. *Journal of Pre-College Engineering Education Research, 9*(2), 19–42.

Aryasa, K., Fabrianes, J. C., Irwan, A. M., Hasyrif, S. Y., Paulus, Y. T., & Irmayana, A. (2021). The use of game puzzle application for presenting arithmetic problems. In *2021 3rd international conference on cybernetics and intelligent system (ICORIS)* (pp. 1–4). IEEE.

Bellas, F., Salgado, M., Blanco, T. F., & Duro, R. J. (2019). Robotics in primary school: A realistic mathematics approach. In *Smart learning with educational robotics* (pp. 149–182). Springer.

Beltrán-Pellicer, P. (2017). Modelado e impresión 3D como recurso didáctico en el aprendizaje de la probabilidad [3D modelling and printing as a didactic tool in probability learning]. *Revista Épsilon, 34*(95), 99–106.

Beltrán-Pellicer, P., & Rodríguez-Jaso, C. (2017). Modelado e impresión en 3D en la enseñanza de las matemáticas: un estudio exploratorio [3D Modelling and Printing in the Teaching of Mathematics: An exploratory study]. *ReiDoCrea, 6*, 16–28.

Beltrán-Pellicer, P., & Godino, J. D. (2020). An onto-semiotic approach to the analysis of the affective domain in mathematics education. *Cambridge Journal of Education, 50*, 1–20.

Beltrán-Pellicer, P., & Muñoz-Escolano, J. M. (2021). Una experiencia formativa con BlocksCAD con futuros docentes de matemáticas en secundaria [A training experience using BlocksCAD with future high school teachers of mathematics]. *Didacticae, 10*, 71–90.

Bennison, G. M., & Bielinski, D. (2018). *Identifying practices that promote engagement with mathematics among students from disadvantaged backgrounds*. 154–161. https://research.usc.edu.au/discovery/fulldisplay/alma99451003002621/61USC_INST:ResearchRepository. Document Type: Published Version.

Blanco, T. F., & Ares-Méndez, I. (2021). Exploratory analysis of mathematical applications as a didactic resource. In L. Gómez Chova, A. López Martínez, & I. Candel Torres (Eds.), *Proceeedings of 13th international conference on education and new learning technologies* (pp. 11639–11645). EDULERAN.

Blanco, T. F., & Fernández-López, A. (2021). Pilgrimage way to Santiago de Compostela through robotics and 3D printing in primary classroom. In L. Gómez Chova, A. López Martínez, & I. Candel Torres (Eds.), *Proceeedings of 13th international conference on education and new learning technologies* (pp. 11628–11633). EDULERAN.

Blanco, T. F., Gorgal, A., Salgado, M., Salinas, M. J., Sequeiros, P. G., Rodríguez, D., Núñez, C., & Diego-Mantecón, J. M. (2018). Interdisciplinary activities for an inclusive mathematics education. In E. Bergqvist, M. Österholm, C. Granberg, & L. Sumpter (Eds.), *Proceedings of the 42nd conference of the international group for the psychology of mathematics education* (Vol. 5, p. 208). PME.

Blanco, T. F., Conde-Lago, J., & Diego-Mantecón, J. M. (2021). Creencias y emociones en el aprendizaje de las matemáticas en alumnado con dificultades afectivas y/o sociales [Beliefs and emotions on math learning in students with affective and/or social difficulties]. In P. D. Diago, D. F. Yáñez, M. T. González-Astudillo, & D. Carrillo (Eds.), *Investigación en Educación Matemática XXIV* (p. 641). SEIEM.

Bouck, E. C., Chamberlain, C., & Park, J. (2017). Concrete and app-based manipulatives to support students with disabilities with subtraction. *Education and Training in Autism and Developmental Disabilities, 52*(3), 317–331.

Bouck, E. C., Working, C., & Bone, E. (2018). Manipulative apps to support students with disabilities in mathematics. *Intervention in School and Clinic, 53*(3), 177–182.

Brad, A., & Tangney, B. (2017). Technology usage in mathematics education research – A systematic review of recent trends. *Computers & Education, 114*, 255–273.

Budhwar, K. (2017). The role of technology in education. *International Journal of Engineering Applied Sciences and Technology, 2*(8), 55–57.

Cárdenas, M., Diego-Mantecón, J. M., & Blanco, T. F. (2020). Robotics as a tool for learning STEAM with students' at risk of exclusion. In S. H. Paik, K. H. Cho, M. Ha, & Y. H. Kim (Eds.), *Proceedings of international conference on the advancement of STEAM 2020: Borderless connectivity* (pp. 125–126).

Cueli, M., González-Castro, P., Álvarez, L., García, T., & González-Pienda, J. A. (2014). Variables afectivo-motivacionales y rendimiento en matemáticas: Un análisis bidireccional [Affective-motivational varibles and performance in mathematics: A bidirectional analysis]. *Revista Mexicana de Psicología, 31*(2), 153–163.

Daniela, L. (Ed.). (2019). *Smart learning with educational robotics. Using robots to scaffold learning outcomes*. Springer.

Daniela, L., Strods, R., & Alimisis, D. (2017). Analysis of robotics-based learning interventions for preventing school failure and early school leaving in gender context. In L. Gómez Chova, A. López Martínez, & I. Candel Torres (Eds.), *EDULEARN17 proceedings* (pp. 0810–0818). Published by IATED Academy, iated.org.

De Witte, K., & Rogge, N. (2014). Does ICT matter for effectiveness and efficiency in mathematics education? *Computers & Education, 75*, 173–184.

DeBellis, V. A., & Goldin, G. A. (2006). Affect and meta-affect in mathematical problem solving: A representational perspective. *Educational Studies in Mathematics, 63*, 131–147.

Diego-Mantecón, J. M., Arcera, O., Blanco, T. F., & Lavicza, Z. (2019). An engineering technology problem-solving approach for modifying student mathematics-related beliefs: Building a robot to solve a Rubik's cube. *International Journal for Technology in Mathematics Education, 26*(2), 55–64.

Dubé, A. K., Kacmaz, G., Wen, R., Alam, S. S., & Xu, C. (2020). Identifying quality educational apps: Lessons from 'top' mathematics apps in the Apple App store. *Education and Information Technologies, 25*(6), 5389–5404.

Ferraguti, F., Villani, V., Sabattini, L., & Bonfè, M. (2020). *Human-friendly robotics 2019*. Springer.

García, M. M., & Romero, I. M. (2009). The influence of new technologies on learning and attitudes in mathematics in secondary students. *Electronical Journal of Research in Educational Psychology, 7*(17), 369–396.

García, M. M., Romero, I. M., & Gil, F. (2021). Efectos de trabajar con GeoGebra en el aula en la relación afecto-cognición [Effects of working with GeoGebra in the classroom on the affect-cognition relationship]. *Enseñanza de las ciencias. Revista de investigación y experiencias didácticas, 39*(3), 177–198.

Goldin, G. A. (2009). The affective domain and students' mathematical inventiveness. In R. Leikin, A. Berman, & B. Koichu (Eds.), *Creativity in mathematics and the education of gifted students* (pp. 181–194). Sense Publishers.

Gómez-Chacón, I. M. (2000). *Matemática emocional. Los afectos en el aprendizaje matemático*. Narcea.

Gómez-Chacón, I. M. (2011). Mathematics attitudes in computerized environments. In L. Bu & R. Schoen (Eds.), *Model-Centered learning. Modeling and simulations for learning and instruction* (Vol. 6, pp. 145–168). SensePublishers.

Gómez-Chacón, I.M., & Marbán, J.M. (2019). Afecto y conocimiento profesional docente en matemáticas [Affect and professional teaching knowledge in mathematics]. En E. Badillo, N. Climent, C. Fernández , M. T. González (Eds.), Investigación sobre el profesor de matemáticas: formación, práctica de aula, conocimiento y competencia profesional (pp. 397–416). Ediciones Universidad Salamanca.

Gómez-Chacón, I. M., Romero, I. M., & García, M. M. (2016). Zig-zagging in geometrical reasoning in technological collaborative environments: A Mathematical Working Space-framed study concerning cognition and affect. *ZDM, 48*(6), 909–924.

Granberg, C., & Olsson, Y. (2015). ICT-supported problem solving and collaborative creative reasoning: Exploring linear functions using dynamic mathematics software. *Journal of Mathematical Behavior, 37*, 48–62.

Hannula, M. S. (2015). Emotions in problem solving. In S. Cho (Ed.), *Selected regular lectures from the 12th international congress on mathematical education*. Springer.

Hansson, S. O. (2020). Technology and mathematics. *Philosophy & Technology, 33*, 117–139.

Hsu, Y. C., Ching, Y. H., Callahan, J., & Bullock, D. (2021). Enhancing STEM majors' college trigonometry learning through collaborative mobile apps coding. *TechTrends, 65*(1), 26–37.

Ingram, N., Holmes, M., Linsell, C., Livy, S., McCormick, M., & Sullivan, P. (2020). Exploring an innovative approach to teaching mathematics through the use of challenging tasks: A New Zealand perspective. *Journal for Research in Mathematics Education, 32*, 497–522.

Kalloo, V., & Mohan, P. (2012). Correlating questionnaire data with actual usage data in a mobile learning study for high school mathematics. *Electronic Journal of e-Learning, 10*(1), 76–89.

Kwon, H. (2017). Effects of 3D printing and design software on students' interest, motivation, mathematical and technical skills. *Journal of STEM Education, 18*(4), 37–42.

Lamana-Selva, M. T., & De la Peña, C. (2018). Rendimiento académico en matemáticas. Relación con creatividad y estilos de afrontamiento [Academic performance in mathematics. Relationship with creativity and coping styles]. *Revista Mexicana de Investigación Educativa, 23*(79), 1075–1092.

Larkin, K., & Milford, T. (2018). Using cluster analysis to enhance student learning when using geometry mathematics apps. In *Uses of technology in primary and secondary mathematics education* (pp. 101–118). Springer.

Lieban, D., & Lavicza, Z. (2019). Dissecting a cube as a teaching strategy for enhancing students' spatial reasoning: Combining physical and digital resources. In *Bridges 2019 conference proceedings* (pp. 319–326). Tessellations Publishing.

Lomibao, L. S., Luna, C. A., & Namoco, R. A. (2016). The influence of mathematical communication on students' mathematics performance and anxiety. *American Journal of Educational Research, 4*(5), 378–382.

Maree, J. G., Fletcher, L., & Erasmus, P. (2013). The relationship between emotional intelligence, study orientation in mathematics and the mathematics achievement of the middle adolescent. *Journal of Psychology in Africa, 23*(2), 205–211.

McGahern, P., Bosch, F., & Poli, D. (2015). Enhancing learning using 3D printing: An alternative to traditional student project methods. *The American Biology Teacher, 77*(5), 376–377.

McLeod. (1992). Research on affect in mathematics education: A reconceptualization. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 575–598). Macmillan.

Mosley, P., Ardito, G., & Scollins, L. (2016). Robotic cooperative learning promotes student STEM interest. *American Journal of Engineering Education, 7*(2), 117–128.

Papadakis, S., Kalogiannakis, M., & Zaranis, N. (2018). Educational apps from the android Google play for Greek Preschoolers: A systematic review. *Computers and Education, 116*, 139–160.

Radović, S., Marić, M., & Passey, D. (2019). Technology enhancing mathematics learning behaviours: Shifting learning goals from "producing the right answer" to "understanding how to address current and future mathematical challenges". *Education and Information Technologies, 24*(1), 103–126.

Rodríguez-García, A., & Arias-Gago, A. R. (2022). Modelos didácticos en matemáticas: relación e influencia en el rendimiento académico [Teaching models in mathematics: Relationship and influence in the academic achievement]. *Profesorado. Revista de Currículum y Formación del Profesorado, 26*(1), 281–302.

Schukajlow, S., & Krug, A. (2014). Do multiple solutions matter? Prompting multiple solutions, interest, competence, and autonomy. *Journal for Research in Mathematics Education, 45*(4), 497–533.

Schukajlow, S., Rakoczy, K., & Pekrun, R. (2017). Emotions and motivation in mathematics education: Theoretical considerations and empirical contributions. *ZDM Mathematics Education, 49*, 307–322.

Segerman, H. (2012). 3D printing for mathematical visualisation. *The Mathematical Intelligencer, 34*(4), 56–62.

Shankar, R., Ploger, D., Nemeth, A., & Hecht, S. A. (2013). Robotics: Enhancing pre-college mathematics learning with real-world examples. In *Proceedings of 2013 ASEE Annual Conference & Exposition* (pp. 1–17).

Stergiopoulou, M., Karatrantou, A., & Panagiotakopoulos, C. (2017). Educational robotics and STEM education in primary education: A pilot study using the H&S electronic systems platform. In D. Alimisis, M. Moro, & E. Menegatti (Eds.), *Educational robotics in the makers era. Edurobotics 2016* (Advances in intelligent systems and computing) (Vol. 560, pp. 88–103). Springer.

Tangarife, D. (2018). La enseñanza de las matemáticas a personas con síndrome de Down utilizando dispositivos móviles [Teaching mathematics to people with down syndrome using mobile devices]. *Revista electrónica de investigación educativa, 20*(4), 144–153.

Vankúš, P. (2021). Influence of game-based learning in mathematics education on students' affective domain: A systematic review. *Mathematics, 9*, 986.

Verzosa, D. M. B., de Las Peñas, M. L. A. N., Sarmiento, J. F., Aberin, M. A. Q., Tolentino, M. A. C., & Loyola, M. L. (2021). Using mobile technology to promote higher-order thinking skills in Elementary mathematics. In *Proceedings of the 8th International Conference on Educational Technologies 2021, ICEduTech 2021 and 17th International Conference on Mobile Learning 2021*, ML 2021 (pp. 19–26).

Wassie, Y. A., & Zergaw, G. A. (2018). Capabilities and contributions of the dynamic math software, GeoGebra–A review. *North American GeoGebra Journal, 7*(1), 68–86.

Wilkerson, J. B. (2021). Cultivating a productive-disposition toward mathematics by engaging in service-learning. *Primus, 31*, 869–882.

Yoganci, S. (2018). A study on the views of graduate students on the use of GeoGebra in mathematics teaching. *European Journal of Education Studies, 4*(8), 63–78.

Zetriuslita, Z., Nofriyandi, N., & Istikomah, E. (2020). The effect of GeoGebra-assisted direct instruction on students' self-efficacy and self-regulation. *Infinity, 9*(1), 41–48.

Zhang, L., Shang, J., Pelton, T., & Pelton, L. F. (2020). Supporting primary students' learning of fraction conceptual knowledge through digital games. *Journal of Computer Assisted Learning, 36*(4), 540–548.

Inquiry-Based Learning Focused on Inclusive Education in Programming of Robots: Challenges, Experience, and Feedback of First Cycle Students

Rasa Bruzgiene, Lina Narbutaite, Tomas Adomkus, Jurate Pauliute, and Nadezhda Kunicina

Introduction

Inquiry-based learning (IBL) is becoming increasingly popular in engineering/science curricula, research and teaching (Eltanahy & Forawi, 2019). Inquiry-based learning is an educational strategy, in which learners follow methods and practices to build knowledge as similar as professional scientists are doing. It is a process whereby a new causal relationship is discovered and the learners formulate hypotheses and tests for it by conducting experiments and/or making observations.

IBL focuses on active participation and the learner's responsibility to discover knowledge that is new to them. This is an active learning approach, where practical problems are presented and the learners try to solve the raised problem themselves by asking questions, exploring situations, finding additional ways or solutions, researching additional material, consulting, etc. In this process, learners (i.e., students) often carry out an independent, partly stimulating and partly deductive

R. Bruzgiene (✉) · T. Adomkus
Department of Computer Sciences, Kaunas University of Technology, Kaunas, Lithuania
e-mail: rasa.bruzgiene@ktu.lt; tomas.adomkus@ktu.lt

L. Narbutaite
Department of Software Engineering, Kaunas University of Technology, Kaunas, Lithuania
e-mail: lina.narbutaite@ktu.lt

J. Pauliute
Department of Applied Informatics, Kaunas University of Technology, Kaunas, Lithuania
e-mail: jurate.pauliute@ktu.lt

N. Kunicina
Institute of Industrial Electronics and Electrical Engineering, Riga Technical University, Riga, Latvia
e-mail: nadezda.kunicina@rtu.lv

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_5

learning process by conducting experiments to explore relationships with at least one set of dependent and independent variables. In this case inquiry-based learning aims to engage students in an authentic process of scientific discovery as it combines both learning and practice (Eppes et al., 2020).

IBL can be applied in variety of fields and ways, depending on the context, the target group of learners and the learning objectives. Generally, all inquiry-based learning approaches have common features as they aim to stimulate:

- Learners' curiosity,
- Engagement in problem-solving activities,
- Deeper learning.

Moreover, the use of inquiry-based learning in practice/laboratories can enhance learners' critical thinking skills. In this case, couple of the examples are in physics education and mathematics (Dorier & Maass, 2020), where it is essential to develop students' curiosity, critical thinking and the relevance of knowledge to everyday life as well the scientific interpretation of events. For example, the importance of inquiry-based learning in teaching the basic physics of mechanical waves led to an assessment of students' ability to analyze, evaluate, and structure the information they perceive (Bezen & Bayrak, 2020).

Another example is teaching of programming, where it is not only important to be able to write a code and understand the logic behind it, but also to assess the external environment – the variables that will determine the suitability of the written code. Application of IBL for understanding programming languages and technologies, learning and using it in robotics enables open findings in programming and its relations with electronic devices or appliances, also the mapping of code logic to the actions performed by robots (Blancas et al., 2020).

Inquiry-based learning essentially provides the following benefits (Meirbekov & Salikhanova, 2021):

- Increases students' motivation to learn,
- Accumulates learning experience,
- Develops knowledge and skills in all areas of learning,
- Develops students' critical thinking,
- Deepens students' understanding of learning,
- Gives students the opportunity to be responsible for their own decisions,
- Provides an opportunity to analyze the results achieved and their compliance with the set of raised goals,
- Enables team building skills.

Unlike the traditional learning, IBL methodology is based on three types of inquiry, described according to the work, written by Li (2021):

- *Structured inquiry* – when problems and questions are raised by students, also material and methods are searched and structured;
- *Guided inquiry* – when students search for ways to solve the raised problem, to find answers to the questions based on the material formed;

- *Open inquiry* – when students make research questions/statements and decide which of searched methods will be chosen to prove it; the facts are formed and its substantiation or refutation is sought.

From the teacher perspective, the traditional teaching allows the teacher to ask students for a specific answer to a given question (Khalaf & Zuhana, 2018). The opposite is in inquiry-based learning, where the teacher forms open answer-seeking questions. In this case, the teacher becomes more as a mentor, who promotes students' independence in solving the task raised by themselves.

In this context, the IBL methodology allows the application of inclusive education principles for students with different needs and abilities (Zweers et al., 2019). Inquiry in a different level provides a deeper understanding of the learning process, object knowledge for students with special needs also improving their critical thinking, executive and collaborative skills (Lee & So, 2015). Particularly, the use of the IBL methodology for such students is an opportunity to support alternative styles of learning, thus reducing the amount of redundant information and its memorization.

On the other hand, students are different in their knowledge and skills. One will be more skillful than another, more familiar with the learning content than other. In this way IBL methodology provides an opportunity to maximize the development of knowledge and skills for every gifted student (Alteren, 2021; Buerk, 2021), as long as they achieve maximum results in the field in which they will realize themselves. Moreover, such learning way can also serve as the effective solution to training the emotional and psychological behavior of gifted students (Ismail et al., 2021).

Algorithmic and computational thinking is a key feature in informatics and software engineering. Students with such a mindset should be able to develop ideas to solve raised questions and problems, design systems and understand how replication of human behavior should be implemented in programmable devices, for example robots. Both – algorithmic and computational thinking – are fundamental skills of human (Yadav et al., 2017), which cannot provide the desired outcome without connection to critical thinking in engineering (Lai, 2018; Mutakinati et al., 2018). In this case, critical thinking is required to enhance enriched content through engineering and technology practices, to gain a deeper intellectual activity, to find answers and solutions by using or adapting existing knowledge and skills within the problem-solving process (Pala & Mıhcı Türker, 2021). Due to this, inquiry-based learning opens space for in-depth development and enhancement of multidimensional skills of gifted students' analysis, association, questioning, prediction, abstraction, inference, and generalization.

Motivated by this, we focus on the application of inquiry-based learning in programming of robots as a basis for inclusive education in informatics and software engineering. The main contributions of this chapter are following:

– We survey the IBL applications that have been presented in literature, focusing also to learning application for gifted students;
– We propose key insights how inquiry-based learning can be applied for teaching gifted students in programming of robots;

- We describe a model of IBL adopted to teaching of the first cycle students by defining two perspectives for students and teachers;
- We analyze the experience of learning as well experience of teaching resulting from the evaluation of changes in abilities, skills and knowledge of students, who learned programming of robots.

The rest of the chapter is organized as follows. Section "State of the Art in Student-Oriented IBL" describes state of the art in inquiry-based learning oriented to gifted students. Section "Application of Methodology to the Course with Focus on Gifted Students" provides a model of the application of IBL methodology to programming of robots with focus on gifted students. Evaluation of the IBL teaching and learning results are analyzed and discussed in section "Results of Evaluation of the Methodology". Final remarks are concluded in section "Conclusions".

State of the Art in Student-Oriented IBL

Changes in learning methods launched after analyzing the shortcomings of traditional learning as well as knowledge, cognition, skills and results in learners' abilities provided by it. As it was mentioned in section above, the inquiry-based learning opens wide space for development and deepen of skills and capabilities for gifted students (Čepič, 2018; Lintner & Puryear, 2021; McKimm, 2021).

The teaching of gifted students quite differs from casual teaching. The main difference is in motivation to learn (Efklides, 2019). Gifted students are not happy to learn in passive way, like to memorize just theoretical facts (Phelps, 2022). Usually they are asking much more questions than others. They raise open questions and unusual, innovative ideas. Gifted students are independent (Attar, 2019) and do not prefer to work in a team. In this case, IBL can become a challenge to them if the task is organized to be solved in a team. Such students can search for the information to support their ideas, structure it, re-think the ideas, bring new solutions, analyze, and conclude results. They also are very curious as they are seeking to know how things are working in the field, which they are interested in (Ibrohim et al., 2020).

As reported in the work by *Chrysovalantis* and *Drigas* (2020), the features of inquiry-based learning are effective for gifted students. Gifted students can work in a team when they feel as an important part of the team and can find a supportive environment. Complexity and detailing of the activities are exiting to them. The authors of this work showed that through IBL activities gifted students develop their metacognitive skills as well those skills that make them experts in the field of their interest. Moreover, their results showed that inquiry-based learning related with robotics is more effective way to teach talented students. It allows approaching interdisciplinary learning thus deepening students' understanding of learning.

It is important to note that inquiry-based learning can strengthen a growth of a critical thinking for talented students. The authors *Onsee* and *Nuangchalerm* in their work (2019) showed that students, using IBL activities, could solve problems based on planning, designing, testing, and sharing of knowledge.

Algorithmic and computational thinking importance in inclusive education under inquiry-based learning was presented in the work written by *Taengkasem* et al. (2020). The authors showed that the robot inquiry-based learning stimulates computational thinking of students. In this way, robotic kits can support students' computational thinking by tasks to boost robots' activity with special missions. The results of this work concluded that the students' behavioral, cognitive, and emotional engagement were at a high level during IBL education.

Accumulation of learning experience plays an important role in needs of gifted students over the learning process. In this case, inquiry-based learning can strengthen the link between teaching and research. Research work provided by *Spronken-Smith* and *Walker* (2010) showed that it could be done when courses are designed using an open inquiry approach. During open inquiry students raise research questions and complete the full inquiry cycle. Moreover, the link is more enhanced if the focus of learning is discovery-oriented.

Staying on the same note, innovativeness has become one of the most important employability skills for gifted students nowadays. The work written by *Acar* and *Tuncdogan* (2018) presents a developed conceptual model that links IBL and student innovativeness as well as introduce teacher-controlled design elements that can influence the strength of links whether learning inquiry is open or closed, discovery-focused or information focused, individual or team-based. The results of this work showed that an open discovery-focused plus team-based inquiry offers the greatest potential for enhancing students' skills in innovation. Especially, if we are talking about the gifted students.

The authors Kırıcı and Bakırcı (2021) in their work reported interesting findings in application of inquiry-based learning for two groups of students – gifted and casual students. There were 64 students as participants of this research in total, 35 of them were in the gifted group and 29 of them were in the casual group. The results of this investigation concluded that gifted students developed their original thinking skills while other group of students made just similar designs according to the raised tasks. It refers to the fact that their original thinking skills may not have developed during the learning process.

Application of Methodology to the Course with Focus on Gifted Students

Giving more opportunities to the students to learn themselves as well to be more responsible for their decisions can be a liberating experience. Inquiry-based learning allows students to take responsibility in becoming experts in the knowledge they create through a process of self-discovery, trial and error.

The teacher's role is to observe how students construct new meaning and to intervene when they need help. On the other hand, teachers using inquiry-based teaching can give students too much freedom untimely to learn. In this case, it is allowed for them to plan everything on their own without the involvement of teachers. However, without the support of the teacher, this early freedom can reduce students' confidence during the course if they are facing with major setbacks in the chosen methodology.

Staying on the same note, it is more appropriate to divide students into groups according to their existing knowledge, skills and scientific goals. The selection should be done according to criteria, which is related to the assessment of the student's skills, knowledge and motivation. It must be said that generally the selection of gifted students is based on the requirements coming from "GIFTed" talent academy in Kaunas University of Technology (KTU, 2022). The first-year student of the bachelor's studies (BSc) at Kaunas University of Technology (KTU) can become a member of "GIFTed" talent academy if his/her competition score for admission to the university is at least eight and if he/she is looking for challenges. The most talented KTU students participate in the selection to join members of "GIFTed" talent academy from August 24 until September 14 every year. After the evaluation of the students' applications and their motivation, the committee of this academy decides who can be a gifted student. For example, more than 80 students are studying continuously at "GIFTed" talent academy every year in KTU.

Teaching Process

According to authors *Kukulska-Hulme* et al. (2017) as well *Lyddon* (2019) education of students especially if we are focusing on gifted ones can be implemented by inquiry-based learning methodology through four progressively higher levels of students' inquiry affordance (Fig. 1).

Working with the integration of technology into learning methodology over study process requires strong analysis by looking on how technology enhances and extends studies in general. Relaying on this, we proposed to apply SAMR (*Substitution*, *Augmentation*, *Modification*, and *Redefinition*) model (Hamilton et al., 2016; Puentedura, 2015) to the course of "Robot Programming Technologies" intended for the first cycle BSc students. It is worth to note here that first steps of inquiry-based learning in this course started in 2018, thus the results, which we showed in this chapter, includes 4 years of IBL based teaching also learning experience.

According to SAMR model, the meaning of last two levels actually alters to the learning process and potentially to the learning outcomes. As we focus on gifted students, these two levels of inquiry (*Modification* and *Redefinition*) integrate properly into the overall student-oriented inquiry-based learning. These two levels together strongly promote digital transformation in study process.

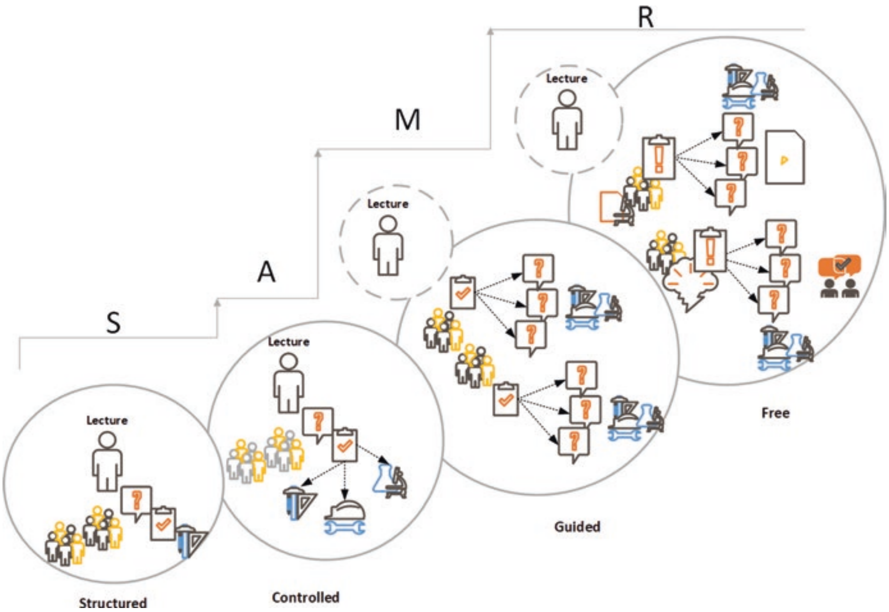


Fig. 1 The model of student's inquiry

The development of an integrated learning model for gifted students is looking on how to introduce interactive elements of technology that enable technological modification of the task.

Technologically modified assignments also allow students to create innovative works. All this allows experimentation with tasks that use many multimodal elements. This requires defining of the scope in the whole learning process.

After the analysis, the main activities of the teacher-student process had been identified (see Fig. 2) in relation to the students' inquiry model.

According to the teacher-student process, two gradations (*Guided* and *Free*) as well two levels of SAMR model (*Modification* and *Redefinition*) were chosen for gifted students under IBL umbrella. This choice is made on the basis that structured inquiry is along with the line of traditional teaching methods. The teachers working together on the practice along with the students. They use materials with detailed instructions. As it goes to controlled students' inquiry group, the teacher usually provides the context, starting ideas, tools and perhaps even some goals.

In the case of last two gradations, the students must develop their own methods of inquiry and processes for moving through concepts, which allow taking responsibility for the students themselves. Such responsibility goes along their learning process, including selection of topics, questions, methods and goals. Hereby they can delve into the topic in any way they desire and explore the concepts and ideas that appeal to them.

The difference between those two gradations is in selection of topic:

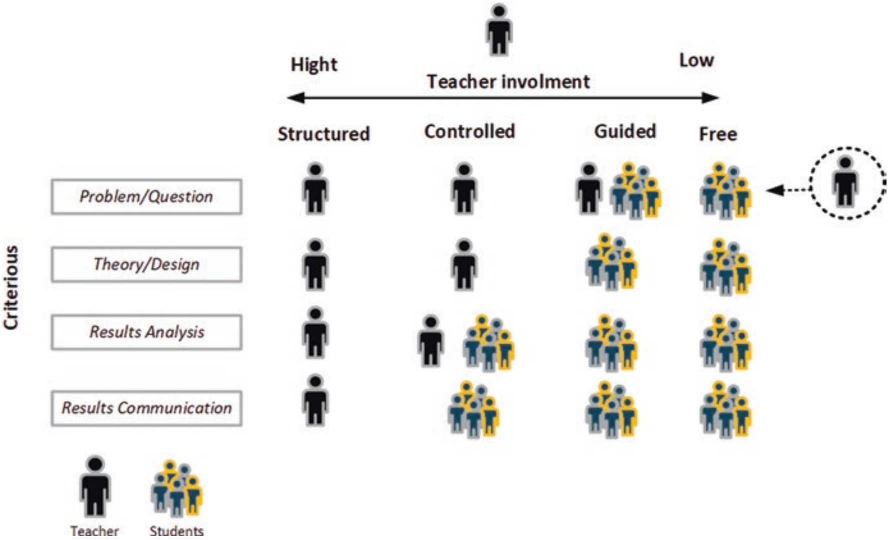


Fig. 2 The main activities of the teacher-student process

Table 1 Perspectives of student and teacher

Student's perspective	Teacher's perspective
IBL focuses on an open-ended question or problem Have to use evidence-based reasoning and creative problem solving to reach a conclusion, which they have to defend or present for other students	IBL focuses on getting students not only interested, but also moving towards critical thinking and understanding Need to encourage students to ask questions and guide them through the process of inquiry, to understand when to start and how to structure the inquiry activity and work in the group

- In a case of *Guided* – the teacher chooses the topic or starting question;
- In a case of *Free* – the students choose topic, raise questions, search for and decide on methods and goals.

The application of inquiry-based learning to our course started from the defining of two aspects: the perspective of the student and the perspective of the teacher. These aspects are presented in Table 1 below.

As our research was carried out by integrating IBL into the course of "Robot Programming Technologies" intended for the fourth year of BSc students, it allows us to make use of variety of technologies and existing students' knowledge.

The students, who were learning in this course, studied on study programs as Informatics, Software Systems and Informatics Engineering in the faculty of Informatics. These students had no experience or any knowledge related to robotics in previous years during their studies in the university. Meaning, their skills and knowledge in this area – the robotics – could only be from their own self-expression

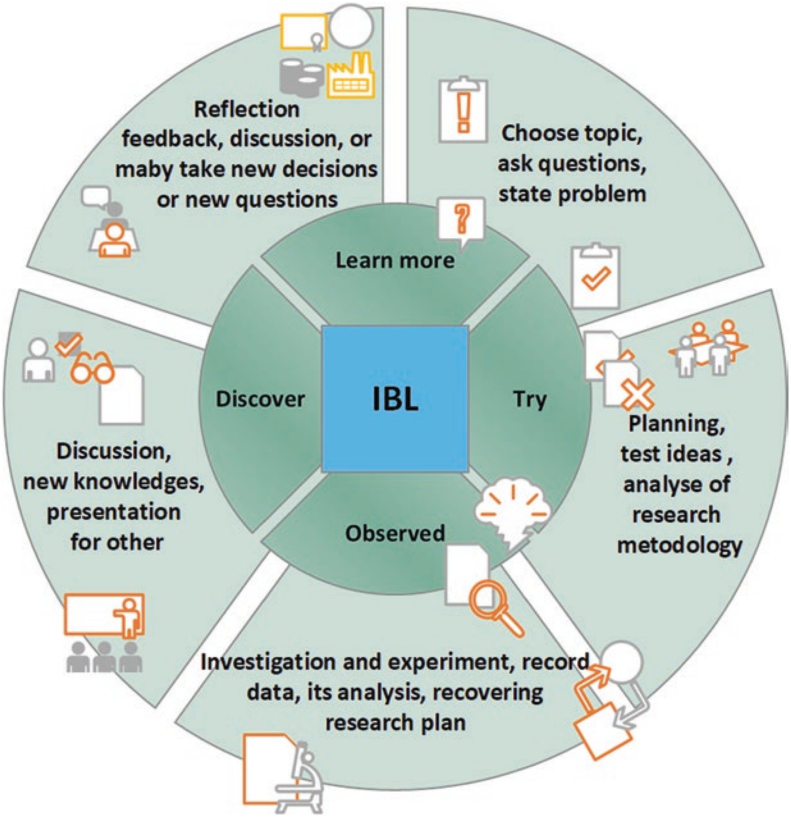


Fig. 3 Model of IBL cycles for the course of "Robot Programming Technologies"

and experience outside the university. Generally, there were 153 students in the course.

In relation to teacher-student process, which is described above, we created a model of inquiry-based learning cycles specially focusing on gifted students in the course (Fig. 3). Fifteen students in the course of "Robot Programming Technologies" were identified as gifted students based on their membership in KTU GIFTed talent academy.

First, the teacher is oriented to a problem or goal of the project. The students need themselves to create group from 2 to 4 peoples. Gifted students were divided into four groups of 3 to 4 students and worked on projects assigned to them or chosen by them. Four lecturers continuously supervised the gifted students. Students learn about the project in general ways; therefore they must ask themselves "*Do I have enough knowledge and skills if I want to reach the raised goal?*". They brainstorm with a guidance from their teacher and have in-group and inter-group discussions. In this process, they can ask the teacher questions about things they do not know and the teacher helps the students to reach the answer by leading them, instead of directly giving the answers.

Due to this, the duration of the cycle, titled "*Learn more*" in the model, was about 2 weeks. During this cycle, the groups decided which tool they would use to implement the idea: a real physical robot or a virtual simulator.

In the part "*Try*", the students' teams analyze possible solutions and propose their own research methodology. Students take a personal interest in the research. They are interested in the topic, raising new questions, demonstrating critical as well computational thinking, seeking self-development, self-awareness and trying to perceive the problem realistically as well trying to propose original ideas. They are seeking realistic solutions to the problem (although at least one solution is usually proposed), seeking feedback on the problem when it is discussed thus developing problem-solving skills. The examples of possible problems include such questions as:

- The determination of the optimal trajectories for the robot to reach the destination,
- The evaluation of different types of surfaces, terrain on the trajectory towards the target,
- The accurate placement of objects in the robot's operating environment,
- The response of a robot to changing conditions of the ambient light,
- The implementation of communication between robots for completion of different tasks, etc.

The next cycle (the duration was about 3 weeks) allows the integration of students' skills: controlling variables, defining activities, formulating hypotheses, collecting data, interpreting data, experimenting and building models. As the example to the activities during this cycle could be taken the case of a robot self-training. In this case, students are defining the sensors, which can be used to assess the environment, in which a robot should navigate, its curves, trajectories. Formulation of the hypotheses starts from questions related on how the robot's sensors will help to collect the necessary parameters, how to input the collected data into a database of the robot, how to design and implement an algorithm for robot's self-training. Thereafter, the parts of implementation, experiments, and analysis of the results were done.

An important part in implementing IBL is reflection, self-observation, self-group sharing and justification of new knowledge. The skills of students are acquired at each stage. Evaluation of the results are indeed part of the whole IBL model. In this case, reflection allows learners to reflex and learn from their mistakes, to analyze actions as well change it to achieve success. Additionally, building of students' confidence and self-awareness, strengthen teamwork skills and development of leadership skills can be reached.

Finally, students need to conclude their achieved results. It is the statements of generalization, which answer the question of inquiry. It can be done by interpreting of data, summarizing, revising, restating or providing a feedback. Students present their reports, do self-assessment, peer assessment or self-reflection. The students can assess final understanding, growth of skills, and development of its positive attitude.

Learning Process: Students' Projects

Students, who studied programming of robots under inquiry-based learning, were offered with two directions in which they could develop their ideas of the projects. A brief introduction was provided to the students knowing a fact that theory it is not enough to finalize robot-based projects. It also requires a practical experience, the ability to put theoretical knowledge into practice, active participation, critical and computational thinking as well evaluation of the situation and making appropriate decisions.

The use of the inquiry approach in learning has different objectives. In our case, we have formulated 7 objectives that we would like to achieve from gifted students by adapting IBL to the course (Fig. 4).

Gifted students work in the teams to generate their own ideas for research aimed at achieving the general objectives of the course and competences also. In general, all students, who are learning in this course, should be able to:

- Explain the architectures of the robot's control,
- Explain and apply the algorithms for the robot's control,
- Use various programming environments to describe and implement the algorithm for the robot's control,
- Model and construct typical robots using programming, modeling and simulation environments as well platforms,
- Design and implement the control of a typical robot,

Students can use real robots to implement their ideas, which could be updated, supplemented with accessories for their own design. Real robots were such as robotic cars, robot humanoids also Lego mind storm robots' constructors. All of it are provided by the university. Moreover, the students can use their own robots also. On the other hand, they can use virtual simulators, such as CoppeliaSim (Coppelia Robotics, 2022), Webots (Cyberbotics, 2022), Gazebo (Open Robotics, 2022), VEXcode VR (VEX Robotics, 2022) and others. Some examples of the robots, which were used by students, are presented in Fig. 5.

As this is a learning process, a group of students briefly introduces their idea of the project and its purpose before the inquiry begins. After that, they can start working towards their inquiry goal. The essential feature of the inquiry is a problem or question solving. It formulates a certain pattern of perception and interpretation of the problem as well as reconstruction and the choice of activities to solve it. All of this involve the team of students in finding an unconventional way to solve the problem, which must be carefully and elaborately thought out.

Some examples of the students' projects, designed during inquiry-based learning studies, are presented below in this chapter.

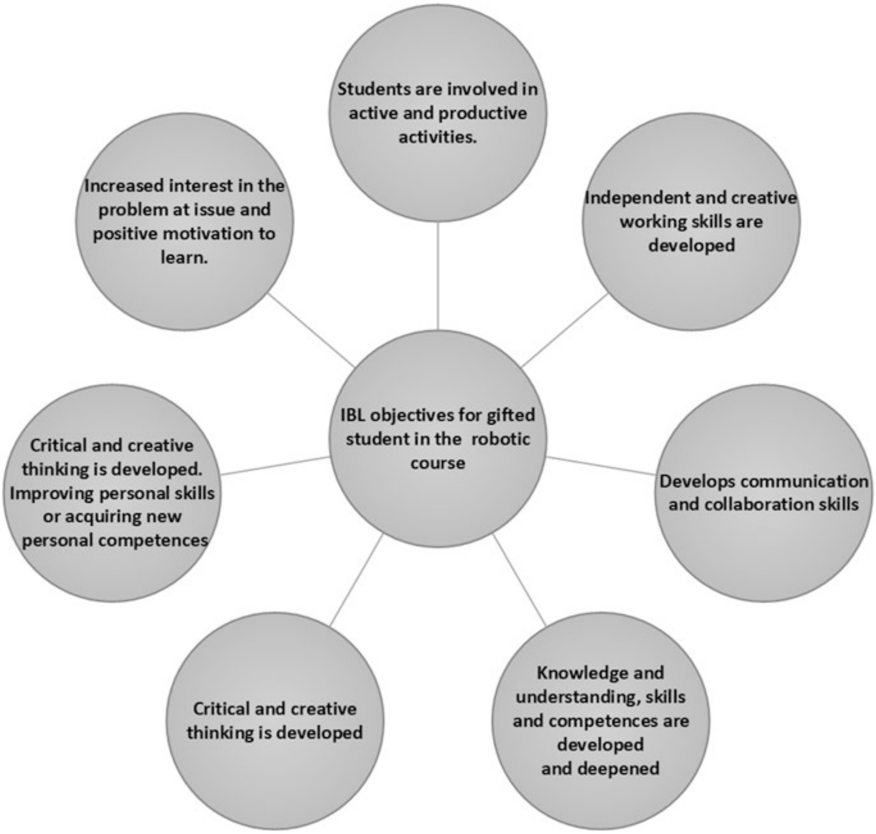


Fig. 4 Formulated 7 objectives for gifted students

Project "Parking System"

Several teams of students were generating the similar ideas about robots' parking system. The teams chose different methods for implementation and different methodologies to carry out the research after the initial analysis. The teachers summarized the purpose of their research for all teams of students to encourage teams of gifted students to look more deeply for unconventional, original solutions to their ideas.

One team of students built their own parking system and tested it with a real robot. Figures 6 and 7 show illustrations of the developed parking system.

Other team of students generated the idea to realize similar parking system using virtual simulator (Fig. 8).

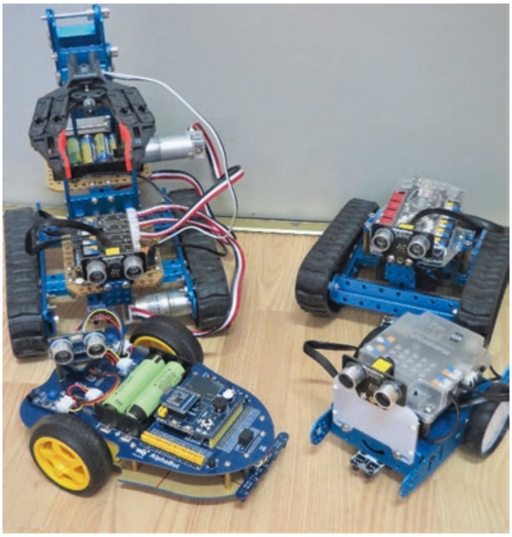


Fig. 5 Examples of real robots used in the robotics' course

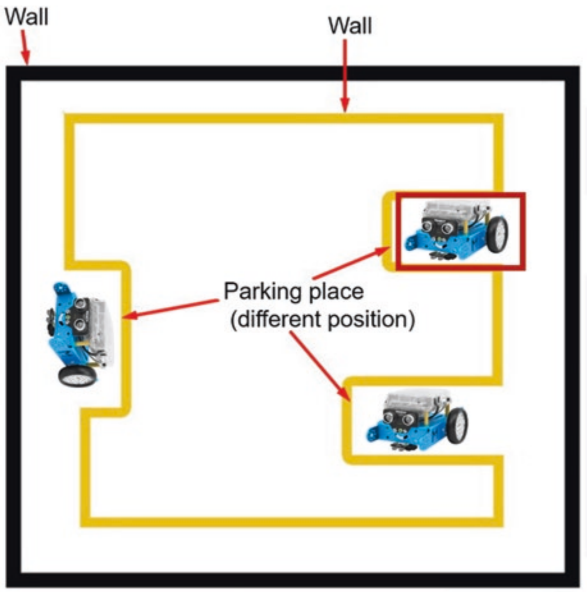


Fig. 6 Scratch of the idea for the parking system

Project "Store Robot Logistic"

One team of students first assessed their knowledge and skills in mechanics after what they found interesting to create a bridge between mechanics, robotics and programming. Students decided to construct their own robot in a *CoppeliaSim* virtual simulator and apply it to logistics (Figs. 9 and 10).

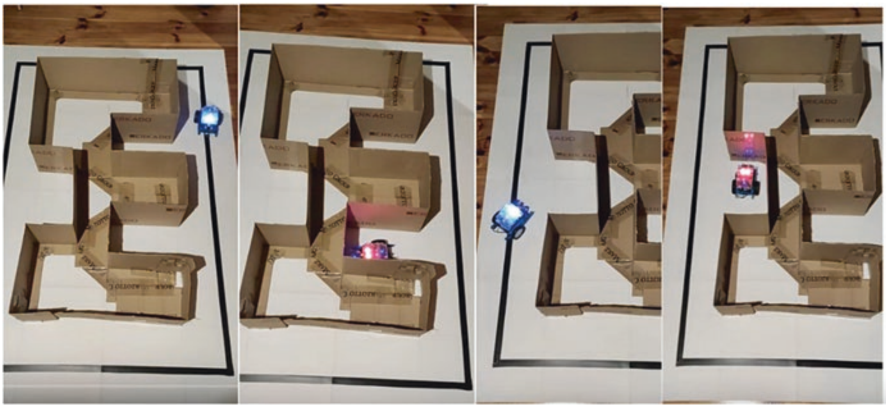


Fig. 7 Solved idea for the parking system

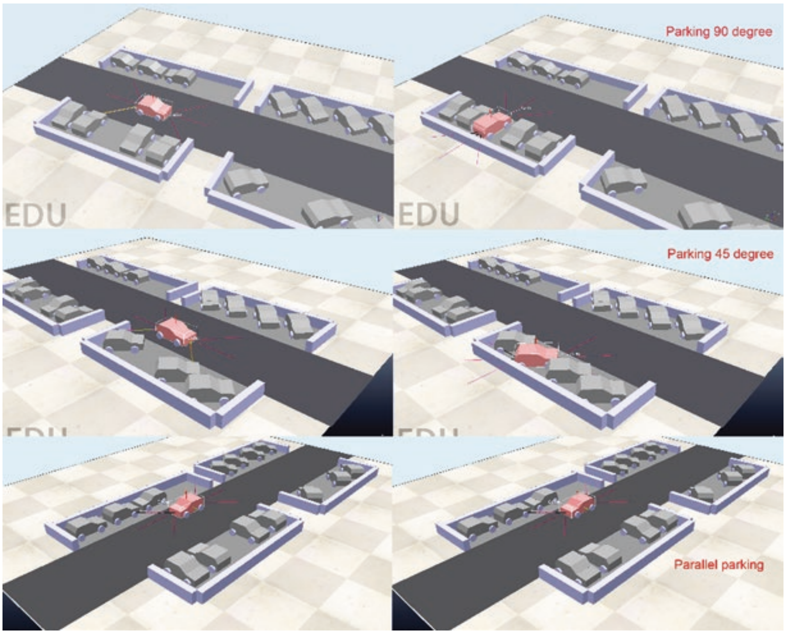


Fig. 8 Solved idea for the parking system in *CoppeliaSim* virtual simulator

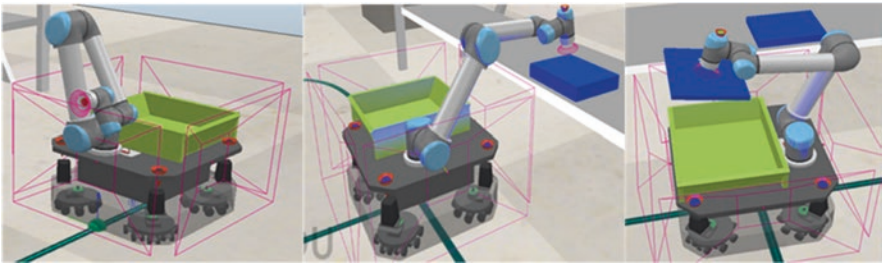


Fig. 9 Solved idea for construction of a robot in *CoppeliaSim* virtual simulator

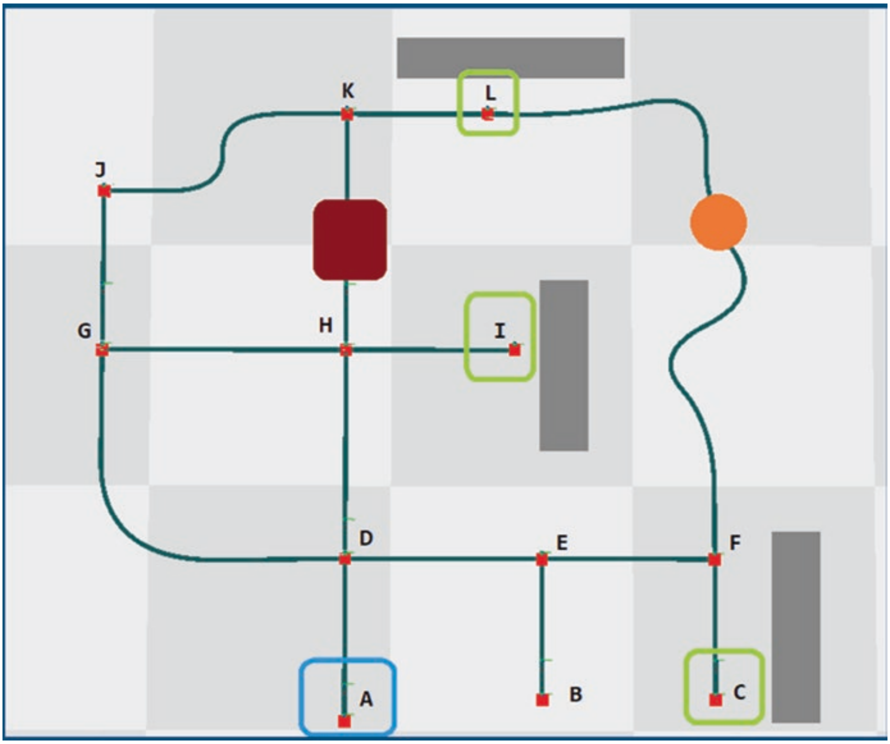


Fig. 10 Solved idea for logistics of constructed robot

Project "Maze Solution"

Autonomous movement is an important feature in robotics. Maze solving is one of the most popular inquiry ideas in robotics, where the robot is self-reliant and can move through a maze from the source to the destination. Due to this, quite lot teams of students chose this idea.

Naturally, there are various algorithms how to solve maze. In this case, students had ability to analyze those algorithms and after to raise ideas how to bring new actions, movements of robots instead of using what is already created. The solving of such ideas includes questions related with known and unknown environments, complexity of algorithms, time for a robot to reach the end of a maze, etc.

Criteria for the Learning Assessment

Solutions of such projects first let to develop students' critical thinking. Furthermore, the implementation of different gradations in students' inquiry has an effect on the development of their different capabilities. Gifted students have a higher level in change of criteria during inquiry process as well generating new ideas, solving technical or engineering problems, understanding learning process and learning experience.

The evaluation of the students' level in critical thinking and inquiry has been done according to the following criteria for the assessment:

- A uniqueness and scope on the provided idea – whether the task performed in the project is wider than the task of general laboratory works,
- The complexity of the algorithm for a robot control – whether multiple algorithms for executing and deciding on the robot's actions are used, i.e., under one condition or multiple; whether the robot performs different actions,
- The use of robot's sensors – whether as many robot's sensors are enabled to control the movement of the robot,
- The preparation of the environment for the robot's movement – whether students create the environment themselves (i.e., a layout, obstacles) or just take an existing environmental solution (i.e., a virtual environment).

Students' understanding and learning skills and abilities were evaluated by their capability effectively and clearly exchange ideas, to solve a problem or raised idea, present their work in a way that is supported by explanations, insights and evidence. In this case, the assessment criteria were divided into two groups – criteria for assessment of the knowledge and skills and criteria for assessment of the understanding, learning and self-expression. Criteria for the assessment of the knowledge and skills are following:

- A completeness of the description of the raised idea and a solution, which was created,
- A compliance with the raised technical requirements,
- The selection of robot's components, parameters required for its appropriate operation,
- The preparation of technical documentation,
- The quality of the task realization,

- The quality of project's report preparation and compliance with general report preparation requirements,
- The formulation and justification of the conclusions,
- The reliability of results,
- The quality of task analysis,

The assessment of the understanding, learning and self-expression was done according to the student's ability to:

- Analyze threats and risks during the implementation of the proposed solution,
- Apply programming principles for the operation of the robot according to the developed operation algorithm,
- Apply the principles of development and operation of robots,
- Identify the components of the robots,
- Practically use methods, communication technologies for operation of robots,
- Solve technical tasks related to the identification, analysis and evaluation of robot‘s control and operation in various environments,
- Summarize in detail, consistently and clearly the aspects of the implemented solution as well as the workflow and obtained results, conclusions, and recommendations.

It was concluded that reflection of gifted students also helped in development of their critical thinking skills, analysis, evaluation of other works, and self-awareness.

Results of Evaluation of the Methodology

The results of evaluation whether the methodology of inquiry-based learning made it possible to achieve the objectives of the course were analyzed as well presented in the chapter from two general perspectives – the results on learning process and on teaching process.

Results on Learning Process

Obviously, inquiry-based learning increases students' motivation to learn. This can be seen by looking at the statistics on overall attendance of the lectures (see Fig. 11). The statistics, presented below, were created according to the feedback provided by the students under university-wide students' survey, which is usually organized at the end of each semester. The aim of this survey is to evaluate the subjects taken and the teachers teaching them. A detailed description of the methodology of this survey is provided in the document approved by KTU (KTU, 2018). The result from the

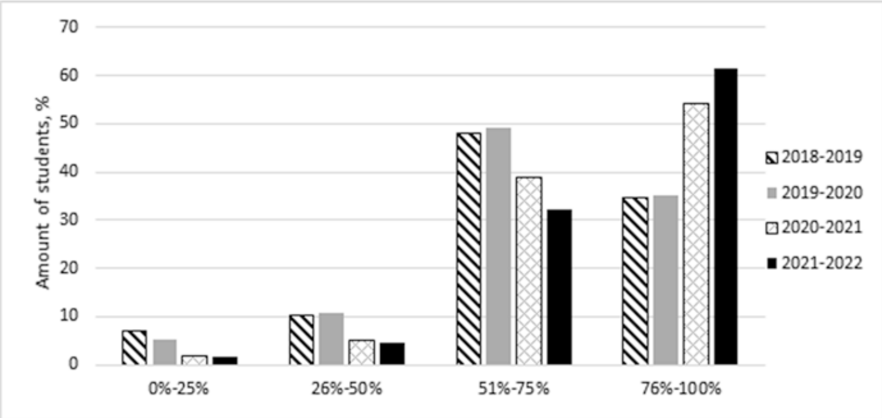


Fig. 11 Motivation of students to participate in IBL-based activities

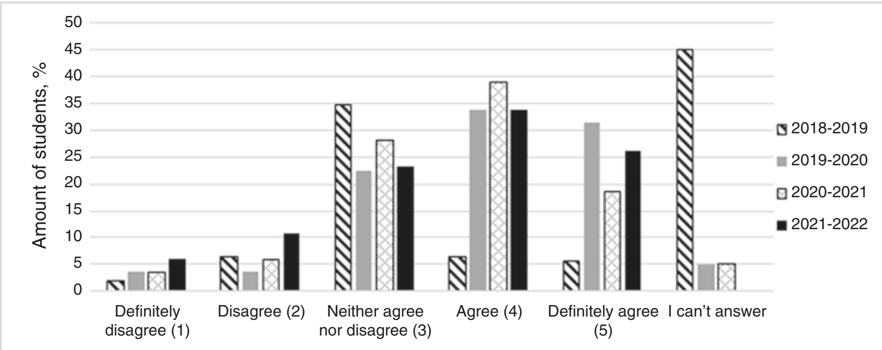


Fig. 12 I am satisfied with the application of IBL in the course

survey presents feedback of 109 students from 153, which were learning the course of robotics.

The motivation of students to participate in classes and to work on topics, ideas has steadily increased since the introduction of IBL in the course. It is clear that the use of new learning methodology motivates students to come to the university auditoriums and work in teams.

The IBL methodology enhances students' critical thinking and ultimately their motivation to learn, to go deeper into engineering processes and to develop their competences in new areas (Figs. 12 and 13). We can see that when the IBL was first introduced in the course even 45% of the students could not answer whether they were satisfied with this method of learning, but in the following years the students were clearly satisfied with the application of the IBL in the course.

A significant number of students, as many as 19%, during 2018–2019 academic year, could not answer whether the IBL methodology and learning resources were

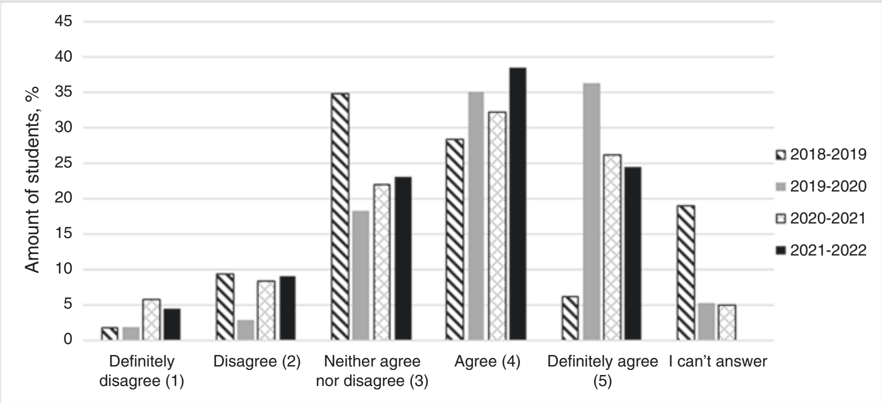


Fig. 13 The IBL methodology and learning resources are interesting and have contributed to the achievement of the course's objectives, outcomes and competences

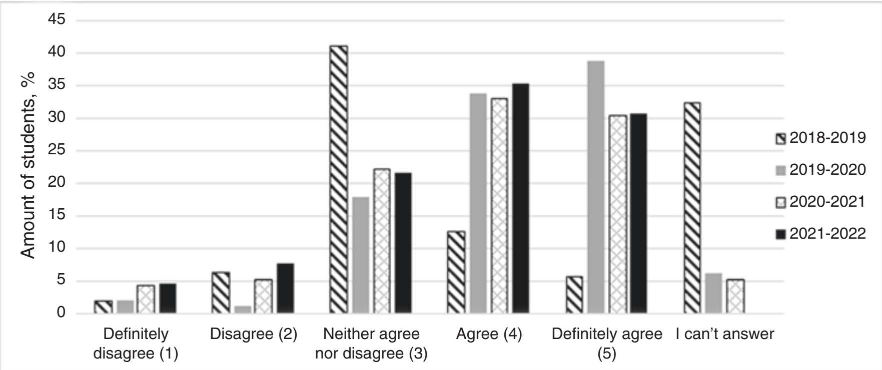


Fig. 14 The course uses advanced learning methods deepens students' understanding of learning

interesting and had contributed to the achievement of the course's objectives, outcomes and competences. This is normal, as the application of a new learning methodology always introduces some confusion. However, the results from the latest semesters showed that the students were clearly satisfied with the progressive and innovative learning methodology.

A question about whether the course uses advanced learning methods deepens students' understanding of learning, students also brought some confusion and 33% of the respondents could not answer whether the IBL learning is useful for them (Fig. 14). However, the students had not such minds at all in the recent years of the course. Those who thought that IBL based course deepened students' understanding of learning increased dramatically.

Generally, it proves once again that the use of advanced and innovative learning methods increases students' motivation to study and develop their competences in new fields.

The implementation of IBL method makes it easier to grade students' projects. It is worth to note that only when new teaching methods are introduced into the course, the assessment criteria become clearer and more understandable for students from the very beginning of the project (Fig. 15). The number of students who thought differently has been very low since the beginning of the IBL process. The clarity and transparency of the assessment criteria is one of the most important factors in motivating students to improve their academic performance.

During the course students can find literature and other study-related materials for their learning in a virtual environment – Moodle system as well share and discuss their achievements and the results on their research. This in turn promotes students' motivation to achieve their goals, provides an opportunity to analyze the results achieved and their compliance with the set of raised goals (Fig. 16).

When the learning literature and other study-related materials are placed in a virtual space, it is much easier for students to work in groups and achieve common learning results. This speeds up the process of exchanging information between students working in different groups and motivates them to achieve even better results. This tendency has been observed since the first years of the IBL methodology in the course.

Discussed results of evaluation of the methodology in learning process substantiates all the statements about the benefits of IBL in the study process and the motivation of students to achieve the highest academic results. Only the application of new advanced methods in the study process can cause the same reaction among students, i.e., high motivation to achieve the best in education and future projects.

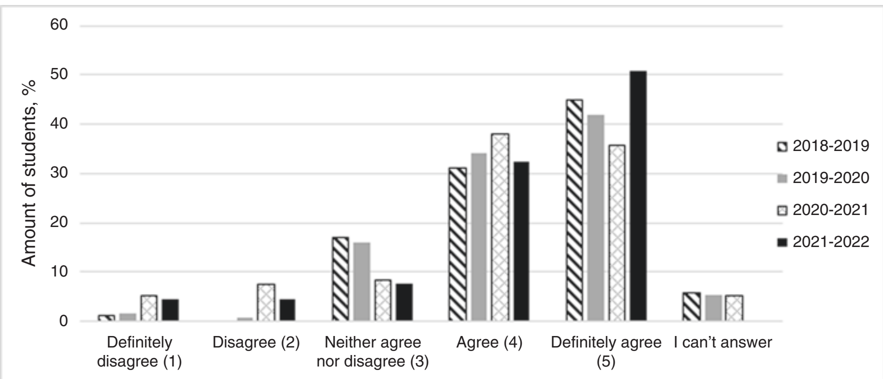


Fig. 15 The evaluation criteria and procedures were clear from the beginning

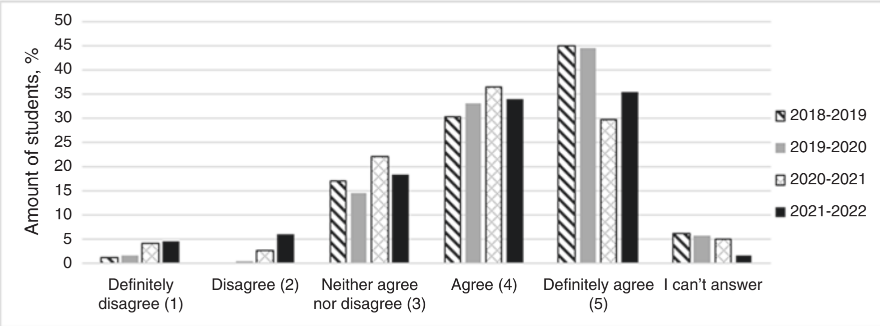


Fig. 16 Using Moodle or other virtual learning environments to achieve learning objectives

Table 2 Average values of course and teaching quality assessment

Activity (%)	Average (to the question "Am I satisfied with the application of IBL in the course?")	Number of students able to grade
42.48	1.27	460

Results on Teaching Process

The assessment of the course and teaching quality is shown in Table 2. We can see that the activity of students who took part in the survey was quite high – 42.48%. According to the students, the application of the IBL methodology has proved its efficiency and the average answer to the question "*I am satisfied with the application of IBL in the course*" was 1.27. According to the rating scale, which is presented in Table 3, such rating is equal to the evaluation "good".

It is clear that the use of innovative teaching methods improves the quality of studies and the level of students' satisfaction with the study process (Table 4). The average students' responses highlighted the benefits of IBL in the course as the evaluations were above average and based on the rating scale (see Table 4).

A survey of gifted students, who participated in the course and worked on projects in different groups, showed that teachers involved in IBL based teaching were rated as "good" or "very good" (Table 5). Based on the results, it is seen that the teachers did a good job and they motivated the students to achieve even higher results.

One of the examples in reflection and feedback of gifted students, who learned programming of robots under IBL, were conducted at the end of 2021–2022 academic year. An open-question survey was presented to the students in a Moodle environment. 153 students were able to participate in that survey and 109 of them provided their feedback and thoughts.

Generally, the students, who were learning the course during that academic year, were pleased and very satisfied with the inquiry-based learning methodology. The questions and examples of the students' answers are following:

Table 3 Assessment values

Students' perceptions of the course / lecturer's work	Average course/lecturer performance rating in course quality assessment surveys
Very good	1.56 to 2
Good	1.12 to 1.55
Average	0.67 to 1.11
Satisfactory	0.23 to 0.66
Unsatisfactory	−0.22 to 0.22

Table 4 Average values of course and teaching quality assessment

I am satisfied with the application of IBL in the course	The IBL methodology and learning resources are interesting and have contributed to the achievement of the course's objectives, outcomes and competences	The course uses advanced learning methods deepens students' understanding of learning	The evaluation criteria and procedures were clear from the beginning	Using Moodle or other virtual learning environments to achieve learning objectives
1.27	1.3	1.57	1.7	1.23

Table 5 Overview of teaching quality assessment of gifted student

Gifted student group that took part in the survey	I am satisfied with the tutor's work on this course	Lecturer teaches/ explains/speaks in a persuasive and understandable way	A collegial/ respectful relationship between the lecturer(s) and the students is maintained	Students receive feedback on their work (discussing the results of assignments, independent work, etc.)	The lecturer does not tolerate academic dishonesty (e.g., cribbing, plagiarism, etc.)
Group 1	1.33	1.17	1.17	1.17	1.18
Group 2	1.15	1.12	1.46	1.15	1.5
Group 3	1.33	1.33	1.33	1.33	1.33
Group 4	1.47	1.71	1.71	1.4	1.77

– In response to the question "*Did teamwork give you an advantage when doing an engineering project?*", 72% of students answered "*Yes*".
– 100% of the students, who took part in the survey, answered "*Yes*" to the question "*Has your level of knowledge and skills increased as a result of taking this course?*".
– In response to the question "*How do you rate the laboratory assignments*?", 85% of the respondents answered that "*the assignments have given me the opportunity to develop my skills*".
– In response to the question "*How do you rate the amount of laboratory assignments*?", 32% of the respondents answered that "*there is not enough time to do the assignments in the class*".

– Students were quite passive to comment on the question "*What needs to be improved in the course's activities?*" thus one of the more detailed and informative answers was: "*there was enough time to do the lab works during the lab sessions, the tasks are clearly described, the assessment criteria are clear. Having an engineering project in a group is definitely a plus, but if the team chose to do a task with one of the robots used in the lab, then it is very realistic that there might not be enough time to complete the task*".

Conclusions

In this chapter, the application of inquiry-based learning according to two gradations (Guided and Free) of the teacher-student process combined with the last two levels of SAMR model (Modification and Redefinition) in the programming of the robots' course was presented. The results, which were presented in this chapter, included 4 years of IBL based teaching and learning experience.

The research showed that the model of inquiry-based learning, which was applied to the course of robots' programming, allowed reaching not only the objectives related to the quality of knowledge in robotics, but also the objectives formulated in teaching and learning point of view. The general results showed that inquiry-based learning is effective for gifted students.

First, gifted students go beyond their "comfort zone" as they were learning to work in a team and be a part of it. It is not always an easy way to reach it as the gifted and talented student has understanding of their perfection in learning process. In this case, IBL methodology allows developing their metacognitive skills.

Second, IBL based learning let to develop students' critical thinking. Gifted students evaluated their learning process as good according to the overall inquiry process. The results from the assessment of the inquiry-based learning implementation to the course showed that such way of learning deepens students' understanding of learning and contributes to the achievement of the course's objectives, outcomes and competences. It was concluded that reflection of gifted students also helped in development of their critical thinking skills, analysis, evaluation of other works, self-awareness.

Finally, results of evaluation of the methodology in learning and teaching process substantiates all the statements about the benefits of IBL in the study process and the motivation of students to achieve the highest academic results.

Acknowledgments The application of new learning methodologies and sharing of teaching experience during the lectures in Kaunas University of Technology, Lithuania has been supported during the process of academic mobility between teachers from Lithuania and Latvia, which was funded by Nordplus Higher Education funds (Nordic Council of Ministers) in the project NPHE-2021/10241 "Advanced Approach for Computer Control of Electrical Technologies".

References

Acar, O. A., & Tuncdogan, A. (2018). Using the inquiry-based learning approach to enhance student innovativeness: A conceptual model. *Teaching in Higher Education, 24*(7), 895–909. https://doi.org/10.1080/13562517.2018.1516636

Alteren, I. R. (2021). *Effect of specificity of guidance on gifted children's learning process, learning outcomes, mood and flow during inquiry-based learning in science education* (Master's thesis). University of Twente.

Attar, S. (2019). A design of gifted personality traits scale. *International Journal of Learning and Teaching, 11*(2), 49–59.

Bezen, S., & Bayrak, C. (2020). Teaching mechanical waves by inquiry-based learning. *Journal of Baltic Science Education, 19*(6), 875–892.

Blancas, M., Valero, C., Mura, A., Vouloutsi, V., & Verschure, P. F. M. J. (2020). "CREA": An inquiry-based methodology to teach robotics to children. In M. Merdan, W. Lepuschitz, G. Koppensteiner, R. Balogh, & D. Obdržálek (Eds.), *Robotics in education* (pp. 45–51). Springer International Publishing. https://doi.org/10.1007/978-3-030-26945-6_4

Buerk, S. (2021). Inquiry learning models and gifted education: A curriculum of innovation and possibility. In *Modern curriculum for gifted and advanced academic students* (1st ed., pp. 129–170). Routledge. https://doi.org/10.4324/9781003236696

Čepič, M. (2018). Inquiry based learning of contemporary physics topics and gifted students. In *The role of laboratory work in improving physics teaching and learning* (pp. 203–215). Springer. https://doi.org/10.1007/978-3-319-96184-2_17

Chrysovalantis, K., & Drigas, A. (2020). S.T.E.M.: Inquiry-based learning and gifted education. *Neurology and Neurobiology, 3*(4), 1–5. https://doi.org/10.31487/j.NNB.2020.04.01

Coppelia Robotics. (2022). *Robot simulator CoppeliaSim: Create, compose, simulate, any robot*. https://www.coppeliarobotics.com/

Cyberbotics. (2022). *Webots: Robot simulator*. https://cyberbotics.com/

Dorier, J.-L., & Maass, K. (2020). Inquiry-based mathematics education. In *Encyclopedia of mathematics education* (pp. 384–388). Springer.

Efklides, A. (2019). Gifted students and self-regulated learning: The MASRL model and its implications for SRL. *High Ability Studies, 30*(1–2), 79–102.

Eltanahy, M., & Forawi, S. (2019). Science teachers' and students' perceptions of the implementation of inquiry-based learning instruction in a middle School in Dubai. *Journal of Education, 199*(1), 13–23. https://doi.org/10.1177/0022057419835791

Eppes, T., Milanovic, I., & Wright, K. (2020). Improving student readiness for inquiry-based learning: An engineering case study. *IJOE, 16*(1), 14. https://doi.org/10.3991/ijoe.v16i01.12051

Hamilton, E. R., Rosenberg, J. M., & Akcaoglu, M. (2016). The substitution augmentation modification redefinition (SAMR) model: A critical review and suggestions for its use. *TechTrends, 60*(5), 433–441.

Ibrohim, I., Sutopo, S., Muntholib, M., Prihatnawati, Y., & Mufidah, I. (2020). Implementation of inquiry-based learning (IBL) to improve students' understanding of nature of science (NOS). *AIP Conference Proceedings, 2215*(1), 030005.

Ismail, M. J., Anuar, A. F., Yusof, R., Yon, N. F. M., & Peter, O. (2021). Exerting inquiry based learning method in improving gifted students' music recorder skill. *Quantum Journal of Social Sciences and Humanities, 2*(2), 11–24.

Khalaf, B. K., & Zuhana, B. M. Z. (2018). Traditional and inquiry-based learning pedagogy: A systematic critical review. *International Journal of Instruction, 11*(4), 545–564.

Kırıcı, M. G., & Bakırcı, H. (2021). The effect of STEM supported research-inquiry-based learning approach on the scientific creativity of 7th grade students. *Journal of Pedagogical Research, 5*(2), 19–35.

KTU. (2018). *Studijų apklausų organizavimo, vykdymo ir rezultatų analizės metodika*. KTU. https://ktu.edu/wp-content/uploads/2016/08/Studiju-apklausu-metodika-2018-06.pdf

KTU. (2022). *GIFTed*. https://students.ktu.edu/ed-programmes/gifted/

Kukulska-Hulme, A., Lee, H., & Norris, L. (2017). Mobile learning revolution: Implications for language pedagogy. In *The handbook of technology and second language teaching and learning* (pp. 217–233). China Central Radio & TV University Press.

Lai, C.-S. (2018). Using inquiry-based strategies for enhancing students' STEM education learning. *Journal of Education in Science Environment and Health, 4*(1), 110–117.

Lee, T. T., & So, W. W. (2015). Inquiry learning in a special education setting: Managing the cognitive loads of intellectually disabled students. *European Journal of Special Needs Education, 30*(2), 156–172.

Li, J. (2021). Discussion in Inquiry-Based Learning (IBL). *International Journal of Education and Management, 6*(3), 140.

Lintner, T., & Puryear, A. (2021). Inquiry-based learning for gifted students in the social studies classroom. In *Teaching gifted children* (1st ed., pp. 247–252). Routledge. https://doi.org/10.4324/9781003238638

Lyddon, P. A. (2019). A reflective approach to digital technology implementation in language teaching: Expanding pedagogical capacity by rethinking substitution, augmentation, modification, and redefinition. *TESL Canada Journal, 36*(3), 186–200.

McKimm, A. N. (2021). *Inquiry-based pedagogy for inclusive classrooms* (Master's thesis). Bethel University. https://spark.bethel.edu/etd/760

Meirbekov, A., & Salikhanova, Y. (2021). Inquiry-based learning: Strategies and benefits. *Вестник КазНУ. Серия Педагогическая, 67*(2), 18–26.

Mutakinati, L., Anwari, I., & Kumano, Y. (2018). Analysis of students' critical thinking skill of middle school through STEM education project-based learning. *Jurnal Pendidikan IPA Indonesia, 7*(1), 54–65.

Onsee, P., & Nuangchalerm, P. (2019). Developing critical thinking of grade 10 students through inquiry-based STEM learning. *Jurnal Penelitian Dan Pembelajaran IPA, 5*(2), 132–141.

Open Robotics. (2022). *Gazebo simulator*. https://gazebosim.org/home

Pala, F. K., & Mıhcı Türker, P. (2021). The effects of different programming trainings on the computational thinking skills. *Interactive Learning Environments, 29*(7), 1090–1100.

Phelps, V. A. (2022). Motivating gifted adolescents through the power of PIE: Preparedness, innovation, and effort. *Roeper Review, 44*(1), 35–48.

Puentedura, R. R. (2015). *SAMR: A brief introduction*. Unpublished. Retrieved from http://www.hippasus.com/rrpweblog/archives/2013/10/02/samr_abriefintroduction.pdf

Spronken-Smith, R., & Walker, R. (2010). Can inquiry-based learning strengthen the links between teaching and disciplinary research? *Studies in Higher Education, 35*(6), 723–740.

Taengkasem, K., Chookaew, S., Howimanporn, S., Hutamarn, S., & Wongwatkit, C. (2020). Using robot-based inquiry learning activities for promoting students' computational thinking and engagement. In *Proceedings of the 28th International Conference on Computers in Education*, pp. 386–393.

VEX Robotics. (2022). *VEXcode VR - Virtual robot*. https://vr.vex.com/

Yadav, A., Gretter, S., Good, J., & McLean, T. (2017). Computational thinking in teacher education. In P. J. Rich & C. B. Hodges (Eds.), *Emerging research, practice, and policy on computational thinking* (pp. 205–220). Springer International Publishing. https://doi.org/10.1007/978-3-319-52691-1_13

Zweers, I., Huizinga, M., Denessen, E., & Raijmakers, M. (2019). *Inquiry-based learning for all: A systematic review of the effects of inquiry-based learning on knowledge, skills, attitudes and behavior of students with social-emotional and behavioral difficulties in primary and secondary education*. https://doi.org/10.31219/osf.io/z45jt

Content Design for Inclusive Educational Environments

Polyxeni Kaimara, Ioannis Deliyannis, and Andreas Oikonomou

Introduction

Equality and non-discrimination are key principles of the international human rights' regulatory framework. Education empowers full human personality development and enhances respect for all human rights and fundamental freedoms (United Nations, 1948, p. 76). Primarily prerequisite for a society without discrimination and exclusions is educational equity. The interest in inclusive education that supports and welcomes the diversity of students with special educational needs and disabilities (SEND) was first enshrined in the early 1970s through decrees, declarations and laws such as the United States "Education for All Handicapped Children Act" (PL 94-142) (U.S. Congress, 1975) and the UK Report of the Committee of Enquiry into the Education of Handicapped Children and Young People, known as "The Warnock Report" (Department for Education and Science, 1978). The "World Conference on Education for All" held in 1990 in Jomtien, Thailand (WCEFA Inter-Agency Commission, 1990) is considered the culmination of the ongoing efforts for educational equity. Subsequently, 92 governments and 25 international organisations ratified the "Salamanca Statement" in 1994. The "Salamanca Statement" is regarded as the most important international document focusing on the principles, policies, practices and framework for action in the field of Special Education (UNESCO, 1994). The actions undertaken following the Declaration adopted by the World Conference on Education for All in conjunction with the Salamanca Statement

P. Kaimara (✉) · I. Deliyannis
Department of Audio & Visual Arts, Ionian University, Corfu, Greece
e-mail: a16kaim@ionio.gr; yiannis@ionio.gr

A. Oikonomou
School of Pedagogical and Technological Education (ASPETE), Thessaloniki, Greece
e-mail: aoikonomou@aspete.gr

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_6

ensure every person's (child, adolescent and adult) right to benefit from the educational opportunities designed to meet their basic needs. The improvement of conditions and the establishment of an appropriate legal framework were the results of inclusive education policies. Therefore, all students can attend their neighbourhood schools in the same class with their typically developing peers, regardless of their cognitive, physical or emotional state, mother language, cultural, religious and socioeconomic background. However, it has been ascertained that there are difficulties in implementing inclusive education, as also evidenced and confirmed by the Committee on the Rights of Persons with Disabilities (United Nations, 2018). Given the adequate legislation worldwide, or at least in most countries, the investigation of the problem led to the conclusion that inclusive education is a process of systemic reform, which, among other factors, incorporates changes in curricula, content, educational materials and teaching methods to provide learning environments that meet the needs of each individual student (European Agency for Special Needs and Inclusive Education, 2017; IBE-UNESCO, 2016). Learning is almost impossible if the educational material is presented to students in a way that does not fit their physical and/or cognitive limitations. To reduce barriers associated with learning difficulties, it is important to ensure that educational content is equally accessible to all students, regardless of possible sensory and/or perceptual difficulties. Hence, students with SEND often require accommodations to access educational content, devices and services.

Teachers are the pillar of such a systemic reform and their role is considered crucial for the implementation of any educational innovation, as is the case with inclusive education (de Boer et al., 2011; Office of Education Research, 2018; Tsibidaki et al., 2020). The literature review demonstrates that teachers' attitudes toward inclusive education are shaped more by practical procedural factors than by negative emotions or prejudices (Kaimara, 2022; Moriña, 2020; Vaz et al., 2015). The lack of differentiated educational material constitutes one of the most significant factors. Teachers, while declaring that they are willing to differentiate their courses to meet their students' different needs, often acknowledge that they lack the necessary know-how and technical expertise to prepare their educational materials and this weakness also raises concerns about their classroom management (Kaimara & Oikonomou, 2018; Tomlinson et al., 2003). Creating appropriate differentiated educational material, which responds to every student's needs and improves the services provided in early intervention and preschool education is a key component of the European Union's educational policy (Bartolo et al., 2021; European Agency for Special Needs and Inclusive Education, 2017). Nowadays, there are educational systems that promote inclusive education and suggest great practices based on the capabilities of cutting-edge technology (Alberta Teachers' Association, 2015; Gelastopoulou & Kourbetis, 2017; Goo et al., 2019). Educational activities, which are either virtual or supported by augmented real-world information and furthermore combine physical interaction, gamification and learning scenarios, can change the landscape of education. In recent years, educational technology and learning based on digital educational games are constantly gaining ground in general and special education (Daniela, 2021; Hersh & Leporini, 2018). Research on educational technology in practice underlines that its integration is a multifaceted issue and that once again teachers' attitudes are a key parameter (Daniela & Žogla, 2013; Kaimara et al., 2022; Mertala, 2019). Although the psycho-pedagogical value of digital educational games is well documented, the literature reveals that teachers are reluctant to use them in the classroom (Kaimara et al., 2021c). The main obstacles to integrating digital educational games in the classroom are considered to be teachers' preference for traditional teaching methods and the lack of training in Information and Communication Technologies. Teachers' professional development provides them with the technological skill sets to create educational material themselves. In the light of the twenty-first-century knowledge society demands, in the field of applied pedagogy and educational psychology, the academic community proposes scientifically based educational methods, interventions and materials that facilitate digital transformation.

The purpose of this chapter is to present the process of designing and developing inclusive transmedia educational material. This process is recommended to educators, therapists, game developers and education decision-makers as a good practice guide for creating meaningful content. A case study is described and analysed in detail from an idea to its implementation and evaluation by potential users of a Greek Training Center for People with Disabilities. The case study, called Waking Up In the Morning (WUIM), focuses on activities of daily living (ADLs) training and combines into one system various modes of interaction with the learning content targeting a wide range of disabilities (Kaimara et al., 2021a, b, e). As a team of audiovisual and educational technology professionals, we are involved in transmedia content-production processes, including traditional board games, digital gaming systems, standard 2D videos and interactive 360º videos created with a novel film-production methodology, as well as augmented reality (AR) and virtual reality (VR) technologies. The psycho-pedagogical affordances of WUIM are drawn from the principles of inclusive pedagogies (Moriña, 2020) and the most influential learning theories such as behaviourism and constructivism, along with the theoretical framework and interventions that are particularly utilised in the field of special education, such as Differentiated Instruction (DI) (Tomlinson et al., 2003), Universal Design for Learning (UDL) (CAST, 2018), Multimedia Learning (ML) (Mayer, 2014) and Transmedia Learning (TL) (Fleming, 2013). The contribution of gamification techniques (Plass et al., 2015) and the perspectives of cutting-edge technology in education were also studied (Dalgarno & Lee, 2010). Given that the target group of WUIM is children, its design and development considered the ethical issues and concerns that have arisen from the use of cutting-edge technologies and especially from VR systems by children (Kaimara et al., 2021e). It is therefore evident that the development of digital educational games, especially when they are aimed at a diverse student population, assumes a transdisciplinary team each member of which will equally contribute to the content design from its scientific field of expertise.

Educational Game Design Frameworks

The transdisciplinary team's preliminary decision was to apply design models and technologies that can be easily implemented by non-experts. For the design and development of WUIM, both educational design frameworks and game development models were studied. ADDIE instructional design model was assumed to be an ideal model that can be easily used by educators and therapists (Bates, 2019; Branch, 2009). Since WUIM would include games, we followed the directions provided in the four-dimensional framework by de Freitas and Oliver (2006). The Game Development Life Cycle proposed by Ramadan and Widyani (2013) was considered to be a suitable game development model as it meets the requirements of WUIM.

Instructional Design Models

ADDIE: A Five-Phase Model of Instructional Design

The five-phase instructional design model ADDIE was the compass for the creation of WUIM. ADDIE is an acronym for Analyse, Design, Develop, Implement and Evaluate (Fig. 1) and was developed in Florida State University's Center for Educational Technology (Branson et al., 1975).

Creating materials, not just for educational purposes, through the ADDIE instructional design model remains one of the most effective planning tools for complex situations and, therefore, is fit for developing effective content and other learning resources (Branch, 2009). The ADDIE model is utilised by many professional

Fig. 1 The ADDIE model of instructional design. (Created by the authors)

designers and educators for technology-supported learning environments, as it provides a comprehensive guidance framework and encompasses a circular process consisting of the following phases (Bates, 2019):

- *Analyse:* identify and analyse variables that must be considered during the design, such as the characteristics of students, their previous knowledge, available resources, etc.
- *Design:* define learning objectives and register ideas for creating and designing materials, e.g., may include a description of the content to be covered, a visual representation (storyboard) that provides text, audio and video, decisions about the choice and use of the technology will be displayed (genre, media, etc.).
- *Develop:* create content, internally or externally, copyright clearance, management and licensing, upload content to a site, etc.
- *Implement:* deliver of the course, including any previous training, briefing of student support staff.
- *Evaluate:* get feedback through data collection to identify areas that require potential improvement.

It should be emphasised that the evaluation phase is not only the conclusion of the entire process but runs through each individual phase with repeated testing and reviews.

For the ADDIE phase "Analyse", de Freitas and Oliver's (2006) four-dimensional framework guides designers to make effective decisions before designing learning materials. The documented design and effective development of a system are based largely on the "Analyse" phase. The more careful and comprehensive the analysis, the more credible the material that will be delivered, as it serves the objectives it promised to achieve.

A Four-Dimensional Framework for Evaluating Games and Simulation-Based Learning

Examining the evolution of interactive educational systems from edutainment to educational use of games (Egenfeldt-Nielsen, 2007), WUIM educational content was decided to have the structure of a game due to its dynamics in the learning process. For this reason, it was studied extensively the four-dimensional framework proposed by de Freitas and Oliver (2006). The four dimensions of the model include (Table 1) (A) context, (B) learner characteristics, (C) pedagogical considerations and (D) mode of representation.

Each dimension of the model includes a series of questions that can serve as a checklist when analysing the features of an educational game and the target group to which it is addressed. The same framework can facilitate teachers in designing and evaluating any interactive educational system.

Table 1 The four-dimensional framework checklist

		Check
A	*Context* (where game/learning takes place)	
1	What is the context for learning? (e.g., school, university, home, a combination)	
2	Does the context affect learning? (e.g., level of resources, accessibility, technical support)	
3	How can links be made between context and practice?	
B	*Learner specification* (age and level, learning background, styles, and preferences)	
1	Who is the learner?	
2	What is their background and learning history?	
3	What are the learning styles/preferences?	
4	Who is the learner group?	
5	How can the learner or learner group be best supported?	
6	In what ways are the groups working together (e.g., singly, partially in groups) and what collaborative approaches could support this?	
C	*Pedagogical considerations* (methods, theories, models and frameworks)	
1	Which pedagogical models and approaches are being used?	
2	Which pedagogical models and approaches might be the most effective?	
3	What are the curricula objectives? (list them)	
4	What are the learning outcomes?	
5	What are the learning activities?	
6	How can learning activities and outcomes be achieved through existing games or simulations?	
7	How can the learning activities and outcomes be achieved through specially developed software (e.g., embedding into lesson plans)?	
8	How can briefing/debriefing be used to reinforce learning outcomes?	
D	*Mode of representation* (tools for use/level of immersion, fidelity, and interactivity)	
1	Which software tools or content would best support the learning activities?	
2	What level of fidelity needs to be used to support learning activities and outcomes?	
3	What level of immersion is needed to support learning outcomes?	
4	What level of realism is needed to achieve learning objectives?	
5	How can links be made between the world of the game/simulation and reflection upon learning?	

Game Development Life Cycle

Game development requires a specific process with guidelines, called Game Development Life Cycle (GDLC) (McAllister & White, 2015; Ramadan & Widyani, 2013). A GDLC generally includes the following phases (Fig. 2): (1) *Concept*, (2) *Alpha version*: (i) pre-production, (ii) production, (iii) testing, (3) *Beta version*, and (4) *Release*.

The first step of the game design is to record the idea, the topic (concept), the game genre and a simple description of the issues that will be negotiated. At this stage, a document called Game Design Document (GDD) is being prepared (GDD) (Pozefsky, 2016; Ramadan & Widyani, 2013). GDD, which can be more than one

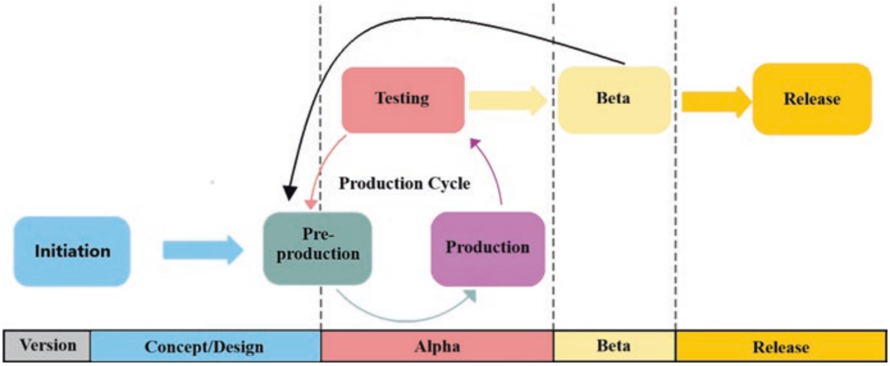


Fig. 2 Game Development Cycle (GDLC). (Source: adapted from Ramadan and Widyani (2013, p. 98))

document, serves two purposes: memory and communication. On the one hand, the designer records and updates the ideas and decisions made at each stage, referring to it any time new data emerges, and on the other hand, GDD facilitates the discussions within the team. GDDs are useful for the whole team so that all members get a sense of the big picture of the game. Through the GDDs, the team members understand what the game that will be developed will look like, details about the game mechanics, interfaces, script or dialogues, time planning, costs and instructions (McAllister & White, 2015; Schell, 2015).

Pre-production is a fundamental step between "Design" and "Alpha" phases. The game design focuses on determining the game genre, gameplay, engineering, story, characters, challenges, factors that cause a fun environment, technical aspects and documentation of the decisions recorded in the GDD (Ramadan & Widyani, 2013). Pre-production is completed when changes to the game design have been approved and documented in the GDD. Production is the basic process that revolves around the creation of assets, such as graphics and 3D models, coding, sounds and sound effects and their integration into the code. Several prototypes are being developed which are constantly being tested to eliminate errors. The Alpha phase includes part of the pre-production, production of prototypes and repeated testing by the design team. Tests are conducted to control the game's usability and playability. The final prototype goes through a final test by other developers, content experts and potential users outside the design team, to check for fun and accessibility. The result of the final test includes bug reporting, change suggestions and a decision on the final development of the game. Depending on the result, it will be decided whether it is time for the game to proceed to the next phase, the Beta or to repeat the production cycle.

Beta is a testing phase of the game by third-party external evaluators. The Beta result is also bug reports and user feedback, which brings together the features of potential players. For example, if the game is aimed at children with SEND, then the potential Beta evaluators are children with SEND. Depending on the results of the Beta phase, the game may be taken back into production to be improved or it can be released accompanied by the appropriate documents and licenses.

The WUIM Production Process

The primary purpose of special education is to prepare students with SEND to function as independently as possible in the community so that they can live a successful and fulfilling life. Therefore, a wide range of adaptive skills should be included in a functional curriculum suitable for students with SEND who are either trained in separate structures (resource rooms) or inclusive classrooms with their typically developing peers (Bender et al., 2008). Based on this specific goal of special education, the educational content of WUIM that was designed, developed and evaluated for this research was drawn from the field of Independent Living Skills. The content focuses on self-care activities performed by children at home in the morning so that they are ready for school. After defining the concept of WUIM, more detailed research followed, through the synthetic approach of the ADDIE model (Bates, 2019; Branch, 2009), de Freitas and Oliver's (2006) framework and the Game Development Life Cycle (Ramadan & Widyani, 2013).

Analyse: The First Phase of ADDIE

In the first phase of the ADDIE model, the analysis of the variables to be considered for educational design was guided by the four-dimension framework (de Freitas & Oliver, 2006): context, learner characteristics, pedagogical considerations and mode of representation.

Context of Learning

The context of WUIM is related to inclusive education programs in formal and non-formal education as well as home schooling. Wehmeyer (2006) emphasised that the debate over the education of students with SEND has shifted from "where" students should be educated to "what" they should be taught. Given the technological support provided to formal and non-formal education settings and resources available, the main concern was for WUIM to be a low-cost application, utilising the devices used daily by teachers and students (smartphones and tablets), according to the "Bring Your Own Device (BYOD)" policy (Attewell, 2015) and with the least possible technological support for its implementation. To this end, the requirements and conditions for the successful implementation of inclusive education were extensively reviewed (European Agency for Development in Special Needs Education, 2003).

Learner Characteristics

Guided by the questions of the second dimension of de Freitas and Oliver's framework, we identified the learners' characteristics. It was decided that students' mental age to whom WUIM is addressed ranges between 5 and 7 years. This decision follows the guidelines of the Greek special education curricula as well as the preschool and the first grades of elementary education, where life skills training is a fundamental axis (Hellenic Ministry of Education and Religious Affairs, 2008, 2020). Regarding the type of students' disability and learning difficulties, the data were obtained from the research of the Hellenic Statistical Authority based on the most recently recorded data for the school year 2019–2020 (Hellenic Statistical Authority, 2021). Data recording led to the analysis of students' particular characteristics and capabilities of each disability category for optimum design of educational content considering the appropriate accommodations. Data reveal that the majority of students with SEND present intellectual disability (33.8%), followed by Autism Spectrum Disorder (33%), multiple disabilities (12.6%), learning difficulties (6.3%), psychosocial and emotional problems (5.2%), mobility difficulties (4%), deaf or hard of hearing students (2.4%), students with Attention Deficit Hyperactivity Disorder (1.5%) and blind or deaf students (1.2%).

Pedagogical Considerations

Regarding pedagogy, an extensive literature review of the so-called traditional learning theories which derive their content from educational psychology, i.e., behaviourism and constructivism (cognitive and social), was conducted. According to Decroly and Montessori (as cited in Plancke, 1983), there is no difference between children with SEND and typically developing children in the nature and quality of their development. The same psychological laws apply also in the case of children with SEND, even if they exhibit a developmental delay. Therefore, studying psychopedagogical theories that describe and interpret the phenomenon of learning was deemed imperative. Behaviourist and constructivist approaches to educating students with SEND present several contradictions. Many practitioners suggest that an amalgam of their principles leads to a more effective educational process. Therefore, effective inclusive teaching practices should incorporate ideas from each of these theories to benefit each student (Al-Shammari et al., 2019).

Some of the best interventions for students with SEND in behaviourism-based inclusive environments comprise teaching practices, such as direct instruction, functional behavioural analysis, assessment and feedback (Al-Shammari et al., 2019; Hattie & Gregory, 2018). For behaviourism, learning is achieved through a systematic series of trial-and-error actions. Inclusive teaching practices based on the principles of behaviourism are (Lim et al., 2012; Pratt & Steward, 2020; Steele, 2005):

- Chaining and task analysis in small sections.
- Acquisition of knowledge or skill through systematic training by multiple repetitions and *rehearsing*.
- Modelling, demonstration and interpretation of each step of a process or a new task.
- Continuous practice, contiguity, repetition, sequencing, reinforcement and review, when required, to establish learning.
- Monitoring and feedback progressively and not at the end of the course.

The constructivist approach to inclusive practice focuses on thinking, memory, reflection and motivation for learning (Al-Shammari et al., 2019). Constructivism-based inclusive learning practices emphasise the use of real-life experiences. For constructivism, individuals need to understand the importance of the social dimension of learning through participation, observation, interpretation and adaptation of information to create a cognitive structure. Teachers are essential mediators, providing basic information and organising students to discover their own learning. Inclusive teaching practices based on the principles of constructivism are (Steele, 2005):

- Connecting content with real-life situations so that they have a meaningful concept.
- Starting with information and examples that are known to the students (from their own experiences).
- Focus on the central idea of each course to form the basis for subsequent cognitive subjects.
- Emphasis on high-level thinking skills and providing clear explanations and guidance for clarification (metacognitive strategies).

The principles of learning theories constitute the scientific documentation of:

1 Psycho-pedagogical approaches to teaching students with SEND in inclusive classrooms (Differentiated Instruction, Universal Design for Learning, Multimedia Learning),
2 Psycho-pedagogical interventions in the field of special education, and
3 Psycho-pedagogical affordances of educational games

Psychopedagogical Approaches for Teaching Students with SEND in Inclusive Classrooms

Differentiated Instruction has its roots in Vygotsky's sociocultural theory (Vygotsky, 1978). The goal of effective differentiated instruction is students' active participation in interactive knowledge construction by creating sufficient flexible content (e.g., simultaneous presentation by visual and audio means), process (e.g., more time available for a student to complete a task), materials (e.g., a variety of expression options) and learning environment (e.g., collaborative learning) to fit students' level of readiness, interests and learning profile (Tomlinson et al., 2003).

Universal Design for Learning (UDL), also a constructivist-orientated framework, resembles Differentiated Instruction. According to UDL, there is no "one-size-fits-all" teaching method, nor a single means of presentation/representation, expression, engagement and assessment that is considered optimal for all students (CAST, 2018). The design and development of multimodal systems and educational materials to meet each student's needs is the goal of UDL. Applying UDL strategies supports removing physical, sensory and cognitive barriers from learning, expands opportunities for all learners and ensures accessibility to an inclusive educational system (Navaitienė & Stasiūnaitienė, 2021).

Multimodality-based educational design is at the core of the Cognitive Theory of Multimedia Learning (Mayer, 2014). Multimedia Learning underlines that deeper learning occurs when people create mental representations by material presented in two or more forms, e.g., words such as spoken text or printed text, and pictures such as illustrations, photos, animation, or video. Multimedia Learning theory provides 12 basic principles and nine advanced ones which are useful to consider when designing personalised learning environments (Kaimara et al., 2020).

Psychopedagogical Interventions in the Field of Special Education

Research conclusions on appropriate strategies for acquiring and/or improving independent living skills by students with SEND have led to several interventions (Kaimara et al., 2021b, d). In-vivo instruction, play-based interventions, picture-based systems, Social Stories™ (Gray & Garand, 1993), TEACCH program (Schopler et al., 1995), video-based instruction, computer-based interventions and *computer-based video instructions* are the most commonly used methods of teaching activities of daily living (ADLs) not only to students with SEND but also to typically developing pre-schoolers and first-grade students. However, considering individual differences, it seems that no single intervention is fully effective. This finding has led many practitioners to design and develop more holistic and flexible interventions using the capabilities of cutting-edge technology to be applied in inclusive learning environments.

Psychopedagogical Affordances of Educational Games

Current research recognises the potential of games to attract children's attention and motivate them to explore the edges of their abilities, skills and knowledge (De Grove et al., 2012) thanks to their 12 structural elements: fun, play, rules, goals, interactivity, outcome and feedback, conflict and competition, problem-solving, social interaction, story and win states (Prensky, 2007). The relationship between learning and games is powerful, as many of the principles of effective learning are fundamental elements of games (Murphy, 2012). However, the key principle to creating a successful educational game relies on the balance between entertainment, fun, engagement, content and pedagogical perspectives (Daniela, 2021). The use of games in learning offers extrinsic and intrinsic motivation (Kaimara & Deliyannis, 2019). Examples of extrinsic motivation are rewards such as points, extra time or lives that are apparently based on the concept of reinforcement introduced by behaviourism. Moreover, drill and practice and tutorial software are another contribution of behaviourism to educational games (Lim et al., 2012). On the other hand, the construction of intrinsic motivation is directly related to the challenge, curiosity, control, imagination (Malone & Lepper, 1987), attention, relevance, self-confidence, satisfaction and self-regulation (Keller, 2016).

Mode of Representation

Regarding the mode of representation, we studied the psycho-pedagogical affordances provided by digital and non-digital technologies concerning the level of immersion, realism, fidelity and interactivity, as well as the research field of user experience. Each technology brings together unique features that can be adapted to students' needs and preferences. It was decided that WUIM would be a transmedia interactive system. According to Fleming (2013), transmedia learning applies storytelling techniques across multiple platforms to create immersive educational experiences while allowing students to continue, expand and/or change the story. So, WUIM would incorporate a combination of technologies and prevailing special educational interventions (in-vivo instruction, social stories, picture-based systems and computer-based video instructions) and leverage the principles of game design. Subsequently, we looked at platforms that can be combined in a transmedia learning environment to better serve WUIM requirements related to the context of learning, learner characteristics and pedagogical considerations.

Respecting the non-digital technologies, research has shown that children who play games based on the Montessori method, e.g., wooden puzzles, show improvement in cognitive and executive functions, such as critical thinking, memory, problem-solving, classification, vocabulary, reading and mathematics. The puzzles support visual-motor coordination and in general the development of visual-spatial perception, coarse and fine motor skills, theory of mind, etc. (Bhatia et al., 2015; Lillard, 2013).

In terms of digital technology, AR and VR technologies have been found to better serve the objectives of digital educational games. From a psycho-pedagogical point of view, AR, in terms of the process, is based on behaviourism, as only if the right trigger is found, the application can work. In terms of the learning climate, AR is based on collaborative learning. VR, on the other hand, thanks to its unique characteristics, i.e., immersion, interactivity and information intensity (Heim, 1998), imagination (Burdea & Coiffet, 2003) and involvement (Freina & Ott, 2015) allows greater freedom of exploration and engagement and therefore knowledge construction through discovery learning. Inspired by video-based instruction and observational learning (Bandura, 1965), we decided that AR and VR content should be a short film that describes a student's morning routine taking place in a typical family home. To ensure higher levels of immersion, representational fidelity and learner interaction, so that WUIM can enhance spatial knowledge representation, experiential learning, engagement and collaborative learning (Dalgarno & Lee, 2010), the content for VR was decided to be filmed with a 360-degree camera to provide realistic and *authentic* environments. After proper video editing, the same content is used for the AR following the filmmaking methodology (pre-production, production and post-production) (Ransburg et al., 2008).

Design: The Second Phase of ADDIE

After the analysis, three games were designed which are interconnected according to transmedia theory: (1) WUIM-Puzzle, which is a classic board game of six wooden blocks each depicting a scene/activity of the morning routine, (2) WUIM-AR, which is an AR application that recognises the content displayed on WUIM-Puzzle (trigger) and uses the same videos as WUIM-VR (overlay) after converting 360-degree videos to standard videos and (3) WUIM-VR, which is a VR application that incorporates the same images used in WUIM-Puzzle (as buttons) and the same videos used in WUIM-AR as 3D videos. The first step in the designing process was to identify the learning objectives (learning the morning routine activities, generalisation and maintenance of the acquired knowledge) and then to create the script, the characters, the plot and the storyboard. These steps were the basis for all three games including the filmmaking process.

In the first stage of *filmmaking (pre-production)*, beyond the script and storyboard, we formed a shot list and the breakdown sheets. The storytelling was based on the questions "who", "what", "why", "when" and "where", as provided by the Social Story™ philosophy (Gray & Garand, 1993). "WUIM is the story of Vicky (avatar) who every morning has to successfully complete certain activities at home so that she is ready to go to school but is prevented by the pressure of time to choose the right sequence of activities". Players choose the correct sequence of the activities that the avatar must perform. The story also features a secondary character, Vicky's mother, giving representational fidelity and social interaction, and a pedagogical agent who provides "help" when requested by the players. Six basic morning activities were selected, which are depicted on six symbols from the Boardmaker collection (after permission of Tobii Dynavox Picture Communication Symbols®): toilet, handwashing, breakfast, tooth-brushing, dressing and hugging the parent (Fig. 3). PCS symbols were used in all three WUIM games.

WUIM-Puzzle design Two difficulty levels were designed which were determined based on the principles of equal participation and inclusion in the learning experience according to differentiated instruction (Fig. 4). At the first level, all symbols are imprinted in square wooden wedges. The correct sequencing of the activities depends only on the content that is displayed. At the second and easiest level, the symbols are imprinted on wooden wedges of different shapes. Thus, players are

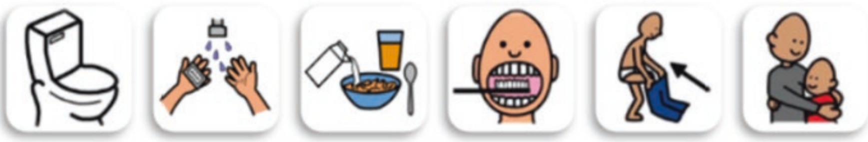


Fig. 3 The six-morning activities

Fig. 4 Design of wooden puzzles

assisted by the shape along with the depicted content. Essentially, the game provides built-in gameplay that promotes constructive thinking (Ke, 2016).

WUIM-AR design WUIM-Puzzle images constitute the AR triggers and videos produced during the filmmaking process constitute the overlays. The first image (alarm clock) marks the start of the game. WUIM-AR *is an Android game app. The "buttons" appeared on the main screen of the game are "play", "help", "instructions" (tutorial), "options", such as difficulty level (3 difficulty levels), language (Greek or English), subtitles, audio settings (mute), vibration on/off, background/fonts, "back", "exit" and "credits". When "play" is selected, then the device is ready to scan the trigger. If the trigger is the correct one,* then the linked video is displayed and players *are rewarded by the pedagogical agent. When players reach the last correct trigger, then the whole story is displayed,* i.e., *the movie with all the activities in sequence. If the correct trigger is not found, then depending on the dif-*

ficulty level chosen, either the pedagogical agent verbally encourages or assists players until the correct sequencing is found.

WUIM-VR design VR game was designed for low-cost Smartphone VR Headset Enclosures, in a way to allow students to interact freely, discover and experiment. The game goal is for students to lead the avatar to the house exit to go to school. However, to finish the game, certain conditions must first be met. There are five conditions (criteria of progress/win) that are at the same time hygiene and behaviour rules. Vicky cannot "win" the game, i.e., to leave the house, if she does not have: (1) eat her breakfast, (2) brush her teeth, (3) take off her pyjamas and put on her clothes, (4) wash her hands and (5) greet her mother. In addition to winning conditions, there are scattered restrictions on avatar movements that meet individual learning behavioural goals. For example, Vicky cannot get out of the bathroom without washing her hands.

Develop: The Third Phase of ADDIE

WUIM development was progressed both in parallel and sequentially for each game. For example, producing the puzzle and filmmaking were parallel actions. However, to develop digital games following the Game Development Life Cycle, the filmmaking process had to be completed. Figure 5, which was created by the authors, illustrates the overview of the WUIM design and development process.

Filmmaking process After the pre-production stage was complete (script, storyboard, shot list, breakdown sheets), we proceeded with the film production stage by shooting the 360-degree videos. When all the video shootings were completed according to the script, we proceeded with the video editing by converting 360-degree videos to standard videos (Fig. 6), pedagogical agent shooting (Fig. 7) and adding sounds, music and subtitles (Fig. 8).

WUIM-Puzzle development Initially, we edited the symbols so that we could have a better resolution for printing them on clear matte vinyl stickers. At the same time, the wooden bases and the wedges were made by a carpenter. The stickers were then stuck to the wooden surfaces (Fig. 9).

WUIM-AR development WUIM-AR was developed with Vuforia and the Unity3D game engine. Vuforia is an open-source AR software development kit (SDK) for mobile devices that connects directly to Unity3D (Fig. 10) and provides Application Programming Interface (API) in C ++, Java, Objective-C ++ and .Net programming languages. The basic features are offered free of charge for educational purposes.

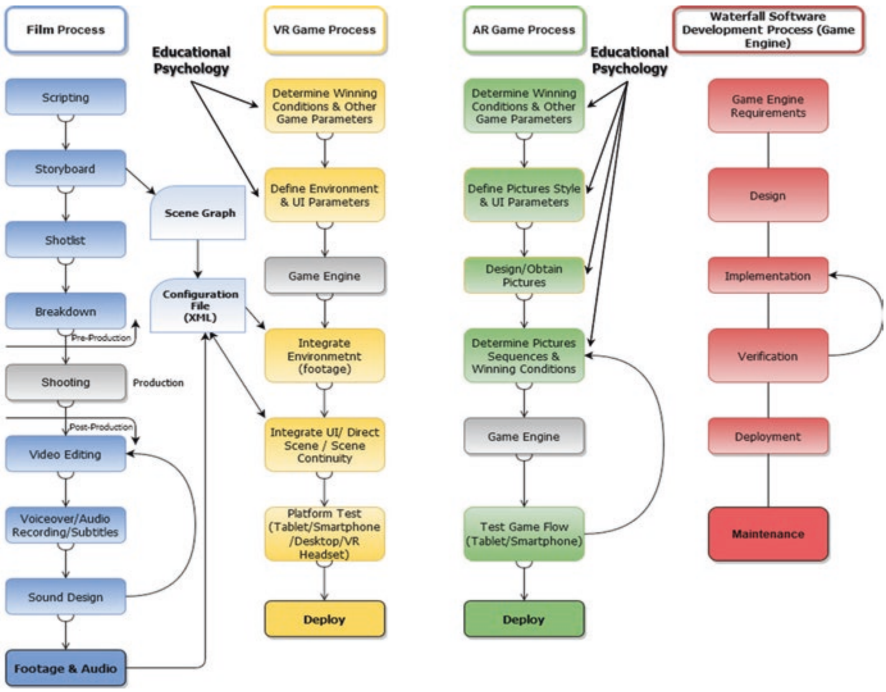


Fig. 5 Overview of the WUIM design and development process

Fig. 6 360-degree videos converted to standard videos

WUIM-VR development WUIM-VR was also developed with the Unity3D game engine (Fig. 11) which allows game developers to manage assets such as graphics, sounds and code, scripts, create game levels, profiling, debugging and other tools useful for the development process. The development of WUIM-VR consists of three parts: source material, XML configuration and game engine. Figure 12 depicts the option buttons offered to players to select the next scene.

Fig. 7 Pedagogical agent shooting. (Source: Kaimara et al. (2021b, pp. 143–145))

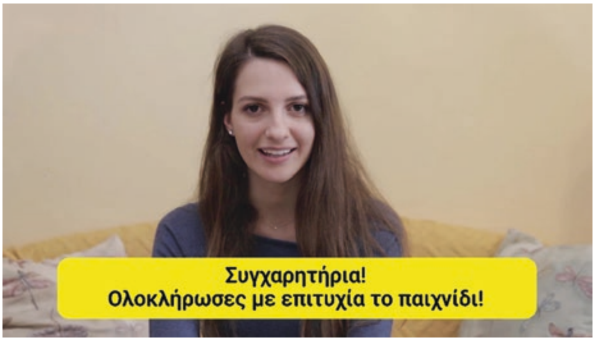


Fig. 8 Adding Greek subtitles. (Source: Kaimara et al., (2021b, pp. 143–145))

Fig. 9 The two-difficulty level of wooden puzzles

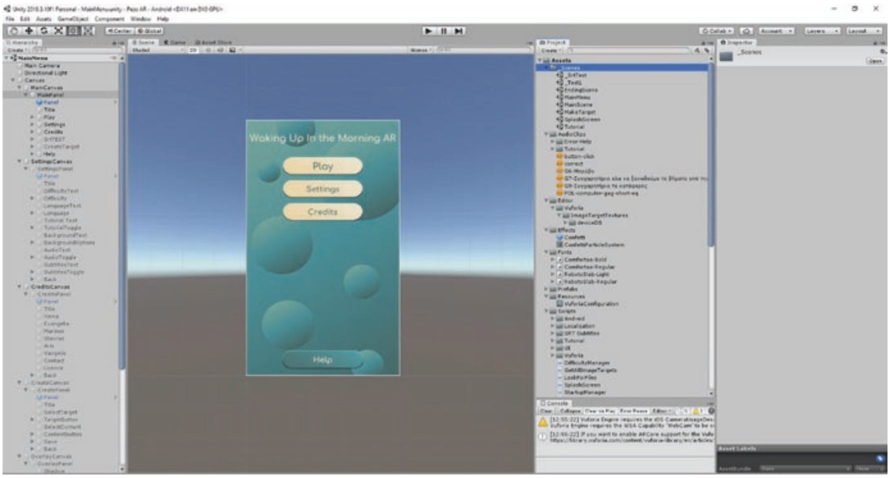


Fig. 10 Unity: main menu

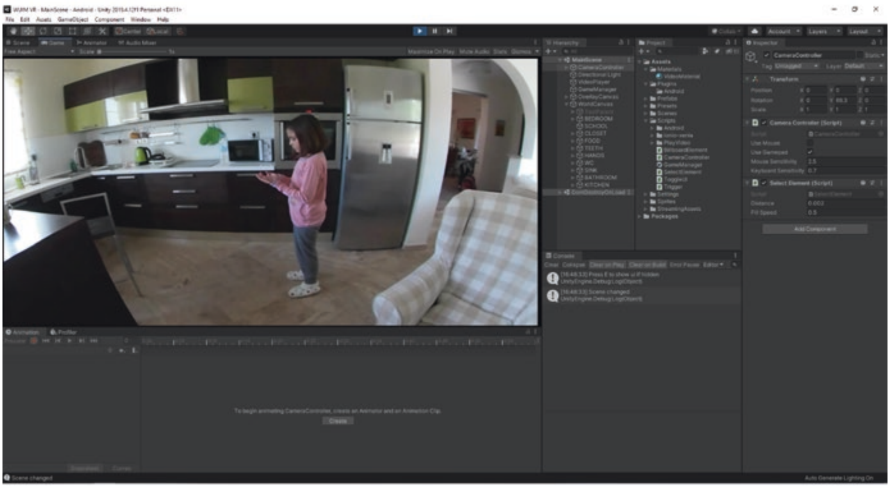


Fig. 11 Unity3D development environment – after loading the XML file

Implement: The Fourth Phase of ADDIE

WUIM was implemented under realistic conditions to be evaluated by potential users (formative evaluation) at the Center for Physical Medicine and Rehabilitation of General Hospital of Florina-Greece (Fig. 13). For this purpose, we ensured permission of the Research Ethics and Conduct Committee of Ionian University, the Scientific Council of the Hospital and parents. The formative assessment aimed to

Fig. 12 Option buttons offered to players to select the next scene in the VR environment

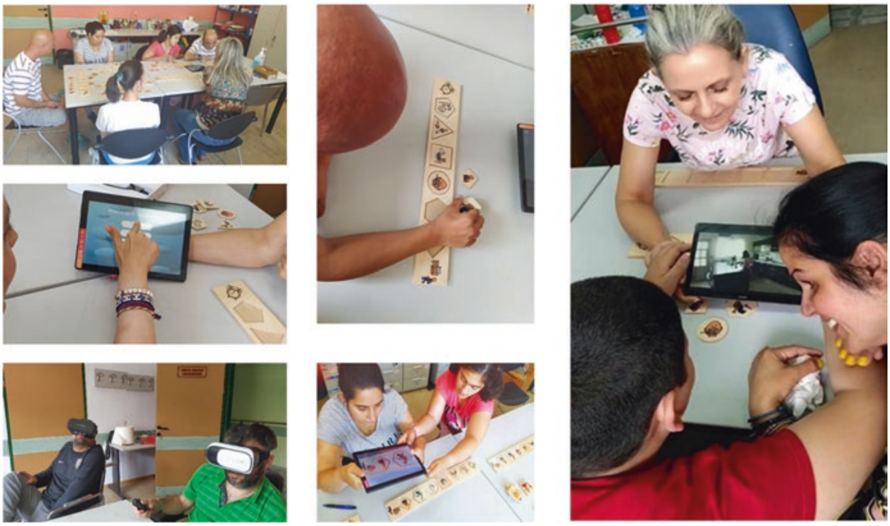


Fig. 13 Option buttons offered to players to select the next scene in the VR environment

answer the main research question, of whether educational games based on transmedia learning can facilitate the implementation of inclusive education.

Evaluation: A Process for Each Phase of ADDIE

After analysing the psycho-pedagogical and technological requirements of WUIM, we designed, developed and performed repeated internal testing in all three games at each stage, as suggested by GDLC. For WUIM external evaluation, user-based and expert-based evaluation methods were conducted (Bernhaupt, 2015; Kaimara et al., 2021a). Data collection techniques included focus groups, questionnaires, structured interviews, observation, and think-aloud protocols. WUIM, before being evaluated by potential users, was evaluated by two experts in digital games (expert focus group) from the field of information technology and multimedia. The data collection from digital game experts was performed using the System Usability Scale (SUS) (Brooke, 1996). The data collection from children with SEND was carried out through structured interviews via Serious Games Evaluation Scale (SGES) (Fokides et al., 2019), observations and think-aloud protocols. SGES is a five-point Likert scale and evaluates games in terms of content (subjective adequacy of feedback, subjective adequacy of educational material, subjective clarity of learning objectives, subjective quality of the narration), technical characteristics (subjective usability/playfulness, subjective audiovisual experience, aesthetic) players' state of mind (immersion, presence, pleasure) and the characteristics that allow learning (subjective relevance to personal interests, motivation). Three focus groups were utilised for WUIM user-based formative evaluation. The two heterogeneous groups were composed of a total of 11 children with different types of disabilities and special educational needs. The third group consisted of 7 content experts (therapists of children). Therapists had a dual role, both as experts in pedagogical content and potential users. There was a great deal of enthusiasm among children about the use of digital devices, which greatly facilitated the implementation of WUIM. The informal assessment through the observation of children during their engagement, identified remarkable behaviours at the individual and group level, related to both the learning process and issues that arise from the particular features of their diagnosis. During the evaluation of WUIM-AR by children, the spontaneous cooperation of the participants emerged. Also, a boy with Autism Spectrum Disorder that exhibits aggressive behaviours, although he had never met the researcher, immediately accepted to cooperate, touched her and had eye contact. Although the research sample was too small to yield valid statistical results, the answers given on the five-point Likert scale concluded that the overall VR-based learning experience (4.65) is slightly better than AR (4.5) in both groups. From the comparative correlation, it is concluded that children with SEND evaluated games more positively than the content experts.

Conclusions

A non-discriminatory society must offer equal educational opportunities for all. The purpose of this chapter was to provide a comprehensive and quality proposal to educators, therapists, developers, educational institutions and rehabilitation centres to generate inclusive educational content. To this end, we described the steps followed to develop the WUIM case study, based on valid educational and game design models. Considering that both general and special education teachers and rehabilitation centre therapists have the willingness to create innovative educational material but are discouraged by the lack of training and technological skills, we recommended a simplified process of content design and development. One of the main concerns was to showcase that the material produced can be low-cost using our daily devices. We concluded that a mixed design framework that incorporates the ADDIE model, the four-dimensional framework by proposed de Freitas and Oliver and the Game Development Life Cycle can facilitate the instructional design. Each dimension of this mixed framework led us to study in-depth the prerequisites regarding the concept, target groups, psycho-pedagogical aspects, technological issues, means and tools. Therefore, our proposal is founded on the eclectic approach, i.e., the combination of traditional learning theories and special educational interventions with the dynamics and flexibility of cutting-edge technology, games and audiovisual art.

References

Alberta Teachers' Association. (2015). *The state of inclusion in Alberta's schools*. The Alberta Teachers' Association. https://www.teachers.ab.ca/SiteCollectionDocuments/ATA/Publications/Research/COOR-101-5The State of Inclusion in Alberta Schools.pdf

Al-Shammari, Z., Faulkner, P. E., & Forlin, C. (2019). Theories-based inclusive education practices. *Education Quarterly Reviews, 2*(2), 408–414. https://doi.org/10.31014/aior.1993.02.02.73

Attewell, J. (2015). BYOD bring your own device a guide for school leaders. In J. Ayre (Ed.), *European Schoolnet*. European Schoolnet (EUN Partnership AISBL).

Bandura, A. (1965). Vicarious processes: A case of no-trial learning. In *Advances in experimental social psychology* (pp. 1–55). https://doi.org/10.1016/S0065-2601(08)60102-1

Bartolo, P. A., Kyriazopoulou, M., Björck-Åkesson, E., & Giné, C. (2021). An adapted ecosystem model for inclusive early childhood education: A qualitative cross European study. *International Journal of School & Educational Psychology, 9*(1), 3–15. https://doi.org/10.1080/21683603.2019.1637311

Bates, A. W. (2019). *Teaching in a digital age: Guidelines for designing teaching and learning* (2nd ed.). https://pressbooks.bccampus.ca/teachinginadigitalagev2/

Bender, M., Valletutti, P. J., & Baglin, C. A. (2008). *A functional assessment and curriculum for teaching students with disabilities – volume I: Self-care, motor skills, house management, and living skills* (4th ed.). Pro-Ed.

Bernhaupt, R. (2015). User experience evaluation methods in the games development life cycle. In R. Bernhaupt (Ed.), *Game user experience evaluation* (pp. 1–8). Springer. https://doi.org/10.1007/978-3-319-15985-0_1

Bhatia, P., Davis, A., & Shamas-Brandt, E. (2015). Educational gymnastics: The effectiveness of montessori practical life activities in developing fine motor skills in kindergartners. *Early Education and Development, 26*(4), 594–607. https://doi.org/10.1080/10409289.2015.995454

Branch, R. M. (2009). *Instructional design: The ADDIE approach*. Springer US. https://doi.org/10.1007/978-0-387-09506-6

Branson, R. K., Rayner, G. T., Cox, L. J., Furman, J. P., King, F. J., & Hannum, W. H. (1975). Interservice procedures for instructional systems development. Executive summary, phase I, phase II, phase II, phase IV, and phase V. in *TRADOC pam 350–30, Ft. Monroe, VA: U.S. Army Training and Doctrine Command.* Center for Educational Technology, The Florida State University.

Brooke, J. (1996). SUS: A 'quick and dirty' usability scale. In P. W. Jordan, B. Thomas, B. A. Weerdmeester, & I. L. McClelland (Eds.), *Usability evaluation in industry* (pp. 189–194). Taylor & Francis.

Burdea, G. C., & Coiffet, P. (2003). *Virtual reality technology* (2nd ed.). John Wiley & Sons, Inc..

CAST. (2018). *Universal design for learning guidelines version 2.2*. http://udlguidelines.cast.org

Dalgarno, B., & Lee, M. J. W. (2010). What are the learning affordances of 3-D virtual environments? *British Journal of Educational Technology, 41*(1), 10–32. https://doi.org/10.1111/j.1467-8535.2009.01038.x

Daniela, L. (2021). Preface: Hopes for game-based learning. In L. Daniela (Ed.), *Smart pedagogy of game-based learning* (pp. v–x). Springer International Publishing. https://doi.org/10.1007/978-3-030-76986-4

Daniela, L., & Žogla, I. (2013). Future teachers' views on using digital media in teaching. In D. Parmigiani, V. Pennazio, & A. Traverso (Eds.), *Learning & teaching with media & technology. ATEE-SIREM winter conference proceedings* (pp. 21–29). ATEE aisbl. http://www.ateegenoa2013.sdf.unige.it/images/proceedings/proceedings_atee_genoa_2013rid.pdf

de Boer, A., Pijl, S. J., & Minnaert, A. (2011). Regular primary schoolteachers' attitudes towards inclusive education: A review of the literature. *International Journal of Inclusive Education, 15*(3), 331–353. https://doi.org/10.1080/13603110903030089

de Freitas, S., & Oliver, M. (2006). How can exploratory learning with games and simulations within the curriculum be most effectively evaluated? *Computers & Education, 46*(3), 249–264. https://doi.org/10.1016/j.compedu.2005.11.007

De Grove, F., Bourgonjon, J., & Van Looy, J. (2012). Digital games in the classroom? A contextual approach to teachers' adoption intention of digital games in formal education. *Computers in Human Behavior, 28*(6), 2023–2033. https://doi.org/10.1016/j.chb.2012.05.021

Department for Education and Science. (1978). *Special educational needs: Report of the committee of enquiry into the education of handicapped children and young people (the Warnock report)*. Her Majesty's Stationery. www.educationengland.org.uk/documents/warnock/warnock1978.pdf

Egenfeldt-Nielsen, S. (2007). Third generation educational use of computer games. *Journal of Educational Multimedia and Hypermedia, 16*(3), 263–281. http://www.itu.dk/courses/MOSP/F2011/papers/egenfeldt_07.pdf

European Agency for Development in Special Needs Education. (2003). In C. J. W. Meijer (Ed.), *Inclusive education and classroom practice*. https://www.european-agency.org/sites/default/files/inclusive-education-and-classroom-practices_iecp-en.pdf

European Agency for Special Needs and Inclusive Education. (2017). In F. Bellour, P. Bartolo, & M. Kyriazopoulou (Eds.), *Inclusive early childhood education: Literature review*. https://www.european-agency.org/sites/default/files/IECELiterature Review.pdf

Fleming, L. (2013). Expanding learning opportunities with transmedia practices: Inanimate alice as an exemplar. *Journal of Media Literacy Education, 5*(2), 370–377. https://files.eric.ed.gov/fulltext/EJ1043444.pdf

Fokides, E., Atsikpasi, P., Kaimara, P., & Deliyannis, I. (2019). Let players evaluate serious games. Design and validation of the Serious Games Evaluation Scale. *International Computer Games Association – ICGA*. https://doi.org/10.3233/ICG-190111

Freina, L., & Ott, M. (2015). A literature review on immersive virtual reality in education: State of the art and perspectives. *Proceedings of The International Scientific Conference ELearning and Software for Education (ELSE), April 23–24, 2015*, 133–141. https://doi.org/10.12753/2066-026X-15-020

Gelastopoulou, M., & Kourbetis, V. (2017). The use of information and communication technologies for inclusive education in Greece. In *Research on e-learning and ICT in education* (pp. 243–255). Springer International Publishing. https://doi.org/10.1007/978-3-319-34127-9_18

Goo, M., Maurer, A. L., & Wehmeyer, M. L. (2019). Systematic review of using portable smart devices to teach functional skills to students with intellectual disability. *Education and Training in Autism and Developmental Disabilities, 54*(1), 57–68.

Gray, C. A., & Garand, J. D. (1993). Social stories: Improving responses of students with autism with accurate social information. *Focus on Autistic Behavior, 8*(1), 1–10. https://doi.org/10.1177/108835769300800101

Hattie, J., & Gregory, D. (2018). A model of learning: optimizing the effectiveness of learning strategies. In *Contemporary theories of learning: Learning theorists ... in their own words*.
Heim, M. (1998). *Virtual realism*. Oxford University Press.
Hellenic Ministry of Education and Religious Affairs. (2008). *Law 3699/2008: The inclusion of learners with special educational needs and/or disabilities*. https://www.european-agency.org/country-information/greece/legislation-and-policy
Hellenic Ministry of Education and Religious Affairs. (2020). *Law 4692/2020: School upgrading and other provisions*. https://eacea.ec.europa.eu/national-policies/eurydice/content/teaching-and-learning-primary-education-20_en
Hellenic Statistical Authority. (2021). *Survey on special education schools end of school year 2019/2020*. Hellenic Statistical Authority. https://www.statistics.gr/en/statistics?p_p_id=documents_WAR_publicationsportlet_INSTANCE_qDQ8fBKKo4lN&p_p_lifecycle=2&p_p_state=normal&p_p_mode=view&p_p_cacheability=cacheLevelPage&p_p_col_id=column-2&p_p_col_count=4&p_p_col_pos=1&_documents_WAR_publicat
Hersh, M., & Leporini, B. (2018). Editorial: Serious games, education and inclusion for disabled people. *British Journal of Educational Technology, 49*(4), 587–595. https://doi.org/10.1111/bjet.12650
IBE-UNESCO. (2016). *Training tools for curriculum development – Reaching out to all learners: a resource pack for supporting inclusive education*. © International Bureau of Education-UNESCO. http://www.ibe.unesco.org/sites/default/files/resources/ibe-crp-inclusiveeducation-2016_eng.pdf
Kaimara, P. (2022). *Design and development of interactive edutainment Systems for Inclusive Education: Interactive educational programs and audiovisual arts as a bridge between typically developing children and children with special educational needs and/or disability*. Audio and Visual Arts, Ionian University, Greece.
Kaimara, P., & Deliyannis, I. (2019). Why should I play this game? The role of motivation in smart pedagogy. In L. Daniela (Ed.), *Didactics of smart pedagogy* (pp. 113–137). Springer International Publishing. https://doi.org/10.1007/978-3-030-01551-0_6
Kaimara, P., & Oikonomou, A. C. (2018). Inclusive education and setting-up new special education school units. Why; In V. Karavakou & K. Tsioumis (Eds.), *1st International Scientific Conference: Educational Leadership, Effective Administration and Ethical Values* (pp. 84–98). 24–26 November 2017, University of Macedonia,Thessaloniki. http://www.leadership2017.uom.gr/en/
Kaimara, P., Poulimenou, S.-M., & Deliyannis, I. (2020). Digital learning materials: Could transmedia content make the difference in the digital world? In L. Daniela (Ed.), *Epistemological approaches to digital learning in educational contexts* (pp. 69–87). Routledge. https://doi.org/10.4324/9780429319501-5
Kaimara, P., Deliyannis, I., Oikonomou, A., & Fokides, E. (2021a). Waking up in the morning (WUIM): A smart learning environment for students with learning difficulties. *Technologies, 9*(3), 50. https://doi.org/10.3390/technologies9030050
Kaimara, P., Deliyannis, I., Oikonomou, A., Fokides, E., & Miliotis, G. (2021b). An innovative transmedia-based game development method for inclusive education. *Digital Culture & Education, 13*(2), 129–162. https://www.digitalcultureandeducation.com/volume-13-2
Kaimara, P., Fokides, E., Oikonomou, A., & Deliyannis, I. (2021c). Potential barriers to the implementation of digital game-based learning in the classroom: Pre-service teachers' views. *Technology, Knowledge and Learning, 26*(4), 825–844. https://doi.org/10.1007/s10758-021-09512-7
Kaimara, P., Oikonomou, A. C., Deliyannis, I., Papadopoulou, A., Miliotis, G., Fokides, E., & Floros, A. (2021d). Waking up in the morning (WUIM): A transmedia project for daily living skills training. *Technology and Disability, 33*(2), 137–161. https://doi.org/10.3233/TAD-200326

Kaimara, P., Oikonomou, A., & Deliyannis, I. (2021e). Could virtual reality applications pose real risks to children and adolescents? A systematic review of ethical issues and concerns. *Virtual Reality*. https://doi.org/10.1007/s10055-021-00563-w

Kaimara, P., Fokides, E., Oikonomou, A., & Deliyannis, I. (2022). Pre-service teachers' views about the use of digital educational games for collaborative learning. *Education and Information Technologies*. https://doi.org/10.1007/s10639-021-10820-9

Ke, F. (2016). Designing and integrating purposeful learning in game play: A systematic review. *Educational Technology Research and Development, 64*(2), 219–244. https://doi.org/10.1007/s11423-015-9418-1

Keller, J. M. (2016). Motivation, learning, and technology: Applying the ARCS-V motivation model. *Participatory Educational Research, 3*(2), 1–15. https://doi.org/10.17275/per.16.06.3.2

Lillard, A. S. (2013). Playful learning and Montessori education. *American Journal of Play, 5*(2), 157–186.

Lim, C. S., Tang, K. N., & Kor, L. K. (2012). Drill and practice in learning (and beyond). In *Encyclopedia of the sciences of learning* (pp. 1040–1042). Springer US. https://doi.org/10.1007/978-1-4419-1428-6_706

Malone, T. W., & Lepper, M. R. (1987). Making learning fun: A taxonomy of intrinsic motivations for learning. In R. E. Snow & M. J. Farr (Eds.), *Aptitude, learning, and instruction volume 3: Conative and affective process analyses* (pp. 223–253). Lawrence Erlbaum Associates.

Mayer, R. (2014). Multimedia instruction. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), *Handbook of research on educational communications and technology* (pp. 385–399). Springer. https://doi.org/10.1007/978-1-4614-3185-5_31

McAllister, G., & White, G. R. (2015). Video Game development and user experience. In R. Bernhaupt (Ed.), *Game user experience evaluation* (pp. 11–35). Springer International Publishing Switzerland. https://doi.org/10.1007/978-3-319-15985-0_2

Mertala, P. (2019). Digital technologies in early childhood education – A frame analysis of preservice teachers' perceptions. *Early Child Development and Care, 189*(8), 1228–1241. https://doi.org/10.1080/03004430.2017.1372756

Moriña, A. (2020). Approaches to inclusive pedagogy: A systematic literature review. *Pedagogika, 140*(4), 134–154. https://doi.org/10.15823/p.2020.140.8

Murphy, C. (2012). Why games work and the science of learning. MODSIM World 2011 Conference and Expo 'Overcoming Critical Global Challenges with Modeling & Simulation', 383–392. https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20130008648.pdf

Navaitienė, J., & Stasiūnaitienė, E. (2021). The goal of the universal design for learning: development of all to expert learners. In A. Galkiene & O. Monkeviciene (Eds.), *Improving inclusive education through universal design for learning* (Vol. 5, pp. 23–57). Springer Cham). https://doi.org/10.1007/978-3-030-80658-3_2

Office of Education Research. (2018). *Teachers at the heart of system change: A consolidation of OER research*. National Institute of Education. https://www.nie.edu.sg/docs/default-source/oer/oer_rcr_final_for_web_v2.pdf?sfvrsn=0

Plancke, R. (1983). ΟΒΙΔΙΟΣ ΝΤΕΚΡΟΛΥ. In Ζ. Σατώ (Ed.), & Κ. Κίτσος (Trans.), *Οι μεγάλοι παιδαγωγοί. Από τον Πλάτωνα και τον Σωκράτη ως τον Τζων Ντιούι και τη Μαρία Μοντεσσόρι* (pp. 307–319). Αθήνα: .

Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of game-based learning. *Educational Psychologist, 50*(4), 258–283. https://doi.org/10.1080/00461520.2015.1122533

Pozefsky, D. (2016). *Game design document outline*. http://www.cs.unc.edu/Courses/comp585-s16/DesignDocTemplate.pdf

Pratt, C., & Steward, L. (2020). *Applied behavior analysis: the role of task analysis and chaining*. https://www.iidc.indiana.edu/pages/Applied-Behavior-Analysis

Prensky, M. (2007). Fun, play and games: What makes games engaging. In *Digital game-based learning* (2nd ed., pp. 105–144). Paragon House.

Ramadan, R., & Widyani, Y. (2013). Game development life cycle guidelines. *2013 international conference on advanced computer science and information systems, ICACSIS 2013*. https://doi.org/10.1109/ICACSIS.2013.6761558.

Ransburg, M., Timmerer, C., & Hellwagner, H. (2008). Dynamic and distributed multimedia content adaptation based on the MPEG-21 multimedia framework*. In *Multimedia semantics — The role of metadata* (Vol. 101, pp. 3–23). Springer. https://doi.org/10.1007/978-3-540-77473-0_1

Schell, J. (2015). *The art of game design: A book of lenses*. CRC Press.

Schopler, E., Mesibov, G. B., & Hearsey, K. (1995). Structured teaching in the TEACCH system. In *Learning and cognition in autism* (pp. 243–268). Springer US. https://doi.org/10.1007/978-1-4899-1286-2_13

Steele, M. M. (2005). Teaching students with learning disabilities: Constructivism or behaviorism? *Current Issues in Education, 8*(10).

Tomlinson, C. A., Brighton, C., Hertberg, H., Callahan, C. M., Moon, T. R., Brimijoin, K., Conover, L. A., & Reynolds, T. (2003). Differentiating instruction in response to student readiness, interest, and learning profile in academically diverse classrooms: A review of literature. *Journal for the Education of the Gifted, 27*(2–3), 119–145. https://doi.org/10.1177/016235320302700203

Tsibidaki, A., Kogiami, A., Flagkou, A., Vagianou, S., & Trecha, S. (2020). Introducing teacher training for special and inclusive education in Cyprus, Germany, Great Britain, Greece, and Italy. *Journal of Education and Human Development, 9*(2), 91–103. https://doi.org/10.15640/jehd.v9n2a10

UNESCO. (1994). World conference on special needs education: Access and quality. Final report. In *The Salamanca statement and framework for action on special needs education*. United Nations Educational, Scientific and Cultural Organization & International Bureau of Education.

United Nations. (1948). *Universal declaration of human rights (UDHR)*. UN General Assembly. https://www.un.org/en/universal-declaration-human-rights/

United Nations. (2018). *General comment no. 6 (2018) on equality and non-discrimination (CRPD/C/GC/6)*. UN, Committee on the Rights of Persons with Disabilities. https://digitallibrary.un.org/record/1626976

U.S. Congress. (1975). *Education for all handicapped children act-public law 94-142. 89 Stat. 773. November 29, 1975*. https://www.govinfo.gov/content/pkg/STATUTE-89/pdf/STATUTE-89-Pg773.pdf

Vaz, S., Wilson, N., Falkmer, M., Sim, A., Scott, M., Cordier, R., & Falkmer, T. (2015). Factors associated with primary school teachers' attitudes towards the inclusion of students with disabilities. *PLoS One, 10*(8), e0137002. https://doi.org/10.1371/journal.pone.0137002

Vygotsky, L. S. (1978). In M. Cole, V. John-Steiner, S. Scribner, & E. Souberman (Eds.), *Mind in society: The development of higher psychological processes* (2nd ed.). Harvard University Press.

WCEFA Inter-Agency Commission. (1990). *World declaration on education for all and framework for action to meet basic learning needs adopted by the World Conference on Education for All: Meeting Basic Learning Needs, Jomtien, Thailand, 5–9 March 1990*. Inter-Agency Commission (UNDP, UNESCO, UNICEF, World Bank) for the World Conference on Education for All. https://unesdoc.unesco.org/ark:/48223/pf0000097551

Wehmeyer, M. L. (2006). Beyond access: Ensuring progress in the general education curriculum for students with severe disabilities. *Research and Practice for Persons with Severe Disabilities, 31*(4), 322–326. https://doi.org/10.1177/154079690603100405

Student-Centered Active Digital Technologies for High Abilities and Gifted Students

Scheila Aparecida Leal Dantas and Luciano Frontino de Medeiros

Introduction

The educational practice, as well as the methodology it uses, needs to locate where it stands in time and space as a dynamic phenomenon for socialization and production of humanizing knowledge in search of a fairer, more egalitarian society, with proposals that are pertinent to the social demands of multiple collective experiences, of sustainability, of harmonious coexistence, of technological accessibility. Since knowledge is not biologically hereditary but built by the process of social and educational construction.

As such, the school should be, par excellence, a place that characterizes itself fundamentally for its social function as the inquirer of knowledge said to be necessary for each new generation. Each generation experiences lifestyles different from its predecessors, however, always keeping its socio-historical identity at its core.

With that in mind, this project was created with the idea to contribute with a practical-theoretical framework seeking to bring important contributions for the discussion of a mobilizing theme about the effectiveness of robotics and programming language, as well as the use of several other technologies, such as learning tools capable of unraveling algorithms that contribute to the development of several important abilities in this century.

S. A. L. Dantas · L. F. de Medeiros
Program of Doctorate and Master in Education and New Technologies, Centro Universitário Internacional UNINTER, Curitiba, Paraná, Brazil
e-mail: luciano.me@uninter.com

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_7

With this perspective, teaching a child to understand, build and program robots and solve technological questions is just as important as teaching mathematics, Portuguese (grammar/literature), etc. Especially since there is a very consistent pedagogical throughline between those subjects. Grabbing students' interest to then contextualize their practical reality with interdisciplinary contents may be the biggest challenge in education.

The digital technologies available in modern society allow access to uncountable information and resources simultaneously. It is up to us, as education professionals, to help said information and technological tools reach students in a way that meets different needs, and all can access it. As such, the school has a fundamental role in providing adequate mechanisms to mitigate the lack of access to technology, contributing with significant learning in an equal and fair way to all students.

It is then intended to present, in this essay, the pedagogical dynamic applied through technological devices and contrasting teaching and learning methodologies for special needs students, especially those with high abilities/giftedness in elementary school, in certain public schools of a city next to Curitiba/Brazil – because according to Law n° 9394/96 Art. 58 (Law of Guidelines and Bases for Education in Brazil), special needs education is defined as a type of school education offered preferably in the regular school system, to pupils with disabilities, pervasive developmental disorders, and high abilities or giftedness.

Aiming to contribute to the access and development of multiple skills concerning the emerging technological context: such as computational thinking; logical reasoning; development of ecological consciousness; problem-solving capacity; the importance of teamwork; as well as the extension of literacy beyond traditional schooling, promoting, thus, digital inclusion.

With the intent of turning class time more exciting and inclusive through educational robotics, methodologies such as STEAM (Science, Technology, Engineering, Arts and Mathematics), Maker Movement; techniques such as *bricolage* and technological tools such as Arduino, Lego, and programming through the Scratch software were used. The main goal was to awaken in students a fondness for technology and an interest to learn in a different way, entertaining and delightful, simple and accessible.

These curricular adaptations were formulated referencing the city's curriculum guidelines and the educational establishment's Political-Pedagogical Project; counting on the partnership of the educational community for the acquisition of the various technological material resources. The partnership and support of the community and the use of the curriculum in a more flexible way as to rethink concepts and values were central to achieve the project's objectives, through adequate active teaching strategies, conceived according to the specific teaching needs and planned, organized and integrated learning. With the goal to fold in the incorporation of new experiences and mental models that, according to the Piagetian theory of knowledge evolution as reported by Nunes and Silveira (2008, p. 82):

> Human development goes through successive stages of organization of the cognitive and affective fields, which are built by virtue of the child's action and the opportunities that the environment provides them.

In this epistemological process, instrumentalizing the pedagogical participation of new technologies according to current educational needs can ease the students' learning process and, thus, transform the classroom dynamics, focused in an education to learn how to think in an interactive way, and not how to memorize thoughts, facts, dates or definitions, in an expository and encyclopedic template that does not capture students' attention anymore.

Since most schools are still trapped within the traditional curriculum, where priorities are still reading, writing and repetitive memorization, forgetting that students in the twenty-first century are increasingly hungry for new forms of acquiring knowledge. Considering the influence and speed of technological advances in people's lives. Therefore, the curriculum of this new student should include new areas of knowledge related to technology, such as: programming, robotics, artificial intelligence, software, hardware, electronics, virtual and augmented realities, games, nanotechnology, among others.

> Everyone is experiencing society changing in its ways to organize, to manufacture goods and commercialize them, to have fun, to teach and to learn. Many ways of teaching today are no longer justified. We lose too much time, learn too little, lose motivation continuously. Teachers as well as students have the clear feeling that many conventional lessons are outdated. The educational field is pressed for changes, as are several other organizations. It is noticed that education is the fundamental path to transform society (Moran et al., 2000, p. 11).

The teacher, in this context, must be the facilitator of the use of such means and tools provided by technology, seeking a professional update with regard to the technical appropriations of the use of educational technologies in the application of their teaching methodology, making it more attractive for the student, reinventing themself and being creative, searching for a way to draw the students' attention, since they may be in that physical space, but not always there. Libâneo (1994) and Netto (1987) claim that for learning to happen, the motivation of the students is necessary, and for that to happen, we must leave the traditional teaching model that is still so present in schools.

As of this introductory exposition, the main goal of this essay as to analyze how tools such as robotics, sustainable robotics, technological methodologies such as STEAM, the Maker Movement and the DIY movement contribute in the teaching and learning of special needs students, especially those with high skills/giftedness, inserted in public schools of the Curitiba metro area, in Paraná, Brazil. Complementarily, it was sought to identify how these methodologies and tools can help in the development of skills such as logical reasoning, problem-solving skills, computational thinking and others. Aligned to that goal, it was also sought to encourage behavioral changes regarding the conscious use of the environment, learning how to use and reuse materials, the adequate separation of waste and acknowledgement of the importance of the resources provided by nature and the need to preserve them. This has allowed to provide, in fact, a technological education that is both inclusive and democratic, being conscious of their role in the preservation and maintenance of the environment, as well as the necessary knowledge of how to responsibly enjoy what technologies give us.

As such, this chapter is divided, starting from this introduction, in the theoretical foundation being broached multidisciplinarily, in the methodological proceedings adopted in the application and development of the research, in the presentation of the achieved results and the subsequent analysis, ending on the future scope of the project.

Review of Literature

Some time ago, with the strengthening of the ongoing integration between people and technology all over parts of the world, the planet's routine has definitely become dependent on technological functions. In the current times, with the daily lives of most people immersed in applications connected to worldwide networks, with their electronic platforms and their algorithms and artificial intelligence systems getting increasingly wide-reaching and faster, all are using these technologies in some way, be it for learning or leisure.

The use of these technological resources should be a part of daily school life as it is an integral part of modern life. However, in school environments, the sight of backward experiences out of touch with technological reality is common. To fulfill its role, the school needs to keep up with the incorporation of these changes gestated by modern society. It is disturbing to ask why, in modern times, these scientific and technological advances cannot be used in the classroom. It is not as if technology is an end in and of itself, but a tool that can be vastly useful to even out educational needs. For it is of no use to strive for the use of technological advances in schools before a methodological reflection over how it would effectively improve teaching.

Considering that, like any organization, schools have their culture, their established practices and, equally, ferocious mechanisms against changes. Teachers teach the same way they learned, although the world has changed. Thus, the relevance of the teacher's understanding of the importance of technology use as a support for teaching and learning, as they must seek adequate training to deal with new times and challenges. Of this matter, Pimenta & Ghedin (2006) adds:

> Education is a complex phenomenon because it is historical. That is, it is a product of the work of human beings, and, as such, responds to the challenges posed by different social and political contexts. Education portrays and propagates society; but it also projects the society it wants. Therefore, it is deeply connected to the civilizing and humanizing processes. As a historical practice it is challenged to answer to the demands the contexts propose (2010, p. 37–38).

To react to these matters requires constant focus on the teachers' training facing educational and school demands and the functional use of technologies. For it is not a simple computer that will change their secular habits. We must understand that just introducing technology in education does not mean everything will be solved. It is not about simply distributing laptops, tablets and smartphones and then expecting a renewed form of education to blossom, but one should employ technology in managerial and creative ways. Creating strategic channels for the development of school materials in a very well-planned way, overcoming the learning whose mechanical and corporate logic has long since stagnated. In that sense, Kenski claims:

> It is not technologies that will revolutionize teaching, and, by extension, education as a whole. But the way in which this technology is used for the mediation between teachers, students and information (Kenski, 2010, p. 121).

Papert (2008) was among the first to advocate for the use of technology in education, mostly computers, claiming that even if technology is not a panacea for educational problems, the lack of it would create lower quality education:

> Technology is not the solution, it is only a tool. Therefore, technology itself does not imply a good education, but the lack of technology automatically implies a bad education (Papert, 2001, p. 2).

In the educational field, technology makes it possible to direct a new point of view, highlighting a curriculum with a functional focus on problem solving and alternatives to unravel new questions that arise constantly, developing the ability to deal with the unknown, and transforming, adapting, devising different functions in an applied and integrated way.

Robotics and programming are good examples of technological tools that may contribute to the students' meaningful and distinguished learning. Among the many advantages of robotics, Netto (1987) cites that robotics in the educational sphere may:

> Cultivate reasoning and logic in the building of algorithms and programs for movement control; favoring interdisciplinarity, promoting the integration of concepts in fields such as: mathematics, physics, electricity (Netto, 1987).

Many educational institutions, above all public ones, face monetary difficulties to acquire more advanced equipment like industrialized robotics kits; in this sense, sustainable and low-cost robots through Arduino and open source software, in the educational field, can be useful and accessible tools, since many times what would be discarded, for being considered trash, can be reused or recycled. Reducing, thus, costs through intelligent resource usage. Not to mention that this type of posturing favors ethical, moral and cognitive growth.

Therefore, beyond the student being introduced to the technological world upon building their robot, utilizing several devices such as engines, leads, lights, etc. will understand the importance of environmental conservation, through the recycling of components for the construction of a new toy/object, using otherwise discarded materials as a base. Such objects built by them are made from scraps, using cardboard, plastic, glass, engines, lights, wires, on/off buttons, scavenged from devices that have gone out of use. Medeiros and Wünsch claim that the use of recyclable or reusable materials contributes to the development of concrete thought, of creativity and the discovery of new knowledge for students and teachers alike:

> Under the lens of Constructionism, robotics with recyclable or reusable materials may deepen the possibilities on dealing with concrete thought, beyond what is offered by robotics platforms with prefabricated robots and well oriented to be used. This is possible due to a deeper level of *bricolage*, which allows for a bigger expression of curiosity and knowledge discovery by both teachers and students (de Medeiros & Wunsch, 2019, p. 07).

Low-cost robotics through the building and programming of Arduino boards is another monetarily viable option, especially for the most poverty-stricken schools, due to the fact that this tool can be inserted in the educational environment, as applicable and fun robotics. Being a great tool for significative and unique teaching and learning, contributing for the development of several skills, indispensable for the twenty-first century student, seeking to ally theory to practice. About the benefits of Arduino, de Medeiros and Wunsch (2019) claim that:

> With regard to cognition and learning, the activity of programming with Arduino allows, thus, the establishment of a bridge between concrete and formal thoughts. While the building of circuitry with Arduino allows dealing with the learning aspects more closely related to physical elements, belonging to reality, programming activities let the student deal with the abstractions arising from code writing in a programming language (de Medeiros & Wunsch, 2019, p. 09).

For programming matters, teachers and students can use a free and easy tool known as Scratch. Scratch is a free software, available online and offline. With this tool it is possible to create stories, games and interactive animations and share them with people all over the world. This language has been used a lot in educational environments because it is simple and does not require complex previous knowledge. Said language is ideal for beginners in programming, developing mathematical and computational concepts. Through Scratch it is possible to create various animations with blocks similar to Lego. de Medeiros and Wunsch (2019) assert that Scratch is an easy and simple way to program, since it is done through the assembling of colorful command blocks that control 2D graphical objects, being a fun way to teach and learn.

We know that the shaping of a society is the result of the Revolutions that happened during the history of humanity, such as the Agricultural, Industrial and Technological ones. Said Revolutions eased the integration of production processes and methods. In our time, the real revolution is information processing. The Internet, for example, is a platform upon which we built a myriad of surprising things over the years. Now, on this platform, we can build things of the physical world to which the word "industrial" can refer to. In this new revolution, we can cite, for example, circuit and sensor 3D printers that give anyone the freedom to create electronics, toys and various objects. Which opens a world of potentialities inside the school, especially in robotics, that is, the students can design a multitude of devices with opportunities to unravel their ideas and actions.

Therefore, it is up to all as society, schools, family and community as a whole to direct formal and informal educational policies, in the sense to rethink the national curriculum for the implementation of plans that can systematically encourage a culture in which innovation and creativity are promoted through education, providing the ideal conditions for today's students and future scientists to have a similar starting point in matters of knowledge, to secure the equality of opportunities to create new "revolutions." No doubt, to foster human resources to students, above all those in need, is the responsibility of all involved and determined to provide a truly inclusive and digital education.

Research Methods

This research has the characteristics of a qualitative methodology, since the analysis consisted of the observation of small groups of students in special needs, mainly those with high abilities or giftedness – seeking deeper knowledge about how they develop and how their behavior changes upon coming across technological tools they are not used to seeing at school. Still analyzing the teaching and learning of these children with the introduction of sustainable educational robotics with scraps and low-cost robotics through Arduino, of programming languages and virtual learning environments (VLE) in their day-to-day life with school and family.

From here, we seek to describe step by step the classes and workshops administered throughout 2018. The educational robotics workshops started at the end of 2017 and going through the entire 2018 school year, with students from the Multipurpose Resources Classroom in the city of São José dos Pinhais, Brazil. The workshops were developed upon the subjects in the official curriculum: art, geography, math, Portuguese (grammar/literature) and history, utilizing technologies crosswise.

In these workshops were administered classes directed to collective and individual knowledge building through ludic workshops in which the students designed and built robotics devices with recyclables or scraps, low-cost robotics with Arduino, introduction to robotics with industrialized kits and research about the history of technological evolution and sustainability, done through VLE with the help of parents or guardians and at the school library. With this perspective, we should consider the contributions of Jean Piaget in which the child develops intelligence, affection and new constructs through relations, be they social or individual:

> In each complex of psychic life, whether it means intelligence or affective life, social relations or rightly individual activity, the appearance of new forms of organization is observed, which complements the sketched constructions during the preceding period, securing a more stable balance and that also begins an uninterrupted series of new constructions (Piaget, 1999, p. 40).

This course was held in-person through weekly meetings and online in a virtual learning environment (VLE), using the Google Classroom platform (see Fig. 1), where various activities were accomplished at home with the help of parents and/or guardians, as well as the workshops run at the school year-round.

The VLE project consisted in asking students to do research at home, whose themes were connected with the in-person workshops: the importance of technology - the history of technology from prehistory to the modern day, history of robotics, what is educational robotics, sustainable robotics or with scraps, industrialized robotics and with Arduino, and subjects related to sustainability. Aiming for the students to deepen their knowledge at home about the themes and/or subjects and, afterwards, discuss them in-person.

During the workshops prehistoric spears were built, which were then stylized by the students with gouache paint, also assembled were posters representing cave paintings, as well as ancient and modern objects using play dough and clay.

Fig. 1 The sustainable robotics VLE page, developed for the activities. (Available at: https://classroom.google.com/c/MTU4NTg0NTMxNjJa)

Workshops using the *bricolage*[1] technique were provided: where the students built objects with tree leaves or flowers, pencil shavings, corn cobs with paint over fabric and/or paper, and a shelf with toilet paper rolls to store toys. In each practical workshop section research was requested, posted weekly in the VLE.

The next workshop consisted of the removal of engines, lights, wires and on/off buttons of DVD devices, printers, cassette players, CD/DVD readers, gaming controllers, etc., which they then used in the construction of their robotic prototypes (Fig. 2). The students used tools such as screwdrivers, pliers and wrenches for the removal. In this stage it was requested of the students to research the history of each object, their utility, why and by what such technological objects were replaced, among other questions (History: of computers, turntables, televisions, radios, airplanes, DVD devices, cassette readers, CD/DVD readers, video game consoles, tablets, landlines, cellphones, the first tools used by human beings in prehistory, etc.)

The next step happened in the school's computer lab, with basic hardware and software classes. At first, the class was about computer history, through a timeline. Next, there was an explanation about the purpose of several external and internal computer parts, where they had the opportunity to handle these parts.

[1] Originating from French, the term *bricolage* means an improvised manual project that appropriates different materials. In Lévi-Strauss (1976)'s interpretation, the concept of *bricolage* was defined as a means of expression through selection and synthesis of chosen components from a culture. On the other hand, rereading the anthropologist's work, Derrida (1978) reframed the term in the sphere of literary theory, adopting it as a synonym for a text collage in any given work. Finally, De Certeau (1994) used the concept of *bricolage* to mean the union of various cultural elements that may result in something new. (Garcia & Lippi, 2012. p. 607).

Fig. 2 Removal of engines, lights, etc. (Source: Authors' personal files)

Fig. 3 Robotic object construction. (Source: Authors' personal files)

In the following workshop, began the construction of robotic objects/toys with recyclable and reusable materials and scraps. Some of the constructed items were: microwaves, cellphones, washing machines, blenders, planes, turntables, radios, robots, etc. (Fig. 3), in which were installed engines, lights, leads, cooler/computer fans and plastic helices, on/off buttons, wheels, wire connections, batteries and energy cells. After the construction of the items with sustainable robotics or scraps we advanced to the next step of the project: Low-cost robotics workshop with Arduino, where the students built some robotic prototypes and their basic programming.

The other step of the workshops was the presentation, only viewing and manipulation, of the industrialized robotics kits, however the students did not get to program during this phase.

Komis et al. (2017) claim that there are several phases of learning in educational robotics, which the authors call educational robotics activity taxonomy. To them, robotics activities should be worked on in different levels, which start out simpler and evolve into more advanced stages, crafting progressive learning (Komis et al., 2017).

When the workshops were finished, at the end of the school year, the results of the students' work were presented to professionals, other students and the school community, in an educational fair about sustainable robotics and the history of technologies, where each student presented the projects they made (Fig. 4).

The visitors, on the other hand, upon entering the showroom, were presented with research, historical objects and pictures, posters, robotic objects, scale models and other materials constructed by the students. In each environment the students presented their projects showing the knowledge acquired during the year. Upon entering the room, the visitors obtained explanations from the students about prehistory, the internal and external parts of a computer, the construction and utility of several old and new objects. During the visit, the guest traveled through technologies, from the oldest and simplest to the most modern that exist in our time.

Findings and Analysis

The practical workshops and research carried out with special needs students with giftedness and/or high abilities were developed over the course of 1 year. It can be said that there were significant and important results, in terms of cognitive, learning and behavioral development, both as a group and each student individually. Upon asking the parents and the teacher responsible for the city's multifunctional resources classroom, they all claimed that most students that were a part of the project used to be scattered, restless and aggressive, did not like group work, and easily distracted, most students changed their attitudes.

With regard to the performance of the students that participated on the sustainable robotics projects, as a part of the official curriculum subjects, the parents

Fig. 4 Cultural fair with the course students. (Source: Authors' personal files)

noticed that on helping their children with homework, they had a better performance and ease of understanding in subjects such as: math – quicker thinking and more focused; Portuguese – better essay writing; sciences – taste for Internet and book research, acting like small scientists; history – more interest in themes related to prehistory and technological evolution.

Through the various workshops executed during the sustainable robotics course and history of technologies, it was noticed during the encounters more ease in problem solving, interaction with their peers, taste for research, cognitive development, among other, thus fulfilling the research objectives.

Future Scope

The development of this research considered several didactic productions, through ludic workshops, with their many implications in the pedagogical and school social relations fields, which consisted of structural elements in the generation of fundamental base knowledge in the concepts of the most rudimentary of technological production. Progressing, through historical cuttings, to the areas of progressive knowledge of technological developments and its impacts on society.

Launching the student beyond their mere function of passive object in the educational action, and relocating them as a subject with will and desire to learn. Said methodology aimed to awake in the student the desire to comprehend electronic phenomena beyond their intended purpose. Exploring the working mechanisms intended for their roles and technological interfaces which intertwine with the field of historical production from the genesis of our species. Contributing to the historical and cultural update and development of historical, computational and sustainable consciousnesses.

When approaching the theme of "sustainability," this research intended to contextualize reality and the issues within the student's own life, aiming to allow them to better comprehend the world in which they live, their role as a historical subject and capable of developing new attitudes for the greater good.

Additionally, it highlighted the importance of the school as a place for social inclusion which may provide access to adequate and better learning opportunities to meet special educational needs. This can happen as long as there are opportunities for the teachers to be trained for a multicultural curriculum and for the introduction of technological resources in their methodological practices in a distinguished and multifunctional way, enabling intellectual training that allows them to innovate in their classes and provide different learning experiences.

The process' dynamics sought to respect the personal development of each student, allowing each one to proceed at their own pace, in a process that needs to be well captained by the teacher. Once any student had trouble with a specific activity, new thematic reinforcement challenges were given until they reached the next step. Meanwhile, the students that progressed quickly were conducted to another level of difficulty. At some point, they came together, with neither of them being left behind nor lacking any pedagogical help.

Although the project was administered to students that stand out due to their superior cognitive abilities, their potential to allow for the emergence of creative productivity and the escalating quality of learning and teaching experiences, extends, still, to other pedagogical challenges.

References

de Medeiros, L. F., & Wunsch, L. P. (2019). Ensino de programação em robótica com Arduino para alunos do ensino fundamental: relato de experiência. [Teaching robotics programming with Arduino for elementary school students: experience report]. *Revista Espaço Pedagógico, 26*, 456–480. Available at: https://doi.org/10.5335/rep.v26i2.8701. Accessed on 02 Mar 2022.

Derrida, J. (1978). Writing and difference. London: Routledge & Kegan Paul.

De Certeau, M. (1994). A Invenção do Cotidiano [The Invention of Everyday Life]. Petrópolis: Vozes.

Garcia, M., & Lippi, N. B. G. (2012). Tecendo a Colcha de Retalhos: a bricolagem como alternativa para a pesquisa educacional [Weaving the Patchwork Quilt: bricolage as an alternative for educational research]. *Educação & Realidade, Porto Alegre, 37*(2), 607–625, maio/ago. Available at: http://www.scielo.br/pdf/edreal/v37n2/15.pdf. Accessed on 20 Dec 2021.

Kenski, V. M. (2010). *Tecnologias e o ensino presencial e a distância* [Technologies and face-to-face and distance learning] (9th ed.). Papirus.

Komis, V., Romero, M., & Misirli, A. (2017). A scenario-based approach for designing educational robotics activities for co-creative problem solving. In D. Alimisis, M. Moro, & E. Menegatti (Eds.), *Educational robotics in the makers era. Edurobotics 2016* (Advances in intelligent systems and computing) (Vol. 560). Springer. https://doi.org/10.1007/978-3-319-55553-9_12. Accessed on 04 Apr 2021.

Levi-Strauss, C. (1976). Structural Anthropology (Volume II). New York: Basic Books, Inc. https://doi.org/10.2307/3032172

Libâneo, J. C. (1994). *Didática* [Didactics]. Cortez.

Moran, J. M., Masetto, M. T., & Behrens, M. A. (2000). *Novas tecnologias e mediação pedagógica [New technologies and pedagogical mediation]* (10th editon ed.). Papirus. Available at: https://www.academia.edu/10222269/moran_masetto_e_behrens_novas_tecnologias_e_media%c3%87ao_pedagogica. Accessed on 16 Dec 2022.

Netto, S. P. (1987). *Psicologia da aprendizagem e do ensino* [Psychology of learning and teaching]. Pedagógica e Universitária/EDUSP.

Nunes, A. I., & Silveira, R. N. (2008). *Psicologia da aprendizagem: processos, teorias e contextos* [Psychology of learning: Processes, theories and contexts]. Líber Livros.

Papert, S. M. A. (2001, January–March). *Education for the knowledge society: A Russia-oriented perspective on technology and school*. IITE Newsletter, UNESCO, No. 1.

Papert, S. M. A. (2008). *Máquina das Crianças: Repensando a Escola na Era da Informática* [The children's machine], revised edition. Artes Médicas.

Piaget, J. W. F. (1999). *Seis Estudos de Psicologia* [Six psychology studies] (24th ed.). Forense Universitária.

Pimenta, S. G., & Ghedin, E. (Org.). (2006). Professor reflexivo no Brasil: gênese e crítica de um conceito [*Reflective teacher in Brazil: Genesis and critique of a concept*]. Cortez.

Inclusive Digital Education of Vulnerable Children During COVID-19 Pandemic: The Role of Social Work

Soňa Kalenda, Alice Gojová, Ivana Kowaliková, and Antonio López Peláez

Vulnerable Children, Digital Gap, and Social Work

According to the latest data from the Czech Statistical Office (2022), Czechia has a total population of 10.7 million people, of which more than 1.7 million children are under 14. Although an individual under the age of 18 is considered a minor child, increased attention is paid to children from this age cohort for the purpose of child social and legal protection. The protection focuses primarily on children referred to in Section 6 of Act No. 359/1999 Coll., on Social and Legal Protection of Children (the "Act"). That is, children with deceased parents (1); or (2) do not fulfil the obligations arising from parental responsibility; or (3) do not exercise or abuse the rights arising from parental responsibility. Records kept by the Ministry of Labour and Social Affairs (MoLSA) for 2020 showed that child social and legal protection authorities registered a total of 151,340 cases involving vulnerable children by year-end. A total of 2903 children were removed from their parents' care in that year. Of these, 144 were removed due to child abuse, 25 due to child sexual abuse, 1463 due to neglect, 552 due to the child's educational and behavioural problems, and 719 due to other obstacles to the child's care on a parental side. In the same year, a total of 2696 social workers were active in the child social and legal protection agenda, equalling 2584 full-time positions (MoLSA, 2021).

S. Kalenda (✉) · A. Gojová · I. Kowaliková
University of Ostrava, Faculty of Science, Ostrava, Czechia
e-mail: sona.kalenda@osu.cz

A. L. Peláez
National Distance Education University, Faculty of Law, Madrid, Spain

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_8

Although households with children and young families in Czechia make up for the most equipped groups with digital technologies, still 7% of school-age children live in households that do not have a computer (Czech Statistical Office, 2021). These are often families of children at risk monitored by a child social and legal protection authority. As a result, these vulnerable children are exposed to a higher rate of both social and digital exclusion compared to their peers.

The issue of the digital gap is closely associated with the concept of digital exclusion. This arises when conditions are incommensurable. For families of vulnerable children, this specifically refers to limited access to digital technologies. Perron et al. (2010) state that Internet access is a human right, as it is essential for full participation in society. Access to technology alone is not an indicator of actual use of technology (Steyaert & Gould, 2009). Digital literacy is an important condition for its use. This is considered a social standard today, and so various actors count on it and digitize many of their activities and services in relation to it. In the Czech environment, these include in particular digitized public administration (e-Government), healthcare (e-Health), and education (e-learning).

However, as the use of digital technology related experience shows, full participation in the running of society is still being "denied" to some groups of people, including families with children from socially disadvantaged environments. Many of them face digital exclusion or digital inequality (van Dijk, 2005), which is not only a consequence of not having access to ICTs but also of the way they use them. In this case, we speak of the transformation of a "digital gap" into an "information gap" (Gillingham, 2014). This may be, for example, a reduced ability to use ICT to find information needed to improve our quality of life. According to Watling (2012), first level digital exclusion (i.e., no access to ICT) is still common today, affecting mainly socially disadvantaged and marginalized groups. As noted by Steyaert and Gould (2009), digital exclusion is mutually reinforced with more general patterns of social exclusion. The consequence can be reduced participation in the labour market, education, and social and public life (MoLSA, 2015).

The above fact becomes a challenge for social workers active in social and legal protection of children. Their role is to draw up an individual child protection plan on the basis of an assessment of the child's situation and his or her family pursuant to Article 10 (3c) of the Act. The plan identifies the causes of the vulnerability, sets out measures to ensure the child protection, to provide assistance to the family of the vulnerable child, and to strengthen the family's functions. It shall also set out a timetable for the implementation of these measures, in cooperation with the parents or other person responsible for the child's upbringing, the child and the professionals involved in dealing with the child and his or her family. The plan should also incorporate processes to mitigate or prevent the digital gap expansion.

COVID-19 Pandemic as an Accelerator of Digitalization in Social Work with Vulnerable Children as Well as Other Areas

The COVID-19 pandemic has accelerated the pace of digitalization processes, thus deepening the problem of digital exclusion in general, but also in vulnerable children and their families who did not have Internet access or devices through which children could engage in online learning and digital skills. Thus, these children remained "cut off" from schooling, leisure activities, and communication with peers, which were all transferred almost exclusively to the Internet environment during the COVID-19 pandemic. The social worker support that many of these families used was also moved to a digital environment. As a result, digital skill level requirements have changed, not only for social work clients, but also for social workers themselves (Picornell-Lucas & Peláez, 2022). The growing emphasis on IT competences in social work interventions apart from the COVID-19 pandemic, is described by Chan and Holosko (2018) or López Peláez et al. (2018). This trend requires social workers to expand their competences to use technology, to change the way they provide interventions, but also to strive for digital inclusion (or e-inclusion) of their clients, which is not only based on access to technology, but on the promotion of their digital skills (Steyaert & Gould, 2009).

In particular, the area of social work with vulnerable children and their families is a sector where further acceleration of the use of digital technology is expected. According to Chan & Ngai (2019), the use of information and communication technologies facilitates children's connection to social services. According to the authors, it is easier for children to discuss personal and sensitive matters in an online environment. The authors talk about "technology-supported social work" becoming an increasingly important component of the interventions provided in social work with vulnerable children. On the other hand, Willoughby (2019) points out the risks that the use of ICT entails. The most serious ones, he argues, include cyberbullying and online abuse, exposing children to inappropriate content, and the misuse of children's personal data and privacy.

The Role of Social Work in Preventing the Widening of the Digital Gap: Evaluation Research

As we have already mentioned, during the COVID-19 pandemic, the digital gap for vulnerable children in Czechia widened. Families registered with the Office of Social and Legal Protection of Children very often use social activation services for families with children due to their difficult life situation associated with low socio-economic status (a total of 254 such services are registered in the Registry of Social Service Providers in 2022). The researchers, in collaboration with two organizations providing social services, introduced a social innovation at the beginning of the

COVID-19 pandemic (in May 2020) that was in supporting the use of ICT in families with vulnerable children and in social work interventions. As part of the innovation, 24 families (with a total of 74 vulnerable children aged 8 to 16) and their 13 key social workers were provided with 37 tablets with Internet access. The selection of families with children at risk for our experiment was purposeful and done by two social activation services providers.

The criteria for our sample were: (1) usage of a particular social service for at least 6 months; (2) at least one of the children has to be in primary school; (3) and absence of Internet connection and ICT equipment in the family, except mobile phones of parents. Tablets used in the experiment were bought in a project funded by European Union Social Fund, Operational Programme "Research, Development, and Education." According to the loan agreement, families with children at risk received tablets for free for 1 year. Due to the COVID-19 pandemic, the loan agreement was prolonged by another year. Although sanctions for tablets damage were part of the agreement with families, they were not clawed back due to their economic situation. Fortunately for our project, damaged tablets were replaced by new ones thanks to the gifts of social donators.

Subsequent evaluation research aimed to find out how social work interventions intending to promote the use of ICT in families with vulnerable children can contribute to mitigating or preventing a digital gap.

The primary objective of the impact evaluation was to find out how the introduced social innovation based on the support of digital education influenced the development of digital skills of vulnerable children and their families. The secondary objective was to find out what impact it had on the formation of the digital gap. The tertiary objective was to formulate recommendations, based on the research findings, for support measures aimed at preventing the widening of digital divide in the case of children from socially and economically disadvantaged families by using ICT in social work interventions (Fig. 1).

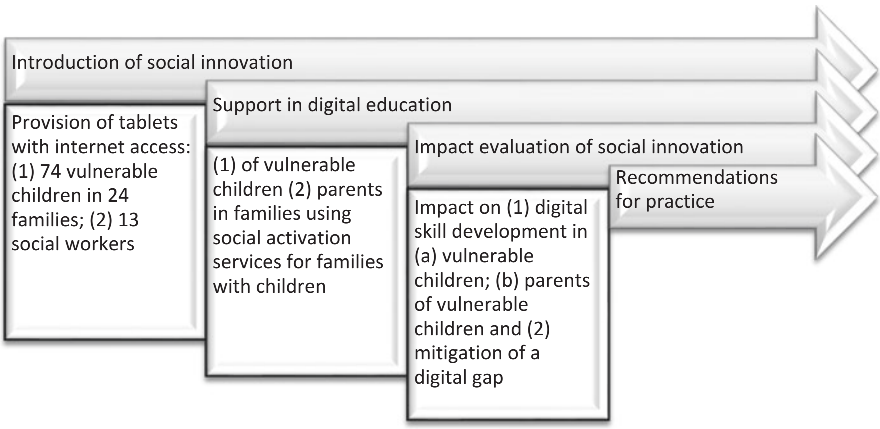


Fig. 1 Research process

Evaluation of Social Innovation

The experimental validation lasted 20 months and continues up to now due to the continuing pandemic. Its effect was assessed in evaluation research which had two phases: (1) ongoing evaluation and (2) impact evaluation. (1) The ongoing evaluation was conducted throughout the implementation of the experimental validation of the introduced social innovation, where the researchers evaluated the implementation of the established research plan. Given the changing conditions during the pandemic, researchers flexibly modified the implementation of the experiment, for example, by moving some contacts to the online environment or adapting the individual phases of the experiment. (2) Data to evaluate the impact of the implemented social innovation on the target group of vulnerable children were collected in two phases: at least 6 months after the implementation of the innovation (November 2020), and at least 18 months after the implementation of the innovation.

The data collection techniques used were (1) semi-structured interviews and (2) questionnaires focused on the assessment of access to technology and subjective assessment of their user skills, including the identification of ICT learning needs with 24 parents (P1 to P24). We also conducted (3) semi-structured interviews with 13 social workers (SW1 to SW13) who provide the families with social activation services. Interviews and assisted fill-in of questionnaires were realized according to the actual epidemiological situation: in face to face" form or online. Participation of all informants was voluntary; hence they could terminate their involvement in qualitative data collection without any consequences for their participation in the experiment. Further, interviews were recorded, transcribed, and subsequently analyzed using open coding. Because the data were collected in the Czech language, all authentic quotations were translated into English.

Results of Social Innovation Impact Evaluation

All informants (parents and social workers) evaluated the introduced social innovation as a suitable tool for reducing the widening of their digital gap. However, all informants mentioned that it needs to be combined with support in digital education of vulnerable children and their parents.

The research results clearly showed that by making technology accessible and developing digital skills, e-safety risks have increased, especially for vulnerable children.

Social Work Intervention as a Tool to Improve Digital Skills

During the COVID-19 pandemic, not only the form of social work intervention with vulnerable children and their families — which was in the first wave mainly conducted online (often via telephone) — has transformed, but also **the objectives of**

the interventions have transformed towards the promotion of digital skills: *The objectives of the collaboration have shifted towards technology. When they have the opportunity to have and use a tablet, they set the contract goal with us this way. For example, the collaboration has expanded to a topic of computer literacy. Or the goal was to learn how to communicate with school electronically...* (SW7). As stated by communication partner SW5: *When we started using tablets, I thought some families would want a tablet for themselves too, but that didn't happen. I even offered to the family that we could request technology equipment from the school. But the family didn't want to. The family claimed that they didn't know how to use it.* Social workers saw the **problems of parents of vulnerable children** in general in low educational background, which is further manifested **in a lower level of digital skills.** As SW8 reported: *Clients' skills are at a minimal level; they use it to search, but they click on the first link and don't look further... They look up the information they need, but it takes time, it's not as fast as it is with us.* In the situation described, **social workers supported parents and their children in development of their digital skills.** These were mainly the parents' skills to **(a) work with the school's information and learning systems:** *how to download school assignments and different school applications* (SW1); **(b) to search the Internet or communicate via email:** *…and I could go on Google, the social worker showed me those sites* (P11), *...she hasn't had any experience with it, so I help her with the search. But I was trying to get her to do her own searches as well...I was trying to write her a sort of guide on how to get into email or some portal. So that she could learn on her own...* (SW2) or **(c) handling the tablet:** *We designed a leaflet with pictograms of what they find where and what they find at the screen bottom…the signs and what they mean and things like that, because some of them really had no idea about them* (SW3); *The social worker showed me how to use it, where to switch it on, how to do it. I never actually had a tablet before. So, I asked him for advice* (P16). **The children's digital skills support** was almost exclusively linked to **distance learning demands**: *...they downloaded some apps, for maths calculations and Czech language...* (SW2); *...the boy showed me what he had downloaded, and we even did some math calculations together* (SW1).

In terms of their attitude towards learning new technologies, we could divide parental statements into three categories. The first category reported on the development of the parents' digital skills and **their interest to develop further in this area**: *I can already do more on the Internet now* (P14); the second group **did not resist the use of ICT** but remained dependent on the support of social workers: *…if I need to deal with something by email, my social worker deals with it together with me* (P19). The last category of parents rejected the use of technology: *...well, to tell you the truth, I'm not good at it. I don't use it* (P10). However, according to the social workers' accounts, parents were more reserved about digital skills support and preferred face-to-face contact with the social worker: *...if clients are not dealing with some urgent problem, they wait for me to come and help them find the information* (SW4). *There are clients who try to work independently and find the information they need. So, either the clients find it on their own or with my help. Or what* *happens is that they sit next to me and watch me look for it. Some clients are afraid to work on this skill...* (SW5).

Previous research shows (Hargittai, 2010; Boydová, 2017) that the level of digital skills often depends on age, access to technology and motivation. This corresponds with van Dijk's (2005) claim that there are three groups: (1) people who use digital technologies and have sufficient skills; (2) people who use digital technologies but cannot use them at the level they would like to; and (3) people who do not want to use digital technologies. In relation to the third group of people, Robles & Cano (2019) talk about "technophobia," which leads to a rejection of the use of information and communication technologies. In contrast, people in the second group who lack the skills to use technology are at risk of secondary digital exclusion. This type of exclusion develops when people have access to technology but lack the skills to use it. According to social workers in our research, low digital literacy is a major barrier for some families and requires regular support from social workers.

Development of Digital Skills to Support the Stop of Digital Gap Expansion

As part of the evaluation, we monitored the transformation of digital skills of families with vulnerable children. Whether and how the level of digital skills has changed was described by SW7: *Some clients tend to use a tablet more extensively, but others just set it aside on their kitchen table at home... Some only use it with a case worker when they are looking something up together. It varies a lot and depends on the skills of those individual clients.* During the social innovation introduction (during the COVID-19 pandemic), a major issue was **supporting digital education of vulnerable children**. Social workers focused their interventions on supporting children's online learning: *The family where distance learning was addressed, such that a tablet would be used to further explain the curriculum. We as social workers do not directly tutor the kids, but we can at least recommend some sites. We try to find a simple key to work on the curriculum with parents and children* (SW5). Activities related to school prep work or actual learning were also declared by parents and children as the most common, as illustrated by P7: *The kids worked most extensively on the tablet within online learning.* The ability to use a tablet with a data plan meant that many vulnerable families with children were able to keep going with regular school learning. *In the state of emergency, it was very beneficial for those families because they could communicate with the school. This enabled them to stay in touch and fulfil their distance learning* (SW4).

In the course of digital education, social workers were also able to support vulnerable children in **maintaining social contacts with their peers:** *...thanks to a tablet and Internet connection, children were not excluded and could stay in contact with their peers... They felt more comfortable and confident in contact with their peers* (SW7). This was also confirmed by some of the parents: *…my daughter…it helped her a lot. She's no longer excluded in that group, and she catches on when* *the kids talk about the Internet... She fits in more and they don't tell her any longer that if we don't have the Internet access, we're some kind of social trash* (P14).

Even among parents, social workers observed the development of digital skills, which contributed to their inclusion: *...thanks to the tablet, clients were able to look up everything themselves, like housing options information... It's motivating for clients to be able to look at flats online on a tablet and see about flat equipment* (SW9). According to social workers, tablets also contributed to greater activation of their clients: *...the tablet made it possible to deal with the situation right away (*e.g.*, to look up the required information), which leads to a greater determination on the part of the client to somehow start dealing with their situation. If dealing with the situation is postponed until later, the clients' determination cools down and it becomes harder to deal with it. This used to be the case in the past, when clients were forced to come to our office or go somewhere else to handle something* (SW5).

Risks of ICT Use for Vulnerable Children

As a result of the use of tablets within the social innovation described above, social workers believe that **online safety and other associated negative phenomena** have become a major issue. According to SW9: *Clients easily fall for different scammers... they would need some guidelines for safe online activity. Our clients are working by trial and error now – short instructional videos from practice would be helpful. The emphasis should also be on prevention... the adults are not motivated to care about such things…meaning where they're supposed to get the information... they have a different day-to-day life*. The findings were confirmed by analysis of interviews with parents. They did not mention their own risks due to the use of ICT at all. If they mentioned some risks, they related them exclusively to their own children.

The themes that emerged during interviews with parents were consistent with expert studies (Spitzer, 2017; Savci & Aysan, 2017; Gerhart, 2017; Haand & Shuwang, 2020) of **children's addiction to the online environment:** *…it wasn't very beneficial, I can tell you. My daughter became quite addicted to it... addictions are a problem* (P2) and of **exposing kids to inappropriate content:** *It's terrible what all the kids find there* (P8). Parents who declared some level of digital literacy, *… I knew what to do with it, I have a computer too. I knew how to handle it* (P2), **were more likely to notice and respond to these risks**: *…and when I told her to turn the tablet off, she was angry. We don't use the tablet now, it's hidden away. I said it would just be for a reward, now we use it once a week. That's it. In the beginning, they had it every day from morning till night. My daughter was on it for 4 hours in the morning and again after lunch* (P2). The theme of excessive time spent with technology was part of the social workers' interventions: *…we addressed spending too much time with technology... like gaming and social media sites... it's a topic in every family to learn to use the tablet sparingly and have control over the time spent on it* (SW6).

In the repertoire of **measures that parents took to prevent or mitigate e-risks,** the most frequent included: (a) control of time spent with ICT: *…if the kids are on Wi-Fi for a long time... then we take it away from them and send them outside because that's too much* (P20); (b) control of content viewed while using ICT *...I started to keep an eye on it* (P3), *...we use YouTube Kids* (P6), or retrospectively by checking the history: *…I check the history after each use* (P3); (c) banning the use of ICT for a certain period of time: *...He may not get a tablet for a week or so* (P3). *...I often stop the kid and tell him that he would be without it for 2 days* (P8); (d) instructing the child before giving him or her a tablet: *...the kids received an almost 3-hour lesson from me* (P6). Serious risks such as cyberbullying, cyber grooming, sexting, paedophilia, and child pornography did not appear at all in the risks formulated by parents, which may be due to the lack of digital knowledge and literacy of parents.

Parents also formulated measures that they thought would be **desirable but of which they had insufficient knowledge or did not know how to take advantage of**. First, these were parental control instruments through filtering software to protect children from inappropriate content: *…I would like it if there was a lock or something* (P3). There was also a request from parents for further education in this area: *… maybe some training on how to use it for the parents as well would probably be good* (P3). The parents also emphasized feelings of helplessness to protect children from risks: *...he locks himself in his room and I'm in the kitchen cooking…how can I possibly know what he's doing?* (P8)

Parents who were more likely to reject the use of ICT and reported their digital skills as very low, *… I don't use a tablet. I'm not into it at all…* (P11), did not acknowledge the ICT associated risks at all… *I don't know what he's doing on it. No, the tablet has no risks. I'm glad we have it (P11).* Parents also reported: … *It probably doesn't have any negative effects, I haven't noticed anything like that, and the kids haven't complained about anything either* (P14) or P16: *...that my kids would come across some naughty stuff…? No, they're little. I'm not worried about that at all.*

For comparison, we present the results of the KiDiCoTi (2020) survey based on self-reporting by children aged 10 to 18 and their parents, which brought findings on children's digital lives during the COVID-19 pandemic. The survey found that children spent an average of six and a half hours a day online, more than half of which was related to school activities. However, 48% of children felt they spent too much time online during the pandemic. In this context, Spitzer (2015) warns of the health risks of digital technologies and describes the negative consequences of a digitalized life. He speaks of cyber-sick people who are more likely to become depressed, have difficulty sleeping, become overweight, and suffer from impaired concentration due to excessive use of digital technology. Children develop poor motor skills and empathy as a result of excessive use of digital technologies. According to Spitzer (2015: 160), *those who communicate through a monitor and keyboard do not learn how to read the communicated emotions from facial expressions, gestures, and speech intonation; they do not learn to empathise with them. Microphones, cameras, and monitors are not suitable for social learning.* These children construct their generational identity in virtual social spaces (Picornell-Lucas & Peláez, 2022), which can negatively affect their socialization.

Recommendations for Preventing the Widening of Vulnerable Children's Digital Gap Through Social Work Interventions

We consider social work interventions aimed at preventing the development or widening of the digital gap to be crucial for the target group of vulnerable children in the contemporary information society, whose power has continued acceleration. Digital participation is an important topic in terms of equal access to education that should be addressed by educators in addition to social workers. Digital exclusion can close off children's access to important educational, professional, organizational, and developmental opportunities (Johnston-Goodstar et al., 2014; Wong et al., 2015). If a digital gap is not bridged, opportunities for socially and economically disadvantaged children can be severely limited compared to their peers. This simultaneously contributes to the development of intergenerational transfer of poverty (Wong et al., 2015). However, in addition to supporting the development of minors, the use of ICT brings along certain risks as described in the above section. These should also be addressed by social workers supporting vulnerable children and their families in their interventions. Based on the results of our research, we have concluded that parents play a key role in protecting children from e-risks. Our data show that the more parents themselves use technology and have higher digital skills, the more aware they are of these threats and actively try to eliminate them (see Fig. 2).

Based on the results of evaluation of the social innovation, it can be concluded that it is crucial to support a digital inclusion of the target group of vulnerable children and their families through social work interventions:

1. Ensuring access to ICT (hardware and software) and Internet access for vulnerable families with children
2. Systemic support of social service clients for families with children (vulnerable children and parents) in the development of their digital skills with an emphasis on e-safety
3. Support of parents by social workers in setting rules and boundaries in the use of ICT by their children
4. Systemic training of social workers in ICT
5. Training of social workers in e-safety with emphasis on the specifics of the target group

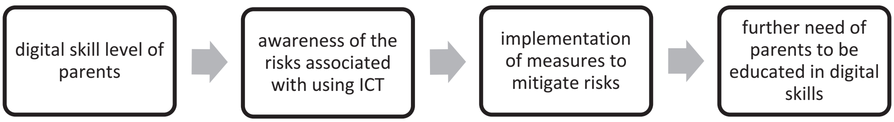


Fig. 2 The role of parents of vulnerable children in e-safety

Conclusion

The COVID-19 pandemic has led to children being “locked” in their homes. Schooling, leisure time, and social contacts were mainly realized through digital technologies in an online environment.

However, not all groups of children were sufficiently prepared for the shift of social contacts to the virtual environment. For example, the target group of vulnerable children and their families became even more vulnerable in this era. Social exclusion was multiplied by digital exclusion. Many families did not only have access to the Internet but also to technological devices due to their low socio-economic status. At this time, we introduced a social innovation aimed at developing the use of ICT in families of vulnerable children through social work interventions.

The results of the subsequent evaluation showed that the support for the development of ICT in families of vulnerable children has indeed contributed on the one hand to the reduction of digital exclusion by providing children with a number of opportunities to acquire new skills (e.g., in the use of digital technologies, in the development of independence in information search, in self-education) or to develop online communication with distant family members or friends. On the other hand, these children have started to consume more digital media and content. As a result, they were more likely to encounter inappropriate content online. They have also, in some cases, started to spend an excessive amount of time online in using new technologies. In relation to this transformation, they are more at risk of cyberbullying, which can have implications on the physical and mental health of children (Spitzer, 2015). The vulnerable children in our research admittedly fall into the category of “Digital Native,” who are assumed to have innate digital skills, as they were born in an era dominated by technological and digital developments. However, Wilson and Grant (2017) warn that mere access to technology does not guarantee adequate knowledge and skills in the safe and effective use of digital technologies by the younger generation, which was evident in the case of the target group of vulnerable children.

For the reasons described above, it is essential that interventions aimed at making technology accessible to groups at risk of a digital gap are accompanied by activities supporting the development of digital skills. This support is often left to social workers who are in contact with vulnerable families in their natural environment. The social workers in our research pointed to the absence of such focused qualifications and professional training, where *…it is difficult to find adequate training courses to meet these specific and individual needs* (SW1). The fact that this is not particular to the Czech context is illustrated by López Peláez et al. (2020) who claims that there is a gap between the desired and actual level of digital skills of social workers. To bridge this digital gap, he recommends a systemic change in professional training. Social workers should be trained to understand the role of ICT in social work, to be able to implement activities aimed at mitigating digital exclusion, and to see this work as an integral part of contemporary (digital) society.

Similarly, Taylor (2017) draws attention to gaps in social workers' knowledge related to digital literacy and technological competence. Social workers should be able to implement or facilitate support for families with vulnerable children in accessing ICT and developing digital skills with an emphasis on e-safety. The challenge that emerges in this context is multidisciplinary collaboration at the level of social workers, educators, andragogues, and educators.

Acknowledgments The research was carried out within the project "Smart technologies for the improvement of quality of life in cities and regions" (CZ.02.1.01/0.0/0.0/17_049/0008452). This project is funded by European Union Social Fund, Operational Programme "Research, Development and Education" led by the Ministry of Education, Youth and Sports of the Czech Republic.

References

Boydová, D. (2017). *Je to složitější. Sociální život teenagerů na sociálních sítích. [It's more complicated. Social life of teenagers on social networks]*. Praha.

Chan, C., & Holosko, M. (2018). Technology for Social Work Interventions. *Technology for Social Work Interventions – Social Work, 2*(23), 1–19. https://doi.org/10.1093/OBO/9780195389678-0263

Chan, C., Ngai, S., & S. (2019). Utilizing social media for social work: Insights from clients in online youth services. *Journal of Social Work Practice, 33*(2), 157–172. https://doi.org/10.1080/02650533.2018.1504286

Czech Statistical Office. (2021). *Česko v číslech 2021*. [*Czechia in numbers 2021*]. https://www.czso.cz/documents/10180/150808213/32020321.pdf/11751856-b9c5-43c5-93bd-56381d529d56?version=1.8

Czech Statistical Office. (2022). *Vybrané demografické údaje podle krajů v roce 2020*. [*Selected demographic data by region in 2020*]. https://www.czso.cz/csu/czso/4-obyvatelstvo-e7kdfzc0cm

De La Fuente Robles, Y., & del Carmen Martín Cano, M. (2019). E-social work and at-risk populations: Technology and robotics in social intervention with elders. The case of Spain. *European Journal of Social Work, 22*(4), 623–633.

Gerhart, N. (2017). Technology addition: How social network sites impact our lives. *International Journal of an Emerging Transdiscipline, 20*, 179–194.

Gillingham, P. (2014). Electronic information systems and social work: Who are we designing for? *Practice Social Work in Action, 26*(5), 313–326.

Haand, M., & Shuwang, Z. (2020). The relationship between social media addiction and depression: A quantitative study among university students in Khost, Afghanistan. *International Journal of Adolescence and Youth, 25*(1), 780–786.

Hargittai, E. (2010). Digital Na(t)ives? Variation in internet skills and uses among members of the "net generation". *Sociological Inquiry, 80*(1), 92–113.

Johnston-Goodstar, K., Richards-Schuster, K., Sethi, J. K. (2014). Exploring critical youth media practice: Connections and contributions for social work. *Social Work,* 59, 4, 339–346.

KiDiCoTi. (2020). *KiDiCoTi: a new study on kids' digital lives during COVID-19 lock-down*. https://ec.europa.eu/jrc/en/science-update/kidicoti-kids-digital-lives-covid-19-times

López Peláez, A., Garíca, R. P., & Massó, M. V. A. T. (2018). e-Social work: building a new field of specialization in social work? *European Journal of Social Work, 21*(6), 804–823.

López Peláez, A., Erro-Garcés, A., Gómez-Ciriano, E., & J. (2020). Young people, social workers and social work education: The role of digital skills. *Social Work Education, 39*(6), 825–842.

MoLSA. (2015). *Strategie digitální gramotnosti ČR na období 2015 až 2020*. [*Digital Literacy Strategy of the Czech Republic for the period 2015 to 2020*]. https://www.mpsv.cz/strategie-digitalni-gramotnosti-cr-na-obdobi-2015-2020

MoLSA. (2021). *Roční výkaz o výkonu sociálně právní ochrany dětí za rok 2020*. [*Annual report on the performance of social and legal protection of children for the year 2020*]. https://www.mpsv.cz/web/cz/statistiky-1

Perron, B. E., Taylor, H. O., Glass, J. E., & Margerum-Leys, J. (2010). Information and communication technologies in social work. *Advances in Social Work, 11*(2), 67–81.

Picornell-Lucas, A., & Peláez, A. L. (2022). The digital citizenship of children and ado-lescents: Challenges for social work education. *Research un Education and Learning Innovation Archives, 28*, 32–37.

Savci, M., & Aysan, F. (2017). Technological addictions and social connectedness: Predictor effect of internet addiction, social media addiction, digital game addiction and smartphone addiction on social connectedness. *The Journal of Psychiatry and Neurological Sciences, 30*, 202–216.

Spitzer, M. (2015). *Kybernemoc! [Cybernemoc!]*. Host.

Spitzer, M. (2017). *Digitální demence. [Digital dementia]*. Host.

Steyaert, J., & Gould, N. (2009). Social work and the changing face of the digital divide. *The British Journal of Social Work, 39*, 740–753.

Taylor, A. (2017). Social work and digitalization: Bringing the knowledge gaps. *Social Work Education, 36*(8), 1–11. https://doi.org/10.1080/02615479.2017.1361924

van Dijk, J. A. G. M. (2005). *The deepening divide: Inequality in the information society*. SAGE Publications. https://doi.org/10.4135/9781452229812

Watling, S. (2012). Digital exclusion: Potential implications for social work education. *Social Work Education, 31*(1), 125–130.

Willoughby, M. (2019). A review of the risks associated with children and young people's social media use and the implications for social work practice. *Journal of Social Work Practice, 33*(2), 127–140. https://doi.org/10.1080/02650533.2018.1460587

Wilson, G., & Grant, A. (2017). *A digital world for all? Findings from a programme of digital inclusion for vulnerable young people across the UK*. Carnegie UK Trust. https://www.basw.co.uk/system/files/resources/basw_92632-10_0.pdf

Wong, Y. C., Ho, K. M., Chen, H., Gu, D., & Zeng, Q. (2015). Digital divide challenges of children in low-income families: The case of Shanghai. *Journal of Technology in Human Services, 33*, 53–71.

Digital Inclusion During the COVID-19 Pandemic: The Case of Austria

Lisa-Katharina Moehlen and Seyda Subasi Singh

Introduction

With the declaration of the COVID-19 outbreak as a pandemic by the World Health Organization in March 2020, the world was introduced to mitigation efforts, new regulations, and rules. This global situation created global stress and has affected the social landscape since then drastically (Ferguson et al., 2020). Social distancing, isolation, and switching to digital alternatives have had consequences for education and schooling, as well (Porter et al., 2021). According to the data of UNESCO (2020), the school closures, delayed school openings, and the switch from classroom teaching to online instruction affected more than 1.5 billion students and their families around the world.

On the other hand, the consequences on education and schools were extremely counterproductive to the efforts of increasing digital literacy and the educational preparedness for digital instruction. The policymakers from various countries summarized this situation during an emergency meeting of the Global Online Learning as “twenty years of talk of digital literacy and educational preparedness for the knowledge economy has been condensed into 20 days of urgency” (Caldwell, 2020, p.11). The movement for increasing the digital literacy of teachers and students was faced with an abrupt examination during the school closures. The tweet posted by UNESCO pointed to this dilemma as “distance learning presents one solution to mass #SchoolClosures but how do we navigate the challenges. Especially for the vulnerable population?” (posted on the 2nd of June 2020).

Among other vulnerable groups, students with disabilities and special education needs were particularly affected by the school closures and shift to digital instruction (Parmigiani et al., 2021; Porter et al., 2021). Virtual instruction brought new

L.-K. Moehlen · S. Subasi Singh (✉)
University of Vienna, Vienna, Austria
e-mail: seyda.subasi@univie.ac.at

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_9

challenges and aggravated the situation of these students. As Azoulay (2020) explains, people with disabilities construe one of the largest minorities in the world. Similarly, the disparity in terms of academic achievement between students with and without disabilities shows that students with disabilities are less likely to achieve and more likely to drop out (UNESCO, 2019). To eliminate the disadvantages for people with disabilities and special education needs, several steps were taken to ensure the rights of people with disabilities and to highlight a more inclusive education system (e.g. The Salamanca Statement and Framework for Action on Special Needs Education in 1994, Convention of the Rights of the People with Disabilities in 2007). All over the world, there have been ongoing efforts to implement these steps (Porter et al., 2021) and although to different extents, we could talk about momentum for preserving inclusive education for all (Hardy & Woodcock, 2014; Parmigiani et al., 2021).

The measures that the COVID-19 pandemic introduced put a hold on the implementation of inclusive learning strategies but at the same time aggravated the challenges for students with disabilities and special education needs in their battle to be a part of the e-inclusion and digitalization (Parmigiani et al., 2021). The exclusion of vulnerable groups from digitalization efforts and the inequalities in terms of accessing digital solutions have been reported by many (Anderson & Perrin, 2018; Rahamin, 2004; Rice & Dykman, 2018). As OECD (2006) explains "gap between individuals, households, business, and geographic areas at different socio-economic levels with regard both to their opportunities to access ICT and to their use of the internet for a wide variety of activities". Participating in inclusive education decreased or vanished due to the switch to virtual learning for many students with disabilities or special education needs (Busby & Tanberk, 2020).

The Austrian context, similarly, experienced a disruption in inclusive education during the pandemic. Labelled as a slow-changing education system, the Austrian education system has undergone uneasy steps towards being more inclusive and experienced challenges due to being rooted in binary categorizations (dis/ability) (Buchner & Proyer, 2020). The Austrian education system has been criticized as being very selective, which leads to inequalities for specific groups such as culturally and linguistically diverse students, students from a refugee background, and students with special education needs.

The current pandemic, as in other countries, introduced further challenges to these students at risk in Austria. There have been some studies to expand the understanding of the disadvantages for vulnerable students. A cross-country study (Austria, Germany, Switzerland) showed that especially these students are considered "Losers of Education" (Bildungsverlierer:innen) of the pandemic (Huber & Helm, 2020). Another quantitative survey with teachers from Austria confirmed that several student groups experienced disadvantages in terms of high demands, downgrading their level of competencies, underachievement, and dropout (Steiner et al., 2020). On the other hand, a study concentrated on the situation of students with disabilities in digital learning depicted a positive picture of distance learning in Austria. The study of Besic and Holzinger (2020) analysed the experiences of inclusive elementary schools with digital learning. They found that the work with digital media promotes and motivates students with disabilities in terms of autonomy and self-directed learning; however, the positive experiences can be enjoyed only by a limited number of students who had the facilities to beat the digital exclusion.

This study concentrated on the challenges of virtual learning during the COVID-19 pandemic for students recognized at risk in Austria. Different from the few studies from the Austrian context, this study reached several stakeholders through focus group interviews. Including the policymakers, directors, and practitioners in the same discussion provided a more holistic picture of the situation.

Methodology

The empirical data consists of four focus group interviews. The four interviews were conducted in April 2020 (1), June 2020 (1), and January 2021 (2) in Austria. The timeline of the interviews covered crucial phases of the pandemic, such as lockdowns but also return to school during the first and second COVID-19 waves. The focus groups were conducted online and the duration of the focus group discussion varied between 90 and 150 minutes. The data providers were a group consisting of two policymakers working for the Education Board, two school principals, five teachers, and one school psychologist. All are involved in different projects at the university and are long-term partners. The participants were selected by targeting the data-rich sources via an online invitation. The participants took part in the focus groups upon informed consent, and the anonymity and the confidentiality of the data were assured by the authors through a written confirmation. Before the focus group discussions, the topics to be included in the discussion were identified by the researchers by analysing the current discourse on digital exclusion during the pandemic and its impact on inclusive education. Some questions were decided beforehand, while some others merged during the focus group discussion based on the flow of the conversation. The data were recorded and transcribed verbatim for the data analysis. The data analysis followed Clarke et al.'s (2016) postmodern grounded theory approach: situation analysis. Through the method, various parallel discourses and voices become visible that are central to the evaluation of the unprecedented situation (Clarke et al., 2016). The usage of the method started with the identification of the issue of digital exclusion during the pandemic in terms of inclusive education. After identifying the issue, the relevant literature was reviewed to draft a shared vision and to decide the scope of the analysis. In this step, the relevant data sources were identified by relying on the long-year cooperation with policymakers, teachers, and other practitioners. During the focus group discussions, anecdotes and narratives were recorded and they formed the majority of the data analysed. On the other hand, media reports, policy documents, and regulations published on the topic were used to increase the sensibility required to organize the data. The data analysis took place immediately after the data collection and both researchers were engaged in the data analysis process. After the data were transcribed, both researchers read the transcripts several times before starting the coding. As a next step, the researchers looked at the data closely to locate the commonalities and differences between different groups of participants. The commonalities were used to depict a picture of the ongoing discourse on digital exclusion, and the differences were used to understand how the practice and policy levels contradict each other. To use the meaningful quotations, all data were labelled based on the data provider' profile: T for teacher, P for policymaker, D for school director, and S or school psychologist. The number of the focus group at which they attended was indicated with the number 1. 2, 3, or 4.

Findings

The analysis pointed out four themes that were derived from the data. The first theme was related to the challenges that students with special education needs experiencing in terms of access to infrastructure. The second theme showed how students with special education needs were excluded from digital learning and virtual infrastructure by being called back to school during the pandemic. While the third theme concentrates on the lack of lobbying for the rights of students with special education needs, the fourth theme reminds us that the intersection of other disadvantages such as low socioeconomic status and refugee background should not be ignored when analysing the situation of students with special education needs. The themes are presented and discussed with the help of quotations from the data providers.

Deprivation from Digital Solutions

The data showed that the provision of distributing hardware to students and teachers did not work the way desired during the first lockdown. With some adjustments, the distribution was accelerated after the early weeks of distance learning. However, the lack of infrastructure pushed the authorities to make a choice, and prioritization was made. Unfortunately, students with special education needs were not given priority and data showed that this decision-making process was politically non-transparent. A policymaker explained this situation as:

> And then there were these laptop issues, and then Vienna city followed and said okay, we're going to set up some infrastructure now, too, and then we just had 5,000 devices for Vienna, it wasn't so much. So there had to be strict limits. (P2, 2)

The blurry and unfair distribution of the technical gadgets created discrepancies throughout the city and the reaction of the schools was coming up with their solutions. There were several campaigns started by the schools to compensate for the lack of laptops, cameras, or headphones for students who did not have them. The frustration of the schools was visible however, and teachers took over the responsibility and did not wait on the ministry of education to provide these technical gadgets. A school director explained this process as:

> If school leaders of SEN schools hadn't actively said, "Hello, we exist, too." we would not have been given any devices. It is not as if the quality managers in the regions are aware that there are also 11-year-old pupils with SEN. Therefore, we solved it in school. Children or the parents reported whether they need laptops or which devices are at home for digital-schooling. Then the community has sponsored with laptops, a few per class. And that turned out quite well, I think, exactly. (D1, 1)

The negligence towards the students with special education needs was very disturbing for the teachers. The data showed that the unfair distribution of the laptops and other technical gadgets was based on an assumption about the students with special education needs. That these students would not even learn with this equipment or they do not have the knowledge to use or the support from their families to use them was visible in the decision of the authorities. These assumptions embedded in the bias against these students were discussed loud in the school context, and authorities were informed about the discontent of the teachers with that situation by school directors.

> And we were lucky because I said that our children with SEN are also in secondary school, so we got 10 laptops. Because they wouldn't have been taken into account, because SEN means they don't need devices anyway. (D2, 2)

The assumptions about the abilities of students with special education needs were also visible in the digital content prepared by the ministry of education. The digital platform provided learning and teaching materials and was launched during the early months of the pandemic. The lack of content for this group of students was relatively disappointing for teachers who tried distance learning with these students. Participating teachers explained their experiences as:

> You can't say, yes well, these are the worksheets for SEN 4th grade. That is just very difficult. There are now general learning platforms, also, it was anyway rather little on it for SEN. (T4, 2)

> So, also the Eduthek by the Ministry of Education, and I have regularly searched through, for example, whether there is something. No. So no matter how you turn it, there comes, there comes nothing. That may, and, well. Zero, yes. (T2, 1)

> Well, certainly not in the SEN area. So in the area of children with SEN, the Eduthek was very blank. Unless I missed something at the end, but I scanned them regularly actually and if there was, I would have discovered anything. (T1, 2)

Exclusion Through Inclusion

The return to school happened for students with special education needs earlier than for the other students. The lack of technical infrastructure and the materials for distance teaching put a hold on the learning process and was not welcomed by teachers and parents. During the second school closure, hence, students with special education needs did go to school while their peers were in distance learning. However, the authorities did not prescribe coming to school but they kept the school for these students open. A policymaker explained this as:

> Yes, and for the SEN children, or the children who need support, we made it so that they are all there. So that was our solution. (T2, 4)

The teachers interpreted this as a mitigation strategy for the missing day-care for these students. They think that based on the high need for care, authorities kept the schools open for this group of students. Students had to wear a mask all the time and get regularly tested. However, wearing a mask and getting tested were very challenging for students with specific needs. These were stress factors for many and not viable. The decision to send their children to school was given to the parents and that meant that the schools were open but challenging to attend and there was no digital alternative. Teachers explained this situation as:

> That was somehow because I have already talked to other colleagues, who said that this is again discrimination, because why can't children with SEN learn from home? (T1, 4)

> Yes, it is prescribed by law that the SEN children have to attend school. However, if the parents are not in favour of it or do not want to, they may be at home. I think the students were quite happy that they were in school and the parents too. But not all came. (T1, 4)

Another reason can be the assumption discussed earlier that these students cannot learn via distance learning. A school psychologist explained that digital solutions could work for her students with special education needs. She reported progress by saying:

> exciting findings [...] that some students have improved their symptoms through distance learning, especially in the SEN area [...]. So we have students who no longer wet themselves, we have symptomatic improvements. (S1, 1)

Lack of Lobbying

Almost all data providers through the study highlighted the lack of importance given to the educational rights of students with special education needs. That these students lack a strong community and support was understood as the reason of focus on their schooling. In the Austrian context, children and young people with disabilities have been equally invisible and they have been virtually absent from the media and politics. Teachers think that there should be more relevance to this issue while making policy but these students lack a voice, and hence they are ignored in the guidelines provided by the policymakers and the education authorities. Teachers supported these themes by:

> (...) specific to inclusive agendas. Zero. There is nothing at all, it's just overall statements. (T2, 1)

> Like, for example, the [Magistrate's Department] has not been able to provide risk guidelines for us to understand which children can go to school and which cannot. What are pre-existing conditions that apply to students and which ones don't. (T4, 2)

This lack of lobbying is also considered a reason for the ongoing negligence in terms of the digitalization of inclusive education. Teachers think if there is no quick reaction, the disadvantaged situation of these students will grow. A teacher summarized this concern by:

> And I'm a bit worried about inclusion in general. I'm a bit afraid of this. So in principle, I have the view that in crises, crises reinforce things that were already there anyway. And I have the feeling that things come out even more clearly. (T3, 2)

Intersecting Challenges

The lack of lobbying is also attributed to the lack of support that these students get from their families. The parents of these students are considered the ones who fall behind in supporting their children and advocating for them. The lack of resources at home or the lack of knowledge of the parents are accepted as the factors that aggravate the situation of students with special education needs. Several data providers referred to that theme by:

> Parents as learning coaches. You can see where the parents are also behind it and take on such a supportive function, you can see that they can follow and that everything is going well. But where they don't even respond. Accordingly, the child is also disorganized and is not present at the online sessions from time to time, so you just have that problem. That's just there. And there are certainly the parents who have it harder generally just for socioeconomic reasons, you notice that, and that's where we have the solution that we bring the kids in. That's why I think we have a high capacity utilization now. (T2, 4)

The lack of resources experienced in low-socioeconomic households or families who are culturally and linguistically diverse such as families from a refugee background was a reason for concern. The lack of support that students get from their parents was not considered enough. Children from special education schools were not offered the necessary support at home that was available in special education schools.

> That is simply there. And there are certainly the parents who have it harder generally simply for socioeconomic reasons (T1,4)

> The socio-economic disadvantage, at least from my point of view, has come massively into focus in recent months. It seems to me that the extracurricular factors just now are extremely powerful. Which I find exciting - in quotes, not for the affected students, of course - but it's a "Brennglas (Binocular glass)" for how much we mostly leave out-of-school factors in school. (T1,3)

The school psychologist, on the other hand, also emphasized the psychological consequences of being in a low-socioeconomic household during the pandemic. This concern was not specific to the students with special education needs. However, this disadvantaged situation can be expected to affect the vulnerable groups to a greater extent.

> Because so many of our students live, in such crowded spaces, difficult family situations. Being at home was no super nice time and certainly no free time. Because they were confronted with the task of organizing themselves and still had these assignments. Even if they did not make their assignments then, probably they had a bad conscience and then still another psychological load point in addition. (T3, 2)

Conclusion

Countries around the globe had to implement new educational programs based on digital solutions during the COVID-19 pandemic. These were efforts to mitigate the effect of the pandemic due to school closures. The aim was to go on providing education. However, the intransigent inequalities that are faced by vulnerable groups were aggravated through this process (Andrew et al., 2020). Students with disabilities were a vulnerable group who experienced the negative impact of the shift to digital learning drastically. As it is seen in this study, students with special education needs were not the prioritized group during the distribution of technical equipment for digital learning. The policymakers did not consider the digital solutions as necessary for this group of students, which was a concern for teachers.

It can be understood that the pandemic highlighted the unfair distribution of sources among students and how this is based on biased assumptions about the students with special education needs. The pandemic reminded us of the justice issues for these students (Porter et al., 2021). The injustices mentioned were not, however, only based on having a special education need. The answers of the data providers showed that they have a holistic perspective and the intersection of different disadvantages is recognized and not ignored. Having a migrant/refugee background, coming from a low-socioeconomic status, and having a disability/special education needs should be taken into consideration. The process of mitigating the impact of the pandemic on education did not attend to these intersections.

To ensure inclusive digital education, several layers of the education system should be adapted with the concept of inclusion and democracy. Promoting digital literacy would require definitely taking the accessibility of the digital tools offered into consideration. The development of the digital tools, their availability, and accessibility to students with special education needs and also to their parents should be encouraged. The content should be prepared carefully to facilitate access with cognitive and physical difficulties as well as in an offline setting. With the optimized digital tools, the learning of students can be facilitated and the support of their families can be ensured. Designing and using digital tools in an inclusive way for all can promote educational equity.

References

Anderson, M., & Perrin, A. (2018). *Nearly one-in-five teens can't always finish their homework because of the digital divide*. Pew Research Center. Retrieved from https://www.pewresearch.org/fact-tank/2018/10/26/nearly-one-in-five-teens-cant-always-finish-their-homework-because-of-the-digital-divide/

Andrew, A., Cattan, S., Costa-Dias, M., Farquharson, C., Kraftman, L., Krutikova, S., Phimister, A., & Sevilla, A. (2020). *Learning during the lockdown: Real-time data on children's experiences during home learning*. The Institute for Fiscal Studies. Retrieved from https://doi.org/10.1920/BN.IFS.2020.BN0288

Azoulay, A. (2020). *Message from Ms. Audrey Azoulay, Director-General of UNESCO, on the occasion of the International Day of Persons with Disabilities*. UNESCO. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000380334

Besic, E., & Holzinger, A. (2020). Fernunterricht für Schüler*innen mit Behinderungen: Perspektiven von Lehrpersonen. In *Zeitschrift für Inklusion,* [Distance learning for students with disabilities: Teacher perspectives.] 3. Retrieved from https://www.inklusion-online.net/index.php/inklusion-online/article/view/580

Buchner, T., & Proyer, M. (2020). From special to inclusive education policies in Austria developments and implications for schools and teacher education. *European Journal of Teacher Education, 43*(1), 83–94.

Busby, J., & Tanberk, J. (2020). *FCC underestimates Americans unserved by broadband Internet by 50%*. Retrieved from https://broadbandnow.com/research/fcc-underestimates-unserved-by-50-percent

Caldwell, B. J. (2020). The leadership of special schools on the other side. *CCEAM, 48*(1), 11–16.

Clarke, A., Friese, C., & Washburn, R. (2016). *Situational analysis in practice. Mapping research with grounded theory*. Routledge.

Ferguson, N., Laydon, D., Nedjati Gilani, G., Imai, N., Ainslie, K., Baguelin, M., & Dighe, A. (2020). *Report 9: Impact of non-pharmaceutical interventions (NPIs) to reduce COVID19 mortality and healthcare demand*. Imperial College of London. Retrieved from https://www.imperial.ac.uk/media/imperial-college/medicine/sph/ide/gida-

Hardy, I., & Woodcock, S. (2014). Inclusive education policies: Discourses of difference, diversity, and deficit. *International Journal of Inclusive Education, 19*(2), 141–164. https://doi.org/10.1080/13603116.2014.908965

Huber, S. G., & Helm, C. (2020). Lernen in Zeiten der Corona-Pandemie. Die Rolle familiärer Merkmale für das Lernen von Schüler*innen. Befunde vom Schul-Barometer in Deutschland, Österreich und der Schweiz [Learning in times of Covid. The role of family dispositions students' learning. Findings of school-bramoter in Germany, Austria and Switzerland]. In D. Fickermann & B. Edelstein (Eds.), *Langsam vermisse ich die Schule .... Schule während und nach der Corona-Pandemie* [Slowly I am mising the school….School during and after corona pandemic]. Waxmann. https://doi.org/10.25656/01:20228.

OECD. (2006). *Digital divide*. Retrieved from https://stats.oecd.org/glossary/detail.asp?ID=4719#:~:text=The%20term%20%22digital%20divide%22%20refers,a%20wide%20variety%20of%20activities.

Parmigiani, D., Benigno, V., Giusto, M., Silvaggio, C., & Sperandio, S. (2021). E-inclusion: Online special education in Italy during the Covid-19 pandemic. *Technology, Pedagogy and Education, 30*(1), 111–124. https://doi.org/10.1080/1475939X.2020.1856714

Porter, S. G., Greene, K., & Esposito, M. C. K. (2021). Access to the inclusion of students with disabilities in virtual learning environments: Implications for post-pandemic teaching. *International Journal of Multicultural Education, 23*(3), 43–61.

Rahamin, L. (2004). From integration to inclusion: Using ICT to support learners with special educational needs in ordinary classroom. In L. Florian & J. Hegarty (Eds.), *ICT and special educational needs. A tool for inclusion* (pp. 35–45). Open University Press.

Rice, M. F., & Dykman, B. (2018). The emerging research base for online learning and students with disabilities. In R. Ferdig & K. Kennedy (Eds.), *Handbook of research on K-12 online and blended learning* (pp. 189–206). ETC Press.

Steiner, M., Köpping, M., Leitner, A., & Pessl, G. (2020). *Covid-19, Distance-Schooling und soziale Ungleichheit* [Covid 19, distance learning and social inequality]. Retrieved from https://inprogress.ihs.ac.at/covid-19-und-home-schooling-folgt-aus-der-gesundheits-nun-auch-eine-bildungskrise

UNESCO. (2019). *The use of UIS Data and Education Management Information Systems to monitor inclusive education* (Information Paper No. 60). UNESCO. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000370915?1=null&queryId=f99f1a14-d33e-4720-b84e-bf3519915a08

UNESCO. (2020). *Global education monitoring report, 2020: Inclusion and education: All means all*. UNESCO, 512. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000373718

Integrating Digital Pedagogies in the Era of the Inclusive Education: Needs Analysis and Use Cases from the Perspective of the "Visitor" Project

Theodora Kouvara, Christoforos Karachristos, Stavroula Karasoula, Theofanis Orphanoudakis, Alexis Lacapele, Berenger Dupont, and Zoe Batsi

Introduction

Modern pedagogy adopts the inclusive education model that dictates that schools must be radically restructured, adopting a dynamic character to cover and adapt to each student's academic and social needs. At the same time, the school context ought to provide educational approaches and teaching aids so that all students can attend the school in their neighborhood, prohibiting any discrimination (Sousa, 2021). In this aim, technology has the means to stand as a valuable enabler of new, improved methods to let school education reach out to broader social categories in an adaptive fashion covering a more comprehensive set of requirements. Of course, the integration of advanced Information and Communication Technologies (ICT)

T. Kouvara (✉) · C. Karachristos · S. Karasoula
Educational Content, Methodology and Technology Laboratory, Hellenic Open University, Patras, Greece
e-mail: tkouvara@eap.gr; karachrist@eap.gr

T. Orphanoudakis
School of Science and Technology, Hellenic Open University, Patras, Greece
e-mail: fanis@eap.gr

A. Lacapele
Interactive 4D, Nice, France
e-mail: a.lacapelle@interactive4d.com

B. Dupont
Logopsycom, Mons, Belgium
e-mail: berenger@logopsycom.com

Z. Batsi
IDEC, Piraeus, Greece
e-mail: zoe@idec.gr

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_10

and related applications and tools in the learning process does not signal the teacher's replacement by the computer. Instead, the teacher must acquire the appropriate pedagogical and technological training to design dynamic learning environments using technology as a valuable tool to adopt in everyday teaching practices (Pellerin, 2013; Ferguson, 2008).

The importance of technological tools for enhancing digital inclusion and, in particular, creating awareness to aid teachers in training for new digital competencies is an essential pillar of inclusive education worldwide. To maximize the effectiveness of these tools is vital to rethink the educational procedure and introduce novelty engagement and governance schemes, considering that the role of educational institutions, teachers, learners, their families, and communities is rapidly changing (Mihovska et al., 2021).

Meanwhile, the appearance of the pandemic has turned out to be a "game-changer" for school education, urging national governments to put much effort so that the schools will be able to deliver their curricula even in the event of a lockdown (Crompton et al., 2021; Papouli et al., 2020). Under the European Skills plan introduced by the European Commission in July 2020, the EU educational policy puts skills at the center, guiding investment in people and their skills for long-term recovery following the COVID-19 pandemic (Mihovska et al., 2021).

Following the urgent situation and the need for teachers' training in inclusion and new technologies, five European organizations from France, Greece, the United Kingdom, and Belgium designed and implemented the project "Virtual Museums In The Covid Era" (VISITOR), a European-funded collective project under the framework of the Erasmus+ Program. VISITOR[1] aims to develop virtual visits to museums, unite European culture, and foster intercultural awareness and conscience through a virtual and inclusive educational process.

This chapter presents a case study of needs analysis research which was conducted as part of the VISITOR project. The research results aimed to establish a structured training program for a specific school unit teachers. The case study focused on defining Greek teachers' skills for implementing museums digital tours via specific digital and inclusive tools and approaches and their opinion on the usefulness of these technologies as supporters of inclusive education.

Specifically, the objectives of the specific study were as follows:

- To investigate the pedagogical methods (if any) that teachers use to support students with disabilities
- To define teachers' competencies for the use of Information Communication Technology (ICT) in digital learning environments
- To identify teachers' inclusive classroom strategies

In Greece, teachers' training in inclusive education and especially in enhancing digital skills in inclusion is insufficient, as it is mainly limited to short seminars detached from the classroom environment (Pappas et al., 2018). This approach leads

[1] https://visitor-project.eu/

to superficial training as factors that determine the specific needs of each school context are not taken into consideration (Stasinos, 2016). In this vein, teachers' training must be led by strategies that reinforce learners' skills and engagement in different ways and adjust to the uniqueness of each school's students to promote diversity (Crompton et al., 2021). Taking into account this requirement, the investigation and the identification of teachers' skills can be an effective strategy for the preparation and implementation of a training course, as it sheds light on the needs that must be met (Garavaglia & Petti, 2013).

In this vein, to implement a practical training course, needs analysis can highlight and investigate teachers' preparedness for inclusive education, including their skills and knowledge in digital literacy (Zagona et al., 2017). Needs analysis is crucial to define the pedagogical methodologies in a training process for digital inclusion. Gentile and Pisanu (2013) claimed that learning results are influenced by technologies and teaching approaches that teachers employ to achieve distinctive objectives, especially when these are easily linked with tasks that emphasize metacognitive thinking. For Ana and Javier (2013), enhancing teachers' digital skills focused on specific objectives may make collaborative learning more effective, reinforcing inter-activity.

Literature Review

The Role of Digital Pedagogies for Virtual Museums

The challenge of the twenty-first century in the learning process is the incorporation and development of digital and visual literacies to ensure that students get equipped with the skills needed to succeed in the new digital era (Statton Thompson et al., 2022). As digital literacy started a new era for learning approaches, with the incorporation of more effective tools, digital museums also formed a new pedagogical approach for schools. Thus, schools now must also deal with the integration of modern pedagogies and, for example, support teachers' digital skills acquisitions and train them in implementing virtual museum tours.

Nowadays, while the term Virtual Museums (VMs) may seem familiar, Pescarin (2014) points out that a VM is not deemed a mere digital copy of a traditional museum, nor is it solely referred to an online museum. Reuter et al. (2014) define VMs as a new model of communication that aims at creating a personalized, immersive, interactive way to enhance our understanding of the world around us. A virtual visitor can learn through immersion and interaction in a physical space inside a conventional museum or through electronic media. An example of a VM is Google Arts and Culture, which helps cultural institutions digitize their content to make art and culture accessible to the wider public and engage visitors in an interactive learning experience. Other notable examples of contributions in the field of virtual museums are Inventing Europe, MUSEON, DynaMus, Scan4Reco, VIRTUE, as well as others (Zidianakis et al., 2021).

Although it is widely believed that VMs are primarily tools to encourage cultural heritage learning, VMs can also enhance other transversal skills that are not related to the specific field. Specifically, personal skills (initiatives, responsibility, risk-taking, creativity, imagination), social skills (networking, empathy, compassion, co-constructing), and learning skills (managing, organizing, metacognitive skills, and failing forward) can be fostered via the adaption of VMs in the learning process given that they enhance creativity (reference). These skills can be beneficial for students. For example, creativity encourages learners' flexibility and the ability to adapt to new ways of thinking and acting. Imagination and divergent thinking are essential characteristics of progressive arts education by schools, universities, and further education providers (Antonaci et al., 2013).

A VM can emerge as a powerful educational tool if it gets integrated into the learning process effectively. In this vein, teachers' ICT competencies (a set of technology standards that define proficiency in using computer technology in the classroom) are focal in creating and shaping a learning environment that would prompt learners to use VMs effectively. The UNESCO ICT Competency Framework for Teachers (ICT-CFT) was launched in 2008 and got updated in 2018 to assist countries in developing effective ICT policies. According to ICT-CFT, teaching approaches can be conducted under three developmental phases: knowledge acquisition, knowledge deepening, and knowledge creation. In the first phase, teachers get trained in ICT competencies to facilitate learners to act accordingly, while the second phase involves teachers making use of ICT competencies to create a learning environment that promotes learners' high-order thinking and problem-solving skills. Given that teachers have mastered ICT competencies, at the last phase (knowledge creation) students are guided to create novel knowledge necessary for "more harmonious, fulfilling and prosperous societies" (https://en.unesco.org/themes/ict-education/competency-framework-teachers).

The New Era of Learning Process Based on Inclusion

Adopting an efficient learning strategy and methodology is deemed a necessity. An essential starting point to boost students' skills is defining how learn. Gentile and Pisanu (2013) provide five fundamental principles. Based on these, students learn better:

- When knowledge is gained as an extension of vested knowledge
- Via a cooperative learning process that reflects what content has been discovered and how the content has been learned is followed
- When teaching and schooling practices are responsive to the students' cognitive needs and learning styles;
- When the knowledge they gain is core knowledge in the curriculum, which should be well-connected to a general context;

- When they receive feedback, evaluate, and are evaluated on their learning outcomes

Hoidn et al. (2021) claimed that constructivism is a learning theory based on cooperative processes with activities and learning paths that engage students in co-constructive learning. According to constructivism, students have an active role in the learning process and the teacher guides them in gaining the theoretical connection between knowledge and the real world. For this purpose, teachers usually work in groups and exchange knowledge. For Andrade (2021), Problem Based Learning (PBL) and the use of ICT are two powerful methods for promoting critical and creative thinking and decision-making. Thus, the need for more training programs to enhance teachers skills and grow their confidence in applying them to their everyday practice is highlighted. Problem Based Learning (PBL) is a student-centered constructivism approach in which students learn about a subject by working in groups to solve an open-ended problem. The PBL model has three different steps (planning, implementation, and evaluation).

Matricardi (2013) suggests that an excellent approach to implementing the PBL model is via interdisciplinary teaching, which combines the analysis of the complicated scientific issues with the design and implementation of a concrete action. To apply this method, the essential tool for teachers is the "lesson plan" to link together the knowledge areas involved in each educational activity, the number of curricular hours employed, and the impact of interdisciplinarity in teaching the academic methods that will be applied. In accordance with Bruner (1996), the scope of the learning process is to help students give meaning to the complexity of the natural world by shifting its focus to their culture and experiences. Therefore, every student should be guided by an effective educational path to express their understanding through their whole culture, sharing knowledge and experiences with others. ICT can provide powerful tools so that interdisciplinary teaching is enhanced and both teachers and students can contribute to constructing their learning path.

Further, Baguma and Wolters (2021) support that an interdisciplinary approach to learning that is constructed with several different digital tools and via different paths can promote inclusion. Inclusion fights against the pinpointing and surmounting barricades all students may have in accessing quality education. Learners do not learn at the same pace; thus, it is incumbent on teachers to cater to all children's needs and provide equal learning opportunities. Inclusion focuses on the student's education path at the center of this procedure. The emphasis is on students. Specifically, via a cooperative process and the diversification of courses (implementation of several different learning tools and approaches addressing all students' needs) can lead to students getting benefitted (Mihovska et al., 2021). With constructionism being the core philosophy underlying inclusive education, the teacher should tailor the curriculum and act as a facilitator, while students construct new knowledge and develop problem-solving skills (Hajisoteriou et al., 2021). Hence, new inclusive approaches to learning are required, which call for teachers to diversify their courses according to all students' needs. For instance, teachers can make use of VMs to their students' advantage so that they create technologically driven tools and make students embark on lifelong learning (Mihovska et al., 2021). For achieving interdisciplinary approaches in the space of inclusion, the digital storytelling[2] process, virtual tours via text-based games,[3] and citizen science (engagement in scientific research) can be three powerful examples of teaching diversification which can be implemented by teachers for Virtual tours in Museums.

Kouvara et al. (2019), via a multi-thematic digital storytelling project based on the PBL model, investigated the changes brought about by its implementation in the academic and social context of a school unit. Learners researched and processed information from diverse cognitive domains (art, science, maths, coding) at their own pace. In this vein, Blas (2013) promotes digital storytelling as a teaching method to compel students and teachers to acquire media literacy[4] skills. Specifically, via a cooperation method, learners have to design and create a multimedia story blending texts, music, images, and drawings to design and implement an interactive story to acquire skills for communication with multimedia. Moreover, Kouvara et al. (2019) and Uher et al. (2021) inserted the role-play in the digital story process with particular attention. They motivated their students, who constructed their stories individually and as a group based on their learning pace.

Regarding the case of the text-based game, digital games engage students in exciting tasks and lead to meaningful writing and projects. The textual nature of interactive fiction and hypertexts accommodates players with special educational needs. The game creation, as a teaching strategy that adopts text-based interaction, offers an inclusive and engaging digital technology (Wyatt, 2018). According to Aristeidou and Spyropoulou (2015), since several virtual learning environments (VLEs) lack a defined goal or rules, users use them freely without restrictions. Therefore, there are many ways to use VLEs, which could trigger learners to gain learning outcomes via navigation through art galleries, museums, digital exhibitions, etc.

Finally, the citizen science approach can cultivate citizens' knowledge and skills. A systematic review by Aristeidou and Herodotou (2020) highlighted that a well-designed learning approach method may affect participants' understanding of scientific processes, enhance pattern-recognition skills, and foster communication skills and digital literacy. In the inclusion area, an essential condition is the alignment of citizen science learning strategies at the planning stage of the process using co-creation approaches to ensure accessibility and inclusivity. With successful coordination, citizen science can potentially empower learners to take ownership of their learning (Roche et al., 2020).

The above literature review highlighted the pedagogical methods, issues, and digital tools, to which teachers should be exposed during a training course focusing

[2] Digital storytelling can be defined as the practice of using multimedia tools such as images, graphics, music, audio narrations, video, written text as well as learners' own voice and hand-drawn images in order to create a story.

[3] A text-based game is a game in which the interaction of players and the game is through text in a virtual reality space.

[4] Media literacy is the ability to synthesize, analyze, and produce mediated messages.

on the implementation of digital tours via inclusive teaching approaches, like the one developed in the framework of the VISITOR project. In the following section, the specific study focusing on the identification and analysis of teacher needs in a Greek school use case is presented.

Methodology

The study took place at a specific school unit in Greece and focused on defining the pedagogical and technological skills via a needs analysis process. The study aimed to establish a structured training program for the school unit teachers in matters of inclusive digital education. Such training programs are even more crucial in emergency times where teachers should be supported with strategies to reinforce student learning and engagement in different ways (Crompton et al., 2021).

To achieve the study aims, a collaborative network between academics and teachers was established. This research was conducted in a Greek primary school and lasted 4 months, involving two fifth grade classes and an integration class, in which students with learning difficulties are provided with personalized training for a few hours every day and are separated from their classmates. Non-participatory observation and semi-structured interviews were employed for the data collection.

The theoretical sampling (deliberate sampling), based on the principle of grounded theory, was adopted for the sample of the overall research. Theoretical sampling provides the opportunity for researchers to conduct an initial sampling and to determine their sample according to the data obtained (Babbie, 2011). The adoption of the above technique leads to the adjustment of the sample to the needs of the study; thus, it always ensures the focus on the school environment, depending on the purpose of each study.

Therefore, the sample size at the initial stage extended to all school staff (teachers and principal), including the teachers attending the integration. Of course, during its progress, the research focused on the techniques that teachers implement to integrate students with learning difficulties. The study focused on fifth grade as it was the only class with students who face learning difficulties, made use of interactive whiteboards, and were taught Scratch – a programming language for students (https://scratch.mit.edu/), on this specific class.

Based on the theoretical framework of the literature review discussed above, the research tools were designed to explore the inclusive educational practices and the digital competencies of teachers in the field of virtual museums and environments. Data were obtained from recorded semi-structured interviews (with a duration of ~30′) with four teachers and the non-participatory observation on their teaching strategies and digital skills via daily notes.

The first four questions of the interviews were related to investigating the teachers' inclusive practices on issues of teaching diversification and cooperation. At the same time, teachers' perceptions of inclusion were explored. The second four questions aimed to define their digital competencies and explore them through virtual museums. The four last ones focused on learning strategies based on PBL models, such as digital storytelling, citizen science, and other virtual environments (e.g., text-based games). All the questions in the interviews were established to draw results related to the research objectives listed above.

The axes of observation were the teaching strategies of the formal and the integration class for 4 months. In essence, teachers' educational strategies were observed both in integration classes and the general ones. Then, as the research progressed, the observation focused on specific learning techniques regarding inclusivity and digital skills.

Data analysis was based on the technique of thematic analysis (Isari & Pourkos, 2015). In particular, the induction and abduction stage were adopted, as suggested by Erickson (1986). The cross-sectional-categorical process was followed (Isari & Pourkos, 2015). The method of grouping followed the stage of data coding, during which the main findings of the study were classified in discrete themes and constructed based on the collected data coding. Finally, the rejection of specific claims and the documentation of the others were followed in the stage of abduction.

For reliability, triangulation was followed by applying different research tools and examining data from different angles (Erickson, 1986). The technique of multimember checks was adopted too by all the authors. Finally, the anonymity of the participants was maintained, while all the instructions on ethical issues regarding the educational research of the Institute of Educational Policy were followed (https://www.hypersystems.gr/en/portfolio/institute-of-educational-policy-iep/). In the following section, results are classified into three different topics organized on three identified themes that answer each research objective.

Findings and Discussion

This study highlights teachers' skills for implementing museums' virtual tours via their opinion on using technologies as supporters of inclusive education. The analysis of the data collected, emerging through the observation process and interviews conducted with the teachers as discussed above, paved the way for comparing the findings and drawing conclusions. To this end, an extensive presentation of the findings related to three emerging main themes regarding the research objectives follows (Creswell, 2002).

Theme 1: Teachers Face Specific Obstacles in Applying Inclusive Pedagogical Practices and Planning Procedures

Specifically, per the first research objective (Investigation of the inclusive teaching approaches), the findings highlighted that teachers face obstacles to inclusion. Data revealed erroneous approaches to issues related to teaching strategies, with the most striking being that the majority of teachers do not follow inclusive methods. The following quotes are examples of their views on the issue of diversification between Interviewee 1 (I1, teacher in grade 5), Interviewee 2 (I2, teacher in grade 5), Interviewee 3 (I3, the deputy director), and Interviewee 4 (I4, the special educational needs teacher).

I1: In a class without equipment and freedom of time, diversification is difficult to implement since the law restricts us. To achieve this, I am trying to teach my lesson using Powerpoint as other teachers do at our school ...

I2: Certainly, time is limited. However, I believe that the teacher should perceive obstacles as challenges that he has to overcome. The lack of infrastructure is not an obstacle but an opportunity to seek and rediscover the limits of my ingenuity. You know, many times, my students' parents accused me of the modern methods of my teaching approach (smiles). Indeed, they changed their mind. My students are interested in doing their homework, which is proof of my ability.

I3: Certainly, the teachers need to be sceptical about their methods. On the other hand, a teacher is often alone in this endeavour. I believe you will agree with me. It often happens that even the parents complain about these issues as diversification. They think that we align the teaching process to the needs only of some children.

From the above statements, teachers – except from I2 – consider that the lack of infrastructure combined with the absence of a decentralized education system implements diversification of teaching challenging. At the same time, parents often do not understand the meaning of this practice. So, they are skeptical about this issue. According to I2, the change of some parents' attitudes is a process that is not completed immediately but requires a long time-space.

As the observation findings identified, teachers did not go deep into issues of diversification. As they also stated in the interview, most believe that their efforts hardly pay off due to certain limiting factors. Therefore, many teachers were using only video projectors as a differentiating tool. These views, combined with the nature of the Greek education system, are obstacles to inclusion (Kouvara et al., 2018).

Furthermore, only a few teachers attempted to organize a collaborative environment for their students. Apart from these cases, lecturing was adopted as the main teaching method by most teachers. Most of the teachers were observed to cooperate only with students who were more "willing" to participate in the learning process.

At the same time, a lack of cooperation among teachers was observed. The I4 teacher (the special educational needs teacher) stated:

I4: In the rest of the courses, – i.e. those where my support is not provided based on the recommendation of the Center for Diagnosis, Evaluation and Support (CDES)-

I am not informed about my students' performance by other teachers; I was not given any instructions from CDE. I am working hard based on the experts' guidelines.

Respectively, teacher I2 stated:

I2: The support which we receive from the special education teacher is excellent. The truth is that children with special educational needs cannot perform fully in my lesson because of the high heterogeneity of the general classroom. However, gaps are being filled in through the integrational class. Unfortunately, the lack of time is an aggravating factor for them, too. Fortunately, the integration class supports our objectives.

Finally, teacher I4 (special educational needs teacher) mentioned again:

I4: In general, we do not interfere with each other's work, but sometimes I feel that the biggest burden falls on me. Many teachers neglect to be informed about the experts' evaluation report from the CDES.

The teacher of the integration class never informed the other teachers about her students' performance. Accordingly, she used to examine and act alone in the integration class. However, the teacher of the general class seemed to consider that overcoming any academic difficulties faced by her students is the responsibility of the integration teacher. Besides, as stated by the special educational needs teacher, many teachers are not interested in informing the experts' evaluation (*CDES*).

In other words, no attempt was made to establish a structured educational strategy based on teachers' collaboration. At the same time, the same results emerged with the observation process. The teachers did not use to plan the day's lesson via a collaboration process. On the contrary, everyone agreed that implementing a collaborative teaching model is impossible in a class with so many students.

The absence of substantial diversification of teaching by the majority of the school's teachers minimizes the teacher's effort to create an accessible learning environment for all students combined with straight teaching, the absence of teamwork, the lack of cooperation networks became apparent to be vulnerabilities that prevented the adoption of such a philosophy. The importance of the above characteristics was supported by many researchers (Ainscow, 1998; Kouvara et al., 2019; Kouvara et al., 2018).

Moreover, outdated pedagogical perceptions were detected, such as those of the special educational needs teacher, as she argued that cooperation with the general class teachers could be a form of intervention in her work. Furthermore, the other teachers believe that the responsibility of children with learning disabilities lies exclusively with the special educational needs teacher. However, the above positions and situations are not unique phenomena. According to recent research in Greek schools of integration, there is a tendency to adopt mainly the "medical model".[5] The responsibility for academic and social performance lies only with the teacher of special education (Kouvara et al., 2019).

Theme 2: Teachers Have Available ICT Competencies That Can Be Expanded

Specifically, per the second research objective (definition of teachers' competencies for ICT use in digital learning environments), the findings showed that teachers have developed several ICT competencies that can be extended further. In specific

[5] Under the medical educational model, the differences of students with special educational needs should firstly be "fixed" in order to integrate them in the general class with the other students.

concerning the use of new technologies at school and their capability to diversify teaching to involve all students in the subject, some findings in the responses indicate that their adoption is considered positive. In particular, these include visual material (e.g., projection of drawings), the use of the Internet, and the quality of teaching provided by the integration section.

In particular, in the general class, the two teachers and the rest of all teachers always used the projector, where they gathered in a blueprint the basic information of the day's lesson. Their font was usually of high definition and adequate size, considering that some students faced some kind of vision disorder (myopia, astigmatism).

Finally, as far as the practices of the teacher of the class integration are concerned, it appeared that the teacher, having developed a friendly relationship with the children, was faithfully following the instructions of CDES. It was observed that she used to direct her intervention based on these guidelines. So she stated:

I4: I try to follow the instructions of CDES. At the same time, I often look for information on the Internet for effective actions. Specifically, I am attending an e-learning seminar from a well-known Greek university on dyslexia...

Indeed, the observation confirmed the teacher's claims in the integration class, as she used various support methods in cases of students with learning difficulties. Such procedures included using an illustrated way in the teaching of spelling, tabs with rules for grammar and mathematics, bookmarks during reading, a projector, social stories, the recording of courses, and rules of grammar and mathematics. However, although the teacher often used the Internet, the computer of the integration class malfunctioned in the last 2 months. As a result, it was not used as a means of teaching, since the special educational needs teacher could not find alternatives (tablet, laptop).

When teachers were asked if they knew of any tools for digital museum tours, very few were aware of them. In particular, there was talk of aggregators such as Google Arts and Cultures and Europeana. At the same time, during the observation, two teachers used material from Google Art and Cultures without using any structured lesson plan with activities that would allow all students to participate.

However, they knew the educational methodology of Digital storytelling, as they had taken part in a digital history creation project for their participation in the Panhellenic Festival of Digital Creation in 2019**.** Regarding the use of digital stories as a tool for museum tours, the teachers replied:

I1: We could plan actions for the three stages of digital storytelling. Educational tours for the planning stage of digital stories and their implementation. Regarding the assessment stage, maybe we could evaluate at the end of each story.

I2 and I3 replied along the same lines, more or less, while the I4 suggested:

I4: Some of my students could take part if we used the material from the digital stories and guided them in my lesson to keep up with the general classroom activities. Of course, this would take time from both the teacher of the class and me to produce activities together and practice the tools, which is difficult because our time is minimal.

Although teachers seem to sense the importance of collaboration, they also seem to consider the lack of time as an obstacle to planning the preparatory work required to involve all their students in these activities and gain fluency in using the technologies needed. At the same time, all teachers responded positively to digital learning environments and stated that they would be interested in receiving relevant training. They felt that quizzes of graded difficulty in three-dimensional games could create incentives for all students to participate, as they have noticed that learning via computers is more enjoyable. Still, they were not aware of such environments.

The willingness of teachers to educate themselves and get to know the virtual learning environments led to the question about using lesson plans for virtual tours. All teachers responded positively, saying they were aware of the process. Still, as the pandemic outbreak created many problems with the coverage of the syllabus, they stated that they were forced to fill the gaps despite the lack of time to be organized. They also indicated that they were not trained to teach scenarios to implement digital tours but would be interested. The I4 teacher said:

> **I4:** I would be very interested to know how I can implement such scenarios to help my students, but I am afraid that I will have a hard time as my knowledge in computer science is limited.

At the same time, teachers did not know citizen science as an educational practice. Still, they thought it was an activity that would be very interesting. Some students like action outdoors or are curious and often search the Internet for topics related to the natural environment. Teacher I4, specifically mentioned:

> **I4:** I have a student on the spectrum of autism who loves to learn about the environment. He has a particular interest in rocks, which would motivate him to get engaged in such a process. I'm afraid he would hardly work with the rest of the students.

According to recent research, when the teachers of primary and high schools try to focus on a more digital inclusive teaching approach, they realize that their competence level regarding ICT tools is not very high to apply these techniques in the teaching process (Ana & Javier, 2013; Gentile & Pisanu, 2013). Moreover, educational systems have shown limitations regarding school policies related to digital literacy since an adequate ongoing assessment of the teaching staff and of their teaching methodologies is required to improve and strengthen their educational standards (Sánchez-Cruzado et al., 2021).

Theme 3: Training Courses on the Efficient Implementation of Virtual Tours as a Pedagogical Tool Provide Valuable Assistance

The combination of the research results with those published in the literature recently brings to the surface the educational framework followed by the teachers regarding inclusivity and their teachers' ICT competencies in the field of the virtual learning environment. Thus, a novel training course got determined based on the third objective of the research (identification of teachers' inclusive classroom strategies).

The VISITOR project introduces an e-learning training course for teachers based on the PBL method. The teachers have to implement virtual tours gathering educational materials through the content of digital museums.

The e-learning training course includes various ICT tools activities, such as digital storytelling, text-based games, and citizen science. Teachers have to:

- Define their stories' topic through learning techniques such as brainstorming and critical thinking, using videos and portfolios of gathered material and synthesizing information.
- Gather digitally available material from museums.
- Plan the map of their story via brainstorming, quick comparative writing, drafting, redrafting, rearranging content, and, ultimately, peer evaluation.
- Pick the technological equipment they will use for the digital story production through a proposed list.
- Assess their projects according to a Rubric assessment.

Additionally, VISITOR aims to deliver:

- A content aggregator of digital museum exhibits toolkit. The specific element will facilitate teachers to search, locate, and retrieve digital materials from museums.
- A digital application for virtual tours. A text-based game will lead the trainer in a virtual 3D futuristic exhibition. It will allow learners to earn knowledge in culture, history, arts, and science. Specifically, the specific tool will enable teachers to design their interactive quizzes into different modules, each corresponding to various thematic aspects.
- Exemplar use cases for digital exhibits and citizen science resources. Exemplar use cases of the museum digital exhibits will involve the presentation of lesson plans, or practices that build toward the creation of an effective lesson plan, such as the concept or objective to be taught, the time duration, procedures and processes, the required museum exhibits, questions to be asked, and the evaluation of the lesson. Teachers can use the exemplar use cases as models to facilitate them in achieving curriculum goals or structuring extracurricular activities.

Through VISITOR, teachers will be empowered to construct their digital stories based on the content of digital museums and digital material and virtual tours made open to the public using appropriate easy to use tools. In this vein, teachers have to collaborate in an e-learning environment combined different interactive digital tools, such as the text-based game tool and digital resources (digital content made available by museums) through a disciplinary approach (literature, science, art, coding, writing, music). Consequently, the fundamental goal of VISITOR is to foster teachers' digital and teaching abilities through an experiential and innovative learning process. If the current plan is met, teachers will be able to facilitate students in digital storytelling construction and exploration of digital resources. Consequently, the teacher gains the opportunity to implement a dynamic project that can fit the pedagogical and social needs of a variety of students. This goal can be acquired as the teachers will have the opportunity to construct many different learning paths for students based on various e-tools.

Conclusion

The specific results concern the context of the school unit in question exclusively, as they are not generalizable, as their qualitative character leaves no room for generalization. The purpose of this pilot research was also to study in-depth the specific research framework to develop as much data as possible to establish the training course for the needs of the VISITOR project. Therefore, the study of a sample which would also lead to the possibility of generalizing the data would be an additional element that would enhance the validity of this research.

At the same time, the use of additional research tools such as the research diary on the part of the researcher – teacher is necessary. Therefore, this research could be a guide for future researchers as well as teachers – researchers so that they become able to map the school context, of which they are part, and act, based on the data they collect.

In conclusion, this research adds a "stone" to inclusion issues in Greece regarding the additive value of study, as the literature is still limited. At the same time, the institution of Digital Inclusion has not been adopted in the educational philosophy. On the contrary, the anachronistic integration institution still takes a dominant position on special education issues in Greece.

Acknowledgments The present work was undertaken in the context of the "Virtual museums in the covid era (Visitor)" project co-funded by the Erasmus+ Program of the European Union.

References

Ainscow, M. (1998). Would It Work in Theory? Arguments for practitioner research and theorizing. In C. Clark, A. Dyson, & A. Millward (Eds.), *Theorizing special education* (pp. 156–173). Routledge.

Ana, G. V., & Javier, T. F. (2013). The methodological value of collaborative work in the teaching-learning process: Explanatory variables. In D. Parmigiani, V. Pennagio, & A. Traverso (Eds.), *Learning & teaching with media & technology* (pp. 259–271). ATEE aisbl.

Andrade, A. B. (2021). O Problem Based Learning no ensino de ciências contábeis para o desenvolvimento de competências e habilidades. [Problem Based Learning does not teach science, you count on the development of skills and abilities. Journal of Administration and Accounting]. *Revista de Administração e Contabilidade-RAC, 7*(14).

Antonaci, A., Ott, M., & Pozzi, F. (2013). Virtual museums, cultural heritage education and 21st century skills. In D. Parmigiani, V. Pennagio, & A. Traverso (Eds.), *Learning & teaching with media & technology* (pp. 185–195). ATEE aisbl.

Aristeidou, M., & Herodotou, C. (2020). Online citizen science: A systematic review of effects on learning and scientific literacy. *Citizen Science: Theory and Practice, 5*(1), 11, pp. 1–12. https://doi.org/10.5334/cstp.224

Aristeidou, M., & Spyropoulou, N. (2015). Building technology and science experiences in 3D virtual world. *Procedia Computer Science, 65*, 259–268.

Babbie. (2011). *The practice of the social research* (9th ed.). Wadsworth Publishing.

Baguma, R., & Wolters, M. K. (2021). Making virtual learning environments accessible to people with disabilities in universities in Uganda. *Frontiers in Computer Science, 3*, 638275.

Blas, N. (2013). Technology at School: Special event or everyday practice? In *ATEE- SIREM winter conference* (pp. 210–217).

Bruner, J. (1996). What we have learned about early learning. *European Early Childhood Education Research Journal, 4*(1), 5–16.

Creswell, J. W. (2002). *Educational research: Planning, conducting, and evaluating quantitative* (Vol. 7). Prentice Hall.

Crompton, H., Burke, D., Jordan, K., & Wilson, S. W. (2021). Learning with technology during emergencies: A systematic review of K-12 education. *British Journal of Educational Technology, 52*(4), 1554–1575.

Erickson, F. (1986). Qualitative methods in research on teaching. In M. C. Wittrock (Ed.). *Handbook of research on teaching* (pp. 119–161). Washington, DC: American Educational Research Association

Ferguson, D. L. (2008). International trends in inclusive education: The continuing challenge to teach each one and everyone. *European Journal of Special Needs Education, 23*(2), 109–120.

Garavaglia, A., & Petti, L. (2013). Needs analysis in classroom digitalization projects. In *ATEE-SIREM* (pp. 251–258). ATEE aisbl.

Gentile, M., & Pisanu, F. (2013). Integrating technology and teaching with learning solutions. In D. Parmigiani, V. Pennagio, & A. Traverso (Eds.), *Learning & teaching with media & technology* (pp. 272–286). ATEE aisbl.

Hajisoteriou, C., Karousiou, C., & Angelides, P. (2021). Children's voices on marginalization and inclusion: Lessons to be learned from two decades of research in Cyprus. *International Journal of Inclusive Education*, *24,* 1–25.

Hoidn, S., Reusser, K., & Klemenčič, M. (2021). Foundations of student-centered learning and teaching. In S. Hoidn and M. Klemenčič (Eds). *Routledge international handbook of student-centred learning and teaching in higher education* (pp. 17–46). London: Routledge.

Isari, F., & Pourkos, M. (2015). *Piotiki Methodologia Ereynas* [Qualitative research methodology]. Syndesmos Elinikon Bibliothikon.

Kouvara, T., Karachristos, C., Stavropoulos, E., & Verykios, V. (2018). Children's voice and school improvement: The role of technology in the inclusive school of the future. *Croatian Journal of Education: Hrvatski časopis za odgoj i obrazovanje, 20*(Sp. Ed. 3), 107–131.

Kouvara, T. K., Karasoula, S. A., Karachristos, C. V., Stavropoulos, E. C., & Verykios, V. S. (2019). Technology and school unit improvement: Researching, reconsidering and reconstructing the school context through a multi-thematic digital storytelling project. *Social Sciences, 8*(2), 49.

Matricardi, G. (2013). "School 21": A project to implement active citizenship skills in the Italian higher education. The role of ICT. In D. Parmigiani, V. Pennagio, & A. Traverso (Eds.), *Learning & teaching with media & technology* (pp. 121–129). ATEE aisbl.

Mihovska, A., Prevedourou, D., Tsankova, J., Manolova, A., & Poulkov, V. (2021, March). Building adaptive and inclusive education readiness through digital technologies. In *2021 Joint International Conference on Digital Arts, Media and Technology with ECTI. Northern.*

Papouli, E., Chatzifotiou, S., & Tsairidis, C. (2020). The use of digital technology at home during the COVID-19 outbreak: Views of social work students in Greece. *Social Work Education, 39*(8), 1107–1115.

Pappas, M. A., Papoutsi, C., & Drigas, A. S. (2018). Policies, practices, and attitudes toward inclusive education: The case of Greece. *Social Science, 7*, 90.

Pellerin, M. (2013). E-inclusion in Early French Immersion Classrooms: Using Digital Technologies to Support Inclusive Practices That Meet the Needs of All Learners. *Canadian Journal of Education*, *36*(1), 44–70.

Pescarin, S. (2014). Museums and virtual museums in Europe: Reaching expectations. *SCIRES-IT-SCIentific RESearch and Information Technology, 4*(1), 131–140.

Reuter, P., Granier, X., Graf, H., Corsini, M., Pagano, A., & Farouk, M. (2014). *Virtual Museums evaluation on portability, tangible visualization and interaction techniques: Methodological guidelines with respect to portability, usability and integration* (Doctoral dissertation, V-Must. net).

Roche, J., Bell, L., Galvão, C., Golumbic, Y. N., Kloetzer, L., Knoben, N., et al. (2020). Citizen science, education, and learning: Challenges and opportunities. *Frontiers in Sociology*, 1–10.

Sánchez-Cruzado, C., Santiago Campión, R., & Sánchez-Compaña, M. (2021). Teacher digital literacy: The indisputable challenge after COVID-19. *Sustainability, 13*(4), 1858.

Sousa, C. (2021). *I.T. integration in inclusive education*. Retrieved from http://www.kriativ-tech.com/wp-content/uploads/2021/11/Carla-Sousa.pdf

Stasinos, D. (2016). *Special Education 2020 (plus). For an inclusive education in the new-digital school with digital champions*. Papazisi Publishing.

Statton Thompson, D., Beene, S., Greer, K., Wegmann, M., Fullmer, M., Murphy, M., et al. (2022). A proliferation of images: Trends, obstacles, and opportunities for visual literacy. *Journal of Visual Literacy*, 1–19.

Uher, A. M., Josol, C. K., & Fisher, M. H. (2021). Behavioral approaches to teaching decision making to individuals with intellectual and developmental disabilities. In *Decision making by individuals with intellectual and developmental disabilities* (pp. 499–517). Springer.

Wyatt, C. S. (2018, May). The natural accommodation of interactive fiction: How text-based games remove barriers to participation. In *The proceedings of the annual computers and writing conference, 2018* (p. 27).

Zagona, A. L., Kurth, J. A., & MacFarland, S. Z. (2017). Teachers' views of their preparation for inclusive education and collaboration. *Teacher Education and Special Education, 40*(3), 163–178.

Zidianakis, E., Partarakis, N., Ntoa, S., Dimopoulos, A., Kopidaki, S., Ntagianta, A., & Stephanidis, C. (2021). The invisible museum: A user-centric platform for creating virtual 3D exhibitions with VR support. *Electronics, 10*(3), 363.

Scales of Inclusion in a Vertically Integrated Program for a Community-Focused Interactive Experience

Joshua A. Fisher and Lauren Liss

Introduction

Increasingly, university departments are working with public organizations and groups to provide learning opportunities for students that result in public-facing artifacts like web pages, apps, and other digital experiences. Scaffolding curricula and pedagogical tactics to support this kind of student work and learning that benefits both the community and students is challenging. One solution is developing Vertically Integrated Programs (VIP) that enable students to work on a singular research or development project over many semesters (Bayer, 2014; Ferri et al., 2017). With each new semester, the students learn new skills that increase the quality of the final artifact and produce more value for the community. Further, these students become part of a community of learners wherein more experienced students elevate new students (Corrie, 1995).

VIP programs encourage different educational tactics that parallel different pedagogical philosophies (Barrella & Watson, 2016). These philosophies are Jian Piaget's Constructivism, Lev Vygotsky's Social Constructivism, Seymour Papert's Constructionism, and Jean Lave and Etienne Wenger's Communities of Practice. These pedagogical theories are implemented at different times in the VIP structure

J. A. Fisher (✉)
Interactive Arts and Media, Columbia College Chicago, Chicago, IL, USA

Center for Emerging Media Design and Development, Ball State University, Muncie, IN, USA
e-mail: joshua.fisher@bsu.edu

L. Liss
Interactive Arts and Media, Columbia College Chicago, Chicago, IL, USA
e-mail: lliss@colum.edu

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_11

in parallel with departmental curriculum. At the same time, the curriculum and VIP projects include students in different ways and within different social arenas depending on their degree progress. Students' participation then occurs within different scales of inclusion depending on whether they are being included in the VIP in the social arenas of the classroom, the academy, or in conversations with the community partner. To explore the VIP model and these scales of inclusion, this chapter presents a case study on a public-facing serious game developed for the Economic Awareness Council (EAC) in Chicago (Economic Awareness Council, 2020). The case study discusses the obstacles that occurred with a first effort and how students overcame them in the second effort. It tracks the development of the game through 18 months of production.

Pedagogical Philosophies in a Vertically Integrated Program

Broadly, the idea of a VIP is rooted in Jean Piaget's concept of Constructivism: as humans, we construct knowledge based upon our learned experiences with the world around us (Ackermann, 2001; Von Glasersfeld, 2005). Engaging in this way can strengthen genuine learning through shared experiences in an educational setting. Concepts of human-centered design parallel this approach. Constructivism and human-centered design understand that information and meaning are contextual—our experiences are subjective. We are creating an environment that encourages an iterative creative practice wherein each iteration builds upon previous information as a foundational process of human learning.

Expanding Constructivism, Lev Vygotsky's theory of Social Constructivism recognizes that learning in a social setting precedes human development and that we construct knowledge through our interactions with others (Liu & Chen, 2010; Liu & Matthews, 2005). As teachers, we guide our students to help them navigate their learning experience. Teachers act as facilitators in the knowledge creation process. It is not passive. The process is an active dialogue with our students that is new and distinct each time.

In Seymour Papert's theory of Constructionism, we create mental models of understanding based upon the information we already know to create new understandings (Papert, 1993; Papert & Harel, 1991). This model mirrors effective learning and industry-standard creative practices. It is a model that validates the basic pedagogical assumption that we create meaning and understanding from our interactions with the world around us, particularly with other humans. We study and design this process for others as practitioners of human-centered design.

A VIP mirrors Jean Lave and Etienne Wenger's Communities of Practice (Lave, 1991; Wenger, 1999). As humans, we learn from each other in our shared experiences. Experience level may vary—student to professor, mentor to mentee, manager to employee—but a community of practice creates a living and breathing environment of situated knowledge and growth through shared and varied experiences. As we learn through iteration, we acquire new knowledge to share with our peers and vice versa. Students learn from their professors, professors learn from their students, clients learn from students, and the community benefits from this learning.

Scales of Inclusion

When speaking about inclusion, there appears to be a disconnect between the abstract idea and its practical implementation. The term requires an operational understanding(Qvortrup & Qvortrup, 2018). Ane and Lars Qvortup, education researchers, recognized that inclusion can happen at different levels for a student's participation. They recognized that "the experience of being included" was required as part of inclusive design—it is not enough to be asked or able to participate—a feeling of being "included" is necessary (Qvortrup & Qvortrup, 2018). Further, that such levels also occur in different types of communities, whether those be inside the classroom, inside the department, or outside of the school.

A VIP model attempts to create the curricular structure of a community of practice, with "inclusion" being a required and expected outcome. Outside of the required foundational courses, students choose to electively engage in this process. The hope is that learning becomes self-motivated, and students choose their level of inclusion as well as depth. A VIP scaffolds this process.

Ane and Lars Qvortrup outline these separate inclusive arenas as, "other arenas related to the classroom and the school." In this chapter, we recognize that such arenas have a particular scale. For example, the arena of inclusion within a classroom has a smaller scale than feeling included within a school. They identify five of these different arenas. These are presented in Table 1 in relation to scales.

Considering these arenas in terms of scale addresses where the impact of this inclusion or exclusion may be felt by the student. In agreement with Qvortrup, we recognize that these scales of inclusion can and do influence learning achievement. The VIP supports the inclusion of students from the initial classroom setting and transitions them into ever larger social arenas of inclusion. In the instance of the case study, students moved from the small social arena of the classroom to the larger

Table 1 Ane and Lars Qvortrup's arenas of inclusion and their definitions

Arena of inclusion	Scale
Social arenas within the classroom as a complex of interaction systems	Within the classroom
Social arenas related to the interpersonal relationships between children	Within the classroom
Social arenas within the professionally organized learning community	Within the academy
Social arenas related to, but not a formal part of the school community	Within the community
Social arenas related to interpersonal relationships between the individual child and one or more adults, e.g., the teacher	Within the community

social arena of the college's Design Lab, and then to the even larger social arena of the community. At each level, their learning was impacted by a different scale of inclusion.

The Case Study: Economic Awareness Council's Investing Game

In the Spring of 2020, the EAC approached the Department of Interactive Arts and Media (IAM) at Columbia College Chicago to design and develop a serious game on investing literacy. The Economic Awareness Council has a 19-year history of working with youth in distressed communities to improve their financial literacy. They run summer camps and youth leadership programs through community groups. After two successful projects with a now-defunct unit of Columbia College Chicago, The Convergence Lab, they wanted to collaborate again.

This collaboration required new scaffolding. The college lost its capacity to administer public-facing projects when the Convergence Lab closed. As a result, the authors and a colleague were asked to direct their efforts to produce a new lab called The Design Lab within the IAM Department. Further, the administration asked the authors to connect classroom work to community-situated and public-facing projects. There was general goodwill and a desire to do this work. Unfortunately, as is often the case, there was no additional funding, release time, or administrative support to establish this effort. Undeterred, the authors and their colleagues met with the EAC to begin scaffolding the program and to develop the project.

The EAC had a short timeline for their project. They wanted to launch the game in the summer of 2021. This timeline allowed for a mere 4 months to design, develop, and launch the experience. The faculty lead warned EAC that the timeline was ambitious and might not result in a viable product. However, with appropriate investment from students and faculty, the experience might be capably produced. To this end, the first author recruited the best performing students in their Serious Games and Simulations class to develop a Game Design Document (GDD) for the game.

Seven students worked independently to draft the GDD using a design brief and educational materials from the EAC. After their first iteration, they met with the faculty lead to revise their work. The faculty lead then scheduled a meeting with the EAC stakeholders so the students could present their work. During this meeting, the students presented the GDD and their rationale for interaction design mechanics, pedagogical goals, and other formal game design qualities. The faculty lead moderated the conversation. Three other meetings occurred during which the students learned to solicit feedback, communicate with clients, and iterate on designs. After the fourth meeting, the faculty lead handling development of the game took over.

During this period, the administration had provided dispensation for two student workers to commit 20 hours each to the project weekly. With only 3 months left until the game was meant to launch, the students were to work tirelessly. However, this effort was not forthcoming for various reasons. First, the hired students were graduating seniors. Accordingly, they were more focused on employment and graduation than the project. This became increasingly evident as graduation approached and their future employers made job offers. Communication breakdowns occurred with increasing regularity. When EAC sought to launch the game, the students had disappeared entirely, leaving an unfinished project, stressed faculty, and an upset client. In short, the first effort at establishing a successful model for The Design Lab failed. At this time, the development faculty member quit to take a job in industry and the lead design faculty was left to salvage the effort.

The Second Effort

After a stressful call with EAC, the faculty lead recommitted The Design Lab to producing a complete experience for the summer of 2022. The lead worked with his colleagues and chair to hire student workers that were second and third-year students. With the longer timeline and younger students, it was possible to institute a VIP where the third-year students could help train the second-year students. Further, the students came from different programs within the IAM Department. Programming students worked with Interaction Design (ID) and User Experience (UX) students. A team was formed and met weekly.

In the fall semester of 2021, the faculty lead worked with the programming student to refactor and complete the core programming of the experience. The students from the first effort worked haphazardly and without documentation. The faculty lead who left had patched up their code where he could, but this resulted in an illegible codebase with many inconsistencies. This failure inspired a revision where the programming student documented each method in code and technical documentation. Understanding that the Design Lab would hand this game to a client, the programming student worked diligently with the faculty to write clear, well-documented code. In the fall semester, the faculty and programming student met with EAC biweekly to confirm that the game was working as designed by the initial group of students.

In the spring of 2022, the faculty lead brought on the ID and UX students to redesign the interface. In January, the faculty lead gave these students the design brief based on the initial GDD and the faculty lead's conversations with EAC. The students then met with EAC to ask questions, solicit insights, and engage in design research. They also reviewed the educational material from EAC and the codebase provided by the programming student. They then engaged in an agile, iterative design process using Figma. Each week they revised the prototype based on internal feedback and comments from EAC. The Economic Awareness Council and the students were happy with the prototype by mid-February and the Design Lab began usability testing.

The UX student led the usability testing with high school students involved in one of EAC's current programs. The usability sessions lasted 3 hours and involved surveys, interviews, and observation by the UX student. The UX student then compiled a report reviewed internally by the team. Design suggestions were put forward to EAC from that review and were discussed by the VIP cohort. Once affirmed, the UX and ID students revised the prototype. The programming student worked in parallel, ensuring that methods and functions would be ready. This iterative process continued through two usability studies—the last one happening in early March 2022.

The final programming, testing, and deployment took place in April of 2022. The testing took place internally for the first 2 weeks of April, with a final public test occurring in the last week of the month. Finally, the project was handed off to EAC for their use in May of 2022 for their summer camps on financial and investing literacy. EAC used the game with at least 1000 students.

In the final meeting between the faculty lead, students, and EAC a postmortem reflection occurred. EAC noted that the complexity of the process was unknown to them and that they were grateful for the students' work. EAC also mentioned that they would have liked more touch points for communication and meetings. They felt that a dedicated staff member to run the project would have greatly benefitted project management. The faculty member and students agreed. The three students engaged in the project felt that they had gained valuable skills in working with a real client on an actual project. Further, they all felt like they learned how to collaborate across their different disciplines in a way that their coursework did not generally allow. Finally, the ID and UX students expressed a desire to be more deeply involved at an earlier point in the project. Since they came in toward the end of the experience, they felt like they did not have adequate time to complete user research and had to work quickly to get up to speed. EAC and the lead faculty member acknowledged this and commended them on the exemplary work they were able to accomplish. The meeting ended with all stakeholders excited about the launch. The Design Lab, VIP students, and EAC felt like all of the project's goals were accomplished.

Analyzing Pedagogy Within the Vertically Integrated Program

The previously mentioned pedagogical theories—Constructivism, Social Constructivism, Constructionism, and Communities of Practice—will be used to analyze the case study. Throughout the project, students took courses that gave them the skills necessary to succeed in the VIP. The first set of pedagogies inspired inclusivity at the classroom and the academy level. The second set expanded the role of community partners and their stakeholders for a different scale of inclusivity.

Constructivism, Social Constructivism, and Constructionism

In the first year of the Interaction Design degree and Game Design degree programs in the IAM Department, instructors teach students psychology and perceptual-cognitive science behind design, interaction design, and effective experience design. They are taught these lessons through hands-on and iterative design activities and lectures. Critically, students are encouraged to incorporate their earned knowledge with their old experiences to produce prototypes. This approach encourages students to take insights from their life experiences and connect them to Human-Centered Design methodologies (Oehlberg et al., 2012). This parallel activates their agency as learners and designers. Critically, agile and iterative development align with Piaget's understanding that learners must modify their mental models when the world no longer fits (Klemmer et al., 2006). In cognitive development, "mental models" are referred to as schemas (McLeod, 2007). Schemas are the collections of information we already understand from our lived experiences about the world. We modify these schemas in two ways:

- *Assimilation*: new information is modified to fit inside of our existing schemas.
- *Accommodation*: existing schemas are modified to fit new information.

Good designers must iterate on their designs when the context in which they are implemented is not what is expected or changes. Instructors instill this agile and flexible design thinking in students from their first semester.

In the second year of study, students take a prerequisite course for the capstone experience. While students can take this course before their final capstone, instructors encourage them to take it as early as possible, as it extends Constructivism into Social Constructivism and Constructionism (Ackermann, 2001; Papert & Harel, 1991). Students call this prerequisite course "The Failure Class," not because most students fail–quite the opposite. In line with Papert's concept of Constructionism and Vygotsky's concept of Social Constructivism, the course creates problem spaces for genuine and empowered exploration by students. Creating this space sets up the possibility that what they make is not what they expect. Unfortunately, students often code this consequence as failure. However, instructors assess students on their participation in the process–not the final artifact–so they are given space to fail, reflect, learn from what happened, and try again. This system mirrors the iterative practice of the creative industry, but it also helps build resilience. Resilient learners are far more likely to become lifelong learners capable of actively supporting a VIP project that leaves a positive impact on the community.

Constructivism, Social Constructivism, and Constructionism in the Vertically Integrated Program

Students in the second effort of the VIP had completed at least four semesters of the interaction design courses. As a result, they came to the project familiar with iterative and agile design. In many ways, this suited the VIP project, wherein they had to revise work from the first effort based on the project's shifted aesthetic context.

The faculty lead also worked solely as the facilitator. The students engaged with the client based on their personal and educational experiences in the classroom. Centering the students enabled the faculty to ask questions regarding the project and their relationship with the client. Each question was meant to be a challenge to encourage critical design thinking (McLeod, 2007). Since the faculty lead was also the students' professor, the questions connected directly to previously covered coursework. This engagement benefited from demonstrating to the students the importance of design knowledge in a real-world application.

Appropriately, the faculty lead only guided the students to fulfill obligations to EAC and the project. Students were encouraged to lead the process actively. Naturally, leaders in the game design group and the second effort group stepped up to guide the efforts. These students had an outsized impact on the final serious game and gained the most from the process.

Communities of Practice

A community of practice is a group of people bound by an intrinsic motivation to create. What that creation is or means is defined by the group. Communities of practice form organically when there is one, an opportunity for people to connect; and two, a shared passion or need is discovered. When that happens, the resulting community of practice is situated within the context of this opportunity. Communities of practice are objectively inclusive because of their shared intrinsic motivation. Inclusivity is likely to continue to thrive if the motivation of community members continues to be intrinsic.

The IAM Team class was designed to create a genuine and authentic learning environment that enables and activates this intrinsic motivation. A professor aligns students with an external stakeholder ("The Client") that has a problem they need help solving. The students then define possibilities of how to solve that problem. Since the students are empowered to explore the problem space through the lens of their shared experiences, knowledge, and resources, the resulting process and product are highly likely to be intrinsically motivated or at least offer that opportunity for everyone within the community. The opportunity for intrinsic motivation is supported by individuals in the community learning and teaching one another. This sometimes happens simultaneously and informs inclusion within this social arena. This inclusivity can help flatten the power dynamics—between the worker and the business, between the student and the mentor, between the creative and the project manager—that historically interfere with creative ideation and breed exclusion.

Communities of Practice in the VIP

Within the VIP project for EAC, two of the three students had taken the IAM Team class, and one was currently enrolled in the IAM Team Capstone. The third student benefitted from their peers' experiences. There were two major overlapping communities of practice: interdepartmental and outside of the academy. These two areas of inclusion included the "Social arenas within the professionally organized learning community" and "Social arenas related to, but not a formal part of the school community"(Qvortrup & Qvortrup, 2018). Accordingly, the scales of inclusion were the academy and the community at large.

The interdepartmental community of practice operated as the Design Lab. Students from Programming, Game Design, and Interaction Design all worked together to create the serious game. Students from the different disciplines approached the common and recurrent problems of interactive media development from each of their situated perspectives. This enabled knowledge sharing and helped frame, constrain, and guide the iterative design process. Over 18 months, students went through the five stages of a community of practice. They saw the potential of working together, coalesced around that potential to ideate the game, and then actively developed the game. As time progressed, the game design students dispersed and returned to their curricula. However, they found the experience memorable and actively checked in on the progress of the game, often offering to beta test the experience. In addition, the Design Lab and VIP project's community of practice developed meaningful bonds between commuter students who often are excluded from this social arena because of logistics.

The community of practice outside of academia included EAC and its students. Design Lab students had to reach out, form relationships, and learn from the client to produce a compelling game. While traditionally, communities of practice have been viewed as internal developments within an organization, the public-facing nature of the Design Lab encouraged a more inclusive approach. EAC and Columbia students had to confederate in their efforts to produce a practical learning tool. This combined effort had to be achieved while maintaining boundaries that protected the students' learning and labor.

Further, EAC needed to be assured that their efforts would be rewarded with an effective educational game. The faculty lead on the experience had to monitor these boundaries even as they were flexed—by both students and EAC—during the iterative development process. Achieving an inclusive community of practice at this scale meant mediating student concerns and needs with the client's desired outcomes. The faculty lead often met with students after client meetings to help students prioritize tasks and responses. Far less often, the faculty lead met with EAC to affirm the lab's commitment.

Students worked with EAC to understand the organization's learning system to teach financial literacy to its students. This engagement meant that the students had to understand where their serious game fit within a larger organization. This approach presented a unique challenge for students as they often iterate on one-off solutions based on a proposed design problem through coursework. To better understand the EAC's learning system, the students analyzed their educational materials, met with existing students, and asked poignant questions of the organization's leaders. They discovered where and when the game would be used, the classrooms in which it would be hosted, the technology available to the students (and educators), and where the game fit in the overall curriculum—accordingly, this impacted design decisions around UX writing and other information. For example, while EAC wanted definitions for financial tools (mutual funds, certified deposits, etc.), they already extensively covered the material outside the game. This pre-work meant that any definition of a financial tool within the game could be concise and presented as a tooltip by hovering over the term. Learning about the system in which the solution (the game) would be presented enabled the students to design and develop a prototype that respected the organization, both its students and stakeholders.

Through the communities of practice, students were able to gain professional skills in agile and iterative development. They learned how to communicate design problems to one another using a shared language. They coalesced around solutions that included all their unique viewpoints on solving those problems. Finally, by working at an inclusive scale at the social arena that is not part of the school community, one that integrates external partners and stakeholders in the community, students produced a viable game that fit within an existing educational plan. This made implementation easier and guaranteed that students would see their game used.

Achieving Inclusivity at Different Scales in a VIP Program

Throughout this case study, we have discussed how different pedagogical philosophies occur in different social arenas for inclusion, each with their own scale, as part of a VIP project. Implementing Papert, Piaget, and Vygotsky in the early parts of a digital media and production curriculum encourages students to solve design problems through iterative development and agile thinking. They learn to fail, try again, and operate in changing contexts. Further, they begin to accept that their situated perspective is valuable as part of a kaleidoscopic effort that includes the experience of their peers.

Finally, this work prepares them to be part of different communities of practice as discussed by Lave and Wagner. At one level, they learn to include the work of other disciplines and mindsets as they coalesce around problems. At another level, they learn that for a solution to be effective, they must work as a community with clients and their stakeholders to produce an effective digital solution. At each level, students are included and learn to be inclusive of others as they work together in ever-expanding social arenas.

The Design Lab at Columbia College Chicago was the first effort to achieve a VIP at the college. While working with EAC, the faculty running the lab accomplished the administration's goals. Over three semesters, they helped students complete a public-facing project for the public good. The students learned valuable skills and produced a strong portfolio piece. EAC can now implement the financial literacy and investing tool into their more extensive curriculum. Hundreds of their students engaged with the tool in the summer of 2022 for the first time.

Given that the project was an overwhelming success, the authors hope that the college will work to support the Design Lab in the future. That said, there are consistently greater demands put on faculty to produce these kinds of public-facing programs with limited support. With more significant investment from academia, VIPs and faculty could be active in forming communities of digital practice throughout cities and regions. This work would help distribute the knowledge often guarded in academia. Further, such public engagement could result in a more just and equitable design space and exemplify inclusivity.

Works Cited

Ackermann, E. (2001). Piaget's constructivism, Papert's constructionism: What's the difference? *Constructivism: Uses and Perspectives in Education*, 1–11. https://doi.org/10.1.1.132.4253

Barrella, E. M., & Watson, M. K. (2016). Comparing the outcomes of horizontal and vertical integration of sustainability content into engineering curricula using concept maps. In *New developments in engineering education for sustainable development* (pp. 1–13). Springer.

Bayer, L. (2014). You complete me: On building a vertically integrated digital humanities program at the University of Georgia. *Against the Grain, 26*(6), 12.

Corrie, L. (1995). Vertical integration: Teachers' knowledge and teachers' voice. *Australasian Journal of Early Childhood, 20*(3), 1–5.

Economic Awareness Council. (2020). *Economic Awareness Council*. Website. https://www.econcouncil.org/

Ferri, A. A., Ferri, B. H., Lineberg, R., Ferri, K. P., Crawford, Z., & Tamayo, J. (2017). Use of a vertically integrated project team to develop hands-on learning modules. *2017 ASEE Annual Conference & Exposition*.

Klemmer, S. R., Hartmann, B., & Takayama, L. (2006). How bodies matter: Five themes for interaction design. In *Proceedings of the 6th conference on designing interactive systems*, 140–149.

Lave, J. (1991). *Situating learning in communities of practice.*

Liu, C. C., & Chen, I. J. (2010). Evolution of constructivism. *Contemporary Issues in Education Research, 3*(4), 63–66.

Liu, C. H., & Matthews, R. (2005). Vygotsky's philosophy: Constructivism and its criticisms examined. *International Education Journal, 6*(3), 386–399.

McLeod, S. (2007). *Jean Piaget's theory of cognitive development*.

Oehlberg, L., Leighton, I., Agogino, A., & Hartmann, B. (2012). Teaching human-centered design innovation across engineering, humanities and social sciences. *International Journal of Engineering Education, 28*(2), 484.

Papert, S. (1993). *Mindstorm: Children computers and powerful ideas.* 252.

Papert, S., & Harel, I. (1991). *SItuating constructionism.*

Qvortrup, A., & Qvortrup, L. (2018). Inclusion: Dimensions of inclusion in education. *International Journal of Inclusive Education, 22*(7), 803–817. https://doi.org/10.1080/13603116.2017.1412506

Von Glasersfeld, E. (2005). Thirty years constructivism. *Constructivist Foundations, 1*(1), 9–12.

Wenger, E. (1999). *Communities of practice: Learning, meaning, and identity*. Cambridge University Press.

New Configurations of Inclusive Education: Contributions of Brazilian Edtechs to Accessibility and Inclusion

Marilene Santos Garcia and Andrea Filatro

Introduction

According to the National Health Survey carried out in 2019 by the Brazilian Institute of Geography and Statistics and the Ministry of Health of the Brazilian Federal Government, there are around 17.3 million people with special needs in the country. On the educational scene, the 2018 school census, carried out by the National Institute of Educational Studies and Research Anísio Teixeira (INEP), registered 1.2 million enrollments of people with disabilities, who represent approximately 2.5% of the total.

In higher education, in turn, of the 8.6 million enrolled students, 48,520 are people with disabilities (0.56% of the total). Over the last 10 years, the amount has almost doubled: in 2009, there were only 20,500 students with disabilities occupying college rooms. Most of these students (16,376) have some kind of physical disability, 13,900 have low vision, and 6569 have a hearing impairment. Among people with intellectual disabilities, 4177 are attending higher education.

In addition to these data, the Brazilian Law for the Inclusion of Persons with Disabilities established the Statute of Persons with Disabilities,[1] which requires accessibility procedures for products and services that guarantee them access to the available information.

[1] Law No. 13,146 of July 6, 2015.

M. S. Garcia (✉)
TIDD – PUC-SP e LE@D – Laboratório de Educação a Distancia, PUC- SP, Universidade Aberta de Portugal- Lisboa, São Paulo, Brazil

A. Filatro
FIA/Enap/Saraiva, São Paulo, Brazil

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_12

Furthermore, the 2019 and 2020 edtech reports published by the innovation hub Distrito registered an ecosystem with 424 and 559 Brazilian edtechs, respectively, that are seeking solutions to contemporary educational problems. In this universe, 13 and 17 startups (or 3% of the total) are dedicated exclusively to developing digital products, processes, and services for inclusion and accessibility in education.

Inclusion, Accessibility, and the Use of Technologies

According to Lexico.com, powered by Oxford University Press, inclusion is "the action or state of including or of being included within a group or structure" (Lexico, n.d.-a), while accessibility is "the quality of being easily reached, entered, or used by people who have a disability" (Lexico, n.d.-b). Both terms are related insofar as accessibility involves designing systems to optimize access, while being included is about giving equal access and opportunities to everyone wherever possible. In education, this means reducing and overcoming the barriers that might occur in content, teaching and learning activities, and assessments (Taylor & Mote, 2021).

Inclusion is a process that permeates several educational guidelines and aims to mitigate barriers that prevent the effective social participation of people with disabilities in different spaces, especially in those that are oriented toward some form of productivity, interaction with the world, decision-making, or well-being, among other aspects.

For Omote (2018), people with disabilities have to go a long way to conquer the current conditions of accessibility and inclusion. In this journey, the human factor can be more decisive than any technological achievement, since it determines the use that will be made of technologies. For the author, it is necessary to build an inclusive culture in which needs, rights, and duties can be adequately addressed in such a way as to ensure the fullest and most productive participation possible for all people, regardless of the nature of the differences that may arise.

The purposes of inclusion, encompassing its various sectors, have been significantly expanded as a result of technologies (Corrêa et al., 2021). The digital world has become widespread in public and private education systems such that it demands learning formats that are more inclusive and achieve equity, productive power in society, a better quality of life, and better coverage of diversities and their current realities. Based on these aspects, we seek to recognize and support the differences in access, learning, and opportunities with the support of technologies.

Inclusion as a process of equity also encompasses groups that do not find social recognition, as is the case with ethnic minorities facing racism, the situation of women, and educational quality for non-dominant classes. Issues involving inclusion processes can also take on a broader scope and are perceived by the initiatives present in edtechs.

Inclusion with Assistive Technologies

Technologies can directly help, through a set of conditions endorsed by society, in the construction of possibilities that give humans with disabilities better conditions to become more complete beings.

Radabaugh (1993) states that technologies make things easier for most people. However, for people with disabilities, technologies can make things possible. In this sense, they can offer real solutions to several needs.

In fact, people with a disability can gain more independence when technologies are well designed and aligned in their favor, insofar as they can erase the situation of their "invisibility" in today's society. Crespo points out that the invisibility of people with disabilities dates back to antiquity and remains to this day:

> It is an immense contingent of people without access to buildings, information, public transport, employment, health, education, culture, and sports. Millions are denied the right to independence and equal opportunities. They are denied the right to make their own choices and to have control over their own body, sexuality, and life. (Crespo, 2011, p. 30)

Assistive technologies – defined by the Assistive Technology Act (ATA) as "any item, piece of equipment, or product system … that is used to increase, maintain, or improve functional capabilities of individuals with disabilities" (Schaller, n.d.) – should be understood, therefore, as aids that promote the expansion of a deficient functional ability or enable the performance of a desired function that is impeded by circumstances of disability or aging. We can say then that the main objective of assistive technology is to provide people with disabilities with greater independence, quality of life, and social inclusion through the expansion of their communication, mobility, control of their environment, learning skills, and work.

In this way, the expression "assistive technology" can be used to identify the entire arsenal of resources and services that contribute to providing or expanding functional abilities of people with disabilities and consequently promoting independent life and inclusion (Bersch & Tonolli, 2006).

Galvão Filho (2009) highlights that the concept of assistive technologies encompasses different dimensions and conditions to cover a variety of existing disabilities. The author indicates that assistive technologies can also generate a form of inclusion through creativity and low cost in some devices, not necessarily digital:

> There is a countless number of possibilities, of simple and low-cost resources, which can and should be made available in inclusive classrooms, according to the specific needs of each student with special educational needs present in these rooms, such as support for viewing texts or books; fixing the paper or notebook on the table with adhesive tapes; pencil or pen thickeners made with sponges that are rolled up and tied, or with a bicycle handle or PVC tubes "filled" with epoxy; replacing the table with wooden or acrylic boards fixed to the wheelchair; various orthoses; and countless other possibilities. (Galvão Filho, 2009, p. 207)

On the other hand, digital resources such as screen readers (Audima, JAWS®, Narrador, NVDA, ReadAloud, TalkBack, and Voice Over), translators for Libras (HandTalk, Rybená and VLibras), simplifiers of complex texts for people with intellectual disabilities (SimplerVoice), and multifunctional readers supported by artificial intelligence (SeeingAI) are examples of products that can benefit not only people with disabilities but also people with partial or temporary disabilities (accident victims, for example) and users in general (such as the elderly or people with a low level of education) or with specific learning preferences and cognitive styles (Filatro & Loureiro, 2021).

Brazilian Edtechs

The digital society creates its differentials at all times through products, services, and practices, which translates into constant movements in search of innovation to fulfill an emerging demand. The field of education cannot be left out of this process, and it directly absorbs these forms of updated and new trends.

Because of this condition, new edtechs, which are specific startups with educational purposes, are emerging every day. Medeiros and Medeiros (2017) emphasize that, in this scenario, there are technologies that qualify the teaching and learning processes in their different modalities and levels.

For Alves and Sartori (2021), such educational technologies seek to expand the sense of innovation in this area. The concept of educational innovation encompasses some essential elements, especially fine-tuning digital technologies and outreach programs with teaching and learning purposes.

Jesus and Azevedo (2021), in a systematic review of the subject, found that educational innovation is aligned with a multidimensional and multilevel vision, as it is continuously in the process of improving school relations, focusing on the human development of its student actors and the search for equity and social justice standards.

Tavares (2019, apud Jesus & Azevedo, 2021, p. 26), in a study based on scientific articles on the use of the concept of innovation in the educational field between 1974 and 2017, found that such innovation can be understood mainly from four perspectives: (1) as something considered a priori positive; (2) as a model of educational change and reform; (3) as modifications to existing curricular proposals; and (4) as alterations of habitual educational practices of certain social groups. In this way, Tavares concludes that the concept of innovation encompasses different practices and a network of meanings, which in turn relate to epistemological and ideological conceptions.

In this context, Silva (2018) states that startups for education are essentially forms of intervention that aim to change attitudes with the introduction of new pedagogical practices, updated curricular topics, as well as reviews of teaching and learning strategies.

Edtech can be conceptualized as a type of startup that seeks innovative solutions, specifically in the educational area. These companies see niches in the market for educational services and products that can meet an identified need or even guide the proposition of new trends with incremental innovations, that is, those that improve a service or an educational product, those that are disruptive, or those that produce a profound change in habits and target new skills in their application.

The products, processes, and services of an edtech can cover online courses, teaching platforms, websites, software, applications, educational games, virtual reality simulators, and augmented reality simulators, among others, and are also present at all levels of education, from basic to higher, technical, and corporate education, expanding beyond school and university walls, aiming not only at lifelong education but also at new settings and players that act in the teaching-learning process.

Having made these considerations, the objective of this chapter is to verify in a more pragmatic way how Brazilian edtechs are providing innovative solutions to the demands for accessibility and inclusion in the educational context.

Methodology

The methodology used in this research is an exploratory documentary study on current information in the form of mapping the products, processes, or services of Brazilian edtechs.

In this study, we are working with data collected by the Distrito innovation hub from various sources, including apps for the acceleration program, information from the Ventures League, the DisruptBox platform, news from business portals specializing in startups, as well as indications of active searches for new Brazilian startups. Two instruments were used, both produced by Distrito (2019, 2020):

- *The Edtech Report 2019*, covering 434 educational startups and 13 edtechs focused on inclusion and accessibility.
- *The Edtech Report 2020*, covering 559 educational startups and 17 edtechs focused on inclusion and accessibility.

This chapter looks at a total of 18 edtechs mapped across the two reports (12 edtechs appear in both annual reports).

Both reports divide edtechs into seven categories, namely: (1) educational content (books, videos, and others); (2) specific teachings (languages, technology, finance and business, entrepreneurship, soft skills, and others); (3) tools for institutions (management of educational institutions, management of communication in education, technology for the classroom, data analytics for education); (4) focus on the student (study and productivity, preparation for entrance exams and competitions, vocation and career); (5) education financing (student credits, scholarships, crowdfunding); (6) platforms for education (ODL platforms, learning management systems (LMS), classroom and teacher marketplaces, course and class platforms); and (7) new forms of teaching (digital educational institutions, gamification, inclusivity and accessibility, differentiated pedagogy, virtual and augmented reality, corporate training).

What particularly interests us is this last category – new forms of teaching – in which solutions that innovate in their method of teaching are inserted, bringing in cutting-edge technology or methodologies as a way to improve results or access to education, more specifically, those generated by edtechs focused on inclusion and accessibility.

For the analysis of edtechs, which are only mentioned in Distrito's *Edtech Reports*, more detailed research was carried out, which involved establishing the startup's start date, target audience, objectives, resources offered, and innovation bias.

Starting with the start date, the mapping carried out in the *Edtech Reports* for 2019 and 2020 considers both the startup edtechs (scalable, replicable, and innovative companies) and consolidated edtechs that already have a broad spectrum of activity and operating time and use technology to primarily solve sector challenges of education. For this reason, we can trace a timeline from the establishment of Jungle Digital Games in 2007 to the most recent edtechs in 2019, with greater concentration in the years 2016 and 2017, probably because they reached a degree of maturity when the reports were published (Table 1).

As for the objectives, the 18 edtechs were grouped into four categories of interest, as shown in Fig. 1.

It should be noted that, within the largest category analyzed, assistive technologies are aimed at autistic people (ALLtism, LifeUp, Matraquinha, and Neurobrinq), neurodiverse people (Domlexia), people with disabilities (Jungle Digital Games), and people with a visual impairment (LookforMe), hearing impairment (Open Senses, Signa and Surdo para Surdo), or cognitive impairment (Tix).

Technologies aimed at disadvantaged social groups mainly target students and teachers from Brazilian public schools (Ensina Brasil, Quero na Escola! and Spreading) and young people from the Brazilian periphery (New School).

Technologies aimed at education for ethnic and cultural diversity target the black community (AfroPython) and students, employees, teachers, and family members in general (Piraporiando).

Finally, technologies aimed at the elderly are aimed at an audience over 50 years of age.

Table 1 Mapping of Brazilian edtechs focused on inclusion and accessibility by year of creation

Year	Total	Edtechs
2007	1	Jungle Digital Games
2013	2	digitalIdade [digitalAge], LifeUp
2015	2	Quero na Escola! [I Want in School!], Piraporiando
2016	4	Ensina Brasil [Teach Brazil], Signa, Spreading, Surdo para Surdo [Deaf to Deaf]
2017	5	AfroPython, ALLtism, Domlexia, Neurobrinq, NewSchool
2018	1	Matraquinha [Chatterbox]
2019	3	LookforMe, Open Senses, Tix

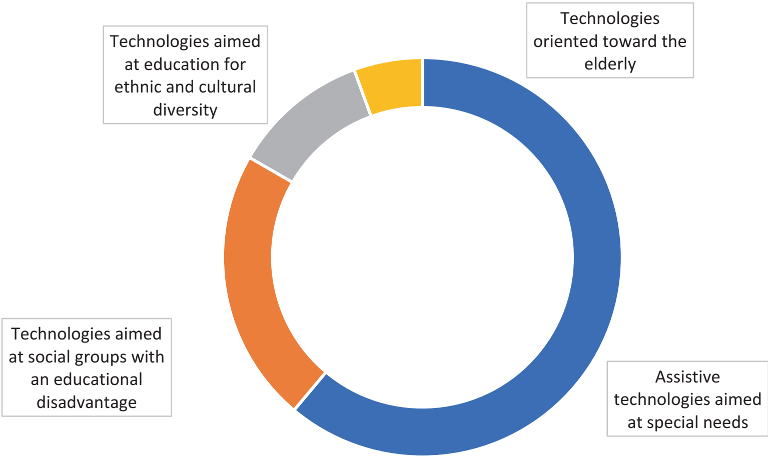


Fig. 1 Mapping of Brazilian edtechs focused on inclusion and accessibility by category of interest

As a general rule, the resources offered by edtechs range from technological solutions (analog and digital) that can be adopted separately to specialized applications and even integrated platforms that bring together several functionalities. Among the resources are forms of training, consulting, events, and marketplaces to meet the needs of interested parties (Table 2).

Final Considerations

The objective of this chapter was to identify and critically address the innovations proposed by Brazilian edtechs in the sense that they effectively support inclusive education with a focus on facilitating and providing quality of life for people with disabilities.

Through this study, it was possible to detect inclusive proposals with an appreciation of learning processes, opening them up to a constant exercise of renewal and improvements, which are mainly down to more recent experiences due to remote teaching in the pandemic period.

It appears that the trajectories of current Brazilian edtechs aim to reach a level that goes beyond innovation when, among different projects, they can support inclusive initiatives. This concerns an orientation toward cultural change that embraces the inclusive cause in the ways of educating and supporting individuals throughout adult life, as well as promoting citizenship.

The point is to align an interactive movement between technologies to foster positive impacts in the educational and social spheres. In this way, products and services must be appropriate and related to the specificities of the various forms of

Table 2 Brief description of the Brazilian edtechs focused on inclusion and accessibility

Edtech	Year of creation	Target audience	Goal	Resources
AfroPython	2017	Black community	To increase the representation of black people within the area of information technology	Events, videos, podcasts
ALLtism	2017	Parents and educators of autistic children	To assist parents and professionals in the treatment of autistic children	Platform
digitalIdade	2013	50+ or 60+ adult audience	To empower maturity in the face of technological advances and enhance the experiences acquired throughout life with new skills and abilities in technologies	Technical support, personalized mentoring, online lectures
Domlexia	2017	Neurodiverse people, families, educators, and therapists of people with dyslexia, dysgraphia, dyscalculia, and ADHD[a]	To generate knowledge in the community, train therapists and educators on learning differently, and facilitate neurodiverse learning	Online community, tests, games, materials, talk groups, chatbot, online training for educators and therapists
Ensina Brazil	2016	Graduates with a degree recognized by the Ministry of Education	To develop leaders for the transformation of education, starting with the classroom	Recruitment and selection services, intensive training, global aluminum network
Jungle Digital Games	2007	Elementary school students	To adapt pedagogical content for people with disabilities	Games and digital learning objects
LifeUp	2013	Parents, doctors, educators who treat autism, and companies offering supported employment	To provide social actions that contribute to a better quality of life, serving diverse groups and offering a disruptive, interactive, and incremental education	CanGame: a set of tools that allow autistic people to carry out everyday activities and communication, promoting greater social autonomy

(continued)

Table 2 (continued)

Edtech	Year of creation	Target audience	Goal	Resources
LookforMe	2019	Visually impaired people in the classroom, particularly mathematics	To develop technological solutions to promote inclusive education for people with visual, hearing, motor, and cognitive impairments	An application that captures audio, transcribes to a smartphone to be interpreted, solved and shared
Matraquinha	2018	Children and teenagers with autism	To help children and adolescents with autism to convey their desires, emotions, and needs	An alternative communication app to help autistic people convey their wants, emotions, and needs
Neurobrinq	2017	Autism therapy clinics and inclusion schools, autistic children from 2 years of age	To offer the market a platform for the integration of various technologies and devices to optimize time and increase the quality of resources in the services offered in the education and health sectors	A stimulation center that implements, integrates, and optimizes different types of therapies and treatments through a bubble column, illuminated ball pool, wind simulator, star projector, sensory panel, rain simulator and human piano, among others
NewSchool	2017	Young people from the Brazilian periphery	To create playful and practical learning experiences	Technology and content curation based on the skills of the future
OpenSenses	2019	Hearing-impaired people, content providers	To democratize information generated that was not initially thought of in an inclusive way	LIBRAS window, captions for the deaf, simultaneous audio description in face-to-face events, BeaconSenses[b], a fully accessible EAD platform, and accessibility consulting
Piraporiando	2015	Students, employees, teachers, and their families	To foster diversity in favor of an anti-racist, anti-bullying, and non-prejudiced education	Books, kits, literary theater, healthy eating
Quero na Escola!	2015	Adolescents and teachers from public schools	To listen to students' demands for learning beyond the required curriculum and connect volunteers to fulfill requests within public schools	Workshops (crafts, photography, ceramics, storytelling, and lectures on machismo and racism)

(continued)

Table 2 (continued)

Edtech	Year of creation	Target audience	Goal	Resources
Signa	2016	Deaf people	To train and prepare deaf people for the job market, offering them opportunities to learn content of interest	An adapted online platform and didactically produced courses in Libras and with subtitles
Spreading	2016	Volunteers, public schools, NGOs	To connect volunteers willing to donate a part of their time to bring knowledge to public school students	A tool for registering volunteers and institutions with *match* and evaluation resources
Surdo para Surdo	2016	Deaf students	To offer an online teaching platform in Libras and access to education in sign language with the best tutors for the deaf	An adaptive learning app with bilingual games in Libras and Portuguese to reinforce learning in addition to private lessons with tutors for the deaf, customized to the needs of each student
Tix	2019	Public schools, Departments of Education, entities of the educational segment linked to the public power, liberal professionals, APAEs[c], private schools, and private institutions	To offer resources to develop autonomy and improve communication and students' ability to use a computer	An application to serve students with cognitive deficits and disorders of various natures

[a]Attention deficit hyperactivity disorder
[b]A Bluetooth device of approximately 4 cm that can be attached to walls, ceilings, furniture, or wherever is suitable to issue programmed signals and trigger information allocated on a cloud computing platform to guide and inform disabled users about routes within establishments, descriptions of artistic or historical works, customized advertising, and student information. It can also be turned into a presence sensor
[c]Associação de Pais e Amigos dos Excepcionais (Association of Parents and Friends of Exceptional Children)

inclusion, such as assistance, which is also subdivided according to the specific needs of human disabilities: autism, deafness, and visual impairment, among others.

Therefore, this mapping of Brazilian edtechs, with their educational products and services, points to a necessary and urgent path that must find a way of interacting between cutting-edge technologies and the current demands of inclusion in a diverse world. This promotes advancements in the different layers of the social fabric to guarantee a better quality of life for more people.

References

Alves, M. A. B., & Sartori, V. (2021). Edtechs: startups que estão transformando a educação brasileira. *Anais do V Encontro Internacional de Gestão, Desenvolvimento e Inovação (EIGEDIN), 5*(1). https://periodicos.ufms.br/index.php/EIGEDIN/article/view/13950

Bersch, R., & Tonolli, J. C. (2006). *Tecnologia Assistiva.* http://www.assistiva.com.br/

Corrêa, L., Ferreira, K., & Taniguti, G. (2021, December 20). *O uso de tecnologias digitais na educação básica e o debate sobre inclusão*. Nexo Jornal: Políticas Públicas. https://pp.nexojornal.com.br/opiniao/2021/O-uso-de-tecnologias-digitais-na-educa%C3%A7%C3%A3o-b%C3%A1sica-e-o-debate-sobre-inclus%C3%A3o

Crespo, A. M. M. (2011). Pessoas deficientes, invisibilidade, saber e poter. *Anais do XXVI Simpósio Nacional de História* (*ANPUH).* http://www.snh2011.anpuh.org/resources/anais/14/1298916664_ARQUIVO_ARQUIVO112.PESSOASDEFICIENTES,INVISIBILIDADE,SABEREPODER.pdf

Distrito. (2019). *Edtech Report 2019*. Distrito.

Distrito. (2020). *Edtech Report 2020*. Distrito.

Filatro, A., & Loureiro, A. C. (2021). *Novos produtos e serviços na Educação 5.0*. Artesanato Educational.

Galvão Filho, T. A. (2009). A Tecnologia Assistiva: de que se trata? In G. J. C. Machado & M. N. Sobral (Eds.), *Conexões: educação, comunicação, inclusão e interculturalidade* (pp. 207–235). Redes Editora.

Jesus, P., & Azevedo, J. (2021). Inovação educacional. O que é? Porquê? Onde? Como? *Revista Portuguesa de Investigação Educacional, 20*, 21–55. https://revistas.ucp.pt/index.php/investigacaoeducacional/article/view/9683

Lexico. (n.d.-a). Inclusion. *Lexico.com*. Retrieved May 10, 2022, from https://www.lexico.com/en/definition/inclusion

Lexico. (n.d.-b). Accessibility. *Lexico.com*. Retrieved May 10, 2022, from https://www.lexico.com/en/definition/accessibility

Medeiros, A. M., & Medeiros, M. F. (2017). Educação e tecnologia: explorando o universo das plataformas digitais e Startups na área de educação. In *Congresso Nacional de Educação 5: Anais eletrônicos do V CONEDU, Maringá-PR* (pp. 1–12). https://editorarealize.com.br/edicao/detalhes/anais-v-conedu

Omote, S. (2018). Atitudes Sociais em Relação à Inclusão: Recentes Avanços em Pesquisa. *Revista Brasileira de Educação Especial, 24*, 21–32.

Radabaugh, M. P. (1993). *Study on the financing of assistive technology devices and services for individuals with disabilities*. https://ncd.gov/publications/1993/mar41993

Schaller, L. (n.d.). *The ADA: Paving the way for assistive technology.* https://www.nationaldisabilityinstitute.org/blog/the-ada-paving-the-way-for-assistive-technology/

Silva, R. C. (2018). *Cultura de Inovação no campo educacional – uma análise do processo de criação e desenvolvimento de uma Startup EdTech* (Master's dissertation). Federal University of Pernambuco.

Tavares, F. G. O. (2019). O conceito de inovação em educação: uma revisão necessária. *Educação, 44*, 1–17. https://www.redalyc.org/journal/1171/117158942006/

Taylor, J., & Mote, K. (2021, March 21). *Getting started with accessibility and inclusion*. https://www.jisc.ac.uk/guides/getting-started-with-accessibility-and-inclusion

A Step Further in Digital Divide: Information and Strategic Skills of the Academy

Nur Samancioglu, Silvia Nuere, Laura de Miguel Álvarez, and Esperanza Macarena Ruiz Gómez

Introduction

This research looks at the issues of the educational perspective of the digital divide, specifically focusing on skills and competency of academics. It takes the skills and competency discourse and examines them with empirical data collected from academics. Considering the COVID-19 pandemic, it is discussed how the use of academics on education-related digital tools has changed and whether this change has narrowed the digital gap.

First, the research explained background information on the digital divide concept and different levels of digital divide. Second, the method of the survey is defined. Third, the demographic data: the academic's use or capability of education-related digital tools before and after the COVID-19 pandemic and the method of adoption of information and communication technology (ICT) tools are explained. Then, the findings of the students' parallel surveys were presented. The discussion and conclusion part will draw a summary of whether this process has provided solutions to the digital divide by narrowing the gap in information and strategic skills.

N. Samancioglu (✉) · S. Nuere
Universidad Politécnica de Madrid, Madrid, Spain
e-mail: nur.samancioglu@alumnos.upm.es; silvia.nuere@upm.es

L. de Miguel Álvarez
Universidad Internacional de la Rioja, La Rioja, Spain
e-mail: laura.demiguel@unir.net

E. M. R. Gómez
Universidad Complutense de Madrid, Madrid, Spain
e-mail: emruiz@pdi.ucm.es

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_13

Background

The digital divide emerged in the second half of the 1990s as a result of unequal access to and use of new media. The term “digital divide” was first used to refer to the inequality in access to new forms of information and communication technology (ICT) between those who have it and those who do not (Hoffman et al., 2006; Soomro et al., 2020). Computers and networks are the most typical examples, although other technological tools are all covered.

The term “digital divide” become popularized around the turn of the century, and it quickly was among the most important problems on the scientific and political agendas. Between 2000 and 2004, many conferences and sessions examined this issue under the name of the digital divide. The rapid rise in access to computers, the Internet, and other technological tools, particularly in developed and high-income countries, has led to the conclusion that the problem has almost been solved (van Dijk, 2006). Later, the “first-level digital divide” was created to explain this access difference (Yu, 2006; Lythreatis et al., 2022; Wei et al., 2011). The digital divide is then interpreted based on characteristics such as accessibility to compelling content, Internet connection reliability, and online users’ skills and abilities. This is considered a “second-level digital gap” that refers to a shift in the notion to focus on digital skills and competency (Hargittai, 2002; Mossberger et al., 2004; van Dijk & Hacker, 2003). van Dijk and Hacker (2003), van Dijk (2005) and Gunkel (2003) later emphasized a number of the metaphor’s drawbacks. They acknowledged that solely having access to and using technology would not simply lead to all its benefits (van Dijk & Hacker, 2003; van Dijk, 2005; Selwyn, 2004). Disparities in how individuals use technology can have a big impact on the outcome. The “third-level digital divide” represents a shift in emphasis from skills and Internet use to the positive outcomes of Internet use (Wei et al., 2011).

Van Dijk (2006) listed ten potential inequalities under five categories: technological, immaterial, material, social, and educational. The inequalities we accept are exacerbated by infrastructure, since this issue may continue to be a significant problem for developing or underdeveloped countries. The digital divide study also shows physical access, social norms, and educational inequalities. Once the intention to use and physical access to computers has been established, the problem of a lack of skills may arise. Terms like “computer, information, or multimedia literacy,” “computer skills,” and “knowledge capital” are used to describe this issue (van Dijk, 2006).

The concept of “digital skills” was defined by Steyaert (2000) and van Dijk and Spoorenberg (1999), van Dijk and Hacker (2003), van Dijk (2005), and van Dijk (2006) as the complementarity of three categories of abilities. The most fundamental is known as “instrumental skills” (Steyaert) or “operational skills” (van Dijk), which are the abilities to operate with hardware and software. The most widely held belief is that once a skill is learned, it is no longer a problem. Steyaert also explains two other skills: structural and strategic skills. Structural skills refer to the ability to use hypertext (looking to other information sources via key phrases) or looking for real-time information. Strategic skills can be explained as a basic willingness to search for information, the attitude of concluding based on existing data, and continuous scanning. Van Dijk suggests two skills: “information skills” and “strategic skills.” The capacity to search, select, and process information in computer and network resources is referred to as information skills. Strategic skills are described as the ability to use network and computer resources as instruments for specific reasons.

The prevailing consensus in skills research is those skill access disparities are larger than physical access disparities. In developed countries, the skills gap (particularly knowledge skills) tends to widen, whereas physical access gaps tend to narrow (Deursen & Van Dijk, 2011; van Dijk, 2006). Another noteworthy finding of the digital skills study is that people learn these abilities more in practice (trial and error), rather than in formal educational settings (de Haan & Huysmans, 2002 as cited in van Dijk, 2006). However, due to the unequal distribution of ICT use and their implications, these abilities are not developed (or gapped) equally across all population groups. Elderly people are deemed to have intermediate digital skills, since they were not raised in an Internet age, but acquired basic abilities throughout their professional lives (Hämmerle et al., 2022). According to a 2020 report, the median age for tenure track academics is 49. Similarly, faculty members (37%) are over aged 55 (McChesney & Bichsel, 2020). Given the average age of academics, formal educational settings may effectively promote their ongoing development of digital skills as well.

As the world struggled with the COVID-19 pandemic, significant inequities in society were brought to the forefront (Bapuji et al., 2020). Education institutes were similarly affected by the crisis (Sun et al., 2022). Colleges and universities around the world were obliged to suspend face-to-face teaching activities such as classroom teaching, research activities, laboratories, and other learning experiences and replaced by emergency remote teaching and learning through ICT technologies (Samancioglu et al., 2021). To compensate for the shift in the teaching and learning paradigm, academia has made great efforts. Some scholars accepted that this abrupt change in teaching methods and modalities has had a negative impact on the quality of teaching and learning, as many individuals and programs have had to rapidly adapt to the use of ICT (Hassell et al., 2021; Shackleton & Mann, 2021). Academics and students strived to adjust to the new scenario at different levels such as basic access to technological devices, digital skills, and competencies, and finally outcomes of Internet use. This demonstrates that inequality still exists at different levels (Cheshmehzangi et al., 2021). This effort, on the other hand, will result in a more permanent shift toward the use of these possibly more efficient digital teaching and learning approaches. This might represent a significant step toward closing the gap on the second level of the digital divide.

Methods

An online survey was conducted to assess the information and strategic skills of academics of universities before and after COVID-19. A parallel survey was conducted on students, using the same method, and the results were compared to those of academics. The surveys are distributed through university emails, and the dates of data collection are from April 4 to May 6. Although the results of the research weighted on Universidad Politécnica de Madrid, academics from Universidad Complutense de Madrid, Universidad Rey Juan Carlos, Universidad Internacional de La Rioja, and other universities participated in this research. The questions were divided into two categories: open-ended and closed-ended. The questions in which they share information about their personal experiences, specifically open-ended, shed light on their academics' insights on the subject.

The key topics are information and strategic skills, and the questions cover the following issues:

1. Search/ select and process the information
2. Graphical presentation (slides, presentations, Microsoft PowerPoint presentations with or without voice-over)
3. Record screens and videos while using a different tool
4. Zoom or similar collaborative tools
5. Web conferencing tool (with and without interactive participation)
6. Live chats (individually or course-wide)
7. Email communication, forums, and discussion boards (written)
8. The method of their progress (formal, practice, trial, and error, or other)
9. The anticipated results of education-related digital tools on the teaching and learning environment in the long term

The names of the respondents were requested while gathering demographic data in the survey. The primary purpose for this is to ensure that the survey findings accurately reflect the academic community. However, it was emphasized that the respondents' confidentiality or anonymity would be protected. Furthermore, the results were solely used for academic purposes, and the raw data will be erased after the findings of this study are published.

Results

In total, 94 individuals responded to the surveys. There are 45 academics and 49 students among them. Academics are typically from technical universities' engineering faculties. Students, on the other hand, are predominantly enrolled in engineering and industrial design faculties. For both parties, the questions are parallel. First, the answers of academics were examined, followed by the responses of students. As a result, this will assist in understanding similarities and differences in their experiences during this period.

Academics are affiliated with the following universities (Table 1): 29 from the Universidad Politécnica de Madrid (UPM), 6 from the Universidad Complutense de Madrid (UCM), 2 from the Universidad Rey Juan Carlos (URJC), 2 from the Universidad Internacional de La Rioja (UNIR), and 6 from other universities. Academic positions include 25 professors, 11 assistant professors, 5 associate professors, and 4 other academic roles. The female and male genders are almost balanced. The weighted average age ranges from 42 to 57 years old (X generation). There are 11 academics between the ages of 22 and 42 (millennials), and 9 academics between the ages of 58 and 67 (boomers).

The survey results revealed a significant change in academic respondents' use of ICT tools from rarely/never to often/always (Figs. 1 and 2). The use of record screens and videos while using a different tool is on the rise after the COVID-19 pandemic. There is a shift from never/rarely to often/always, in particular. Written communication, such as email, forums, and discussion boards, is comparable before and after a pandemic. The use of these tools has increased slightly. Despite the fact that live chats (individually or in groups) were nearly never used, it has become the most common tool among academics. The transformation was highlighted by the adoption of collaborative platforms. There was also a significant inclination for collaboration tools such as Zoom, Microsoft Teams, and Google Meet after COVID-19. The graphical presentation remained consistent. The primary use of ICT technology which is "search, select, and process" is slightly inclined. While there is no significant improvement in information skills (due to the fact that they already have high results), the advances in strategic skills are noteworthy.

According to the data, there has been a considerable increase in the usage of ICT by academics. Another research question is what method the academics employed to meet current requirements (Fig. 3). It must be conceded that a quick transformation occurred, and universities struggled to adjust. However, as seen in Fig. 3, this process has included both formal educational settings and "practice, trial, and error." Furthermore, open-ended responses revealed that YouTube has become another tool used for the adaptation of this process.

Finally, academics were asked open-ended inquiries about the long-term impact of education-related digital tools on teaching and learning environments (Fig. 4). The majority of academics (70%) are in favor of the issue, with only 9% opposed.

Table 1 Demographics (academics)

University	№	Role	№	Gender	№	Age	№
UPM	29	Professor	25	Female	23	22–42	11
UCM	6	Assistant professor	11	Male	21	42–57	25
URJC	2	Associate professor	5			58–67	9
UNIR	2						
Other	6	Other	4	Other	1	Other	0

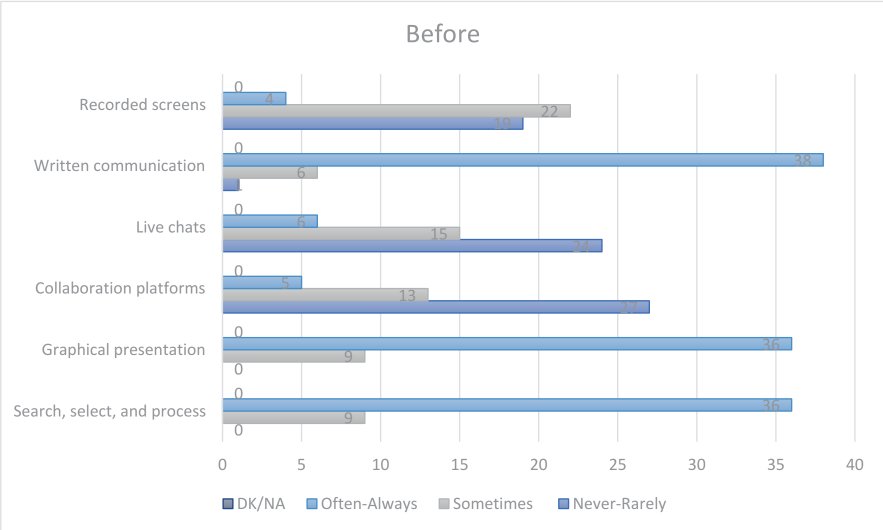


Fig. 1 The frequency of using ICT before COVID-19 by academics

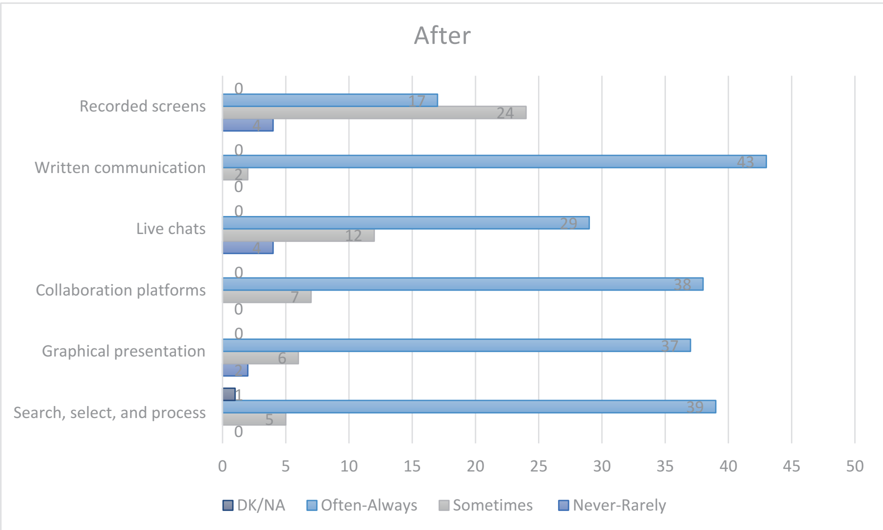


Fig. 2 The frequency of using ICT after COVID-19 by academics

According to 21% of participants, blended education will be effective in the long term.

The following are some positive ideas of academics:

- Greater range of communication possibilities with the student
- Agility in communications

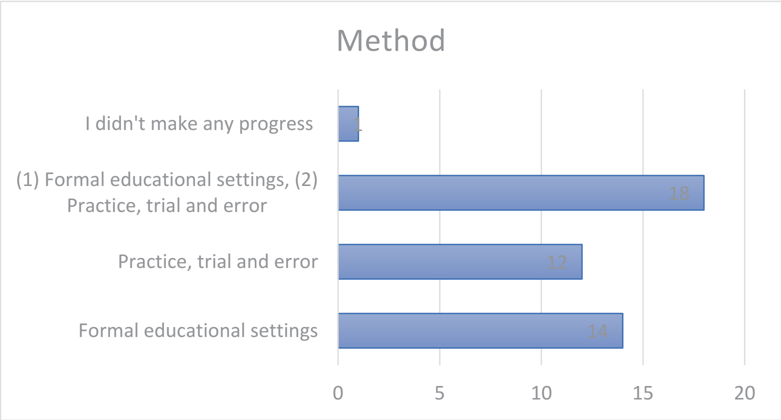
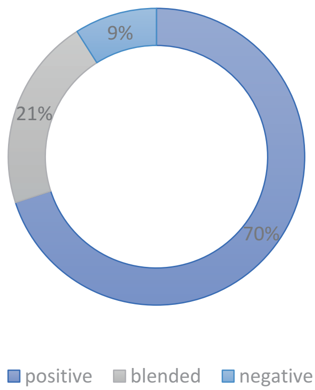


Fig. 3 Method of ICT adoption (academics)

Fig. 4 The long-term impact of education-related ICT tools (academics)



- Updated content, interactivity, and the possibility of using various resources
- Ability to use interactive materials on pre-existing educational platforms frequently (e.g., Moodle)
- Efficiency in meetings
- Versatility, tutorials adapted to the schedule
- Accessibility for people with visual disabilities

Ideas from academics in support of blended education:

- Support tools in teaching and learning
- Having both (blended) makes the training more dynamic, available to more people, and good for refreshing knowledge

The following are some negative ideas of academics:

- Losing part of the learning process along the way, such as comprehension, concentration, abstract reasoning, and critical thinking, among others.

- Education via ICT is not replacing the effectiveness and does not improve student concentration.

The student survey was completed by 49 respondents (Table 2); 39 of them are from UPM, 9 from UCM, and 2 from other universities. The gender ratio is 36 females and 13 males. The students are all between the ages of 22 and 42 and thus represent the millennial generation.

When the behavior patterns of students in this process are analyzed, the use of ICT tools increased in the post-pandemic period (Figs. 5 and 6). There is a shift from never/rarely to often/always, especially when using recorded screens, live chats, and collaboration platforms. There is also a minor increase in the usage of written communication and graphical presentation. The increase in the "search, select, and process" is less than in previous subjects.

With 24 responses, the emphasis in the ICT adoption method is on "practice, trial, and error." Seven students voted for formal educational settings and 9 students who indicate they used both methods. Furthermore, 9 participants stated that they had made no progress (Fig. 7).

Table 2 Demographics (students)

University	№	Gender	№	Age	№
UPM	38	Female	36	22–42	49
UCM	9	Male	13		
Other	2	Other	0	Other	0

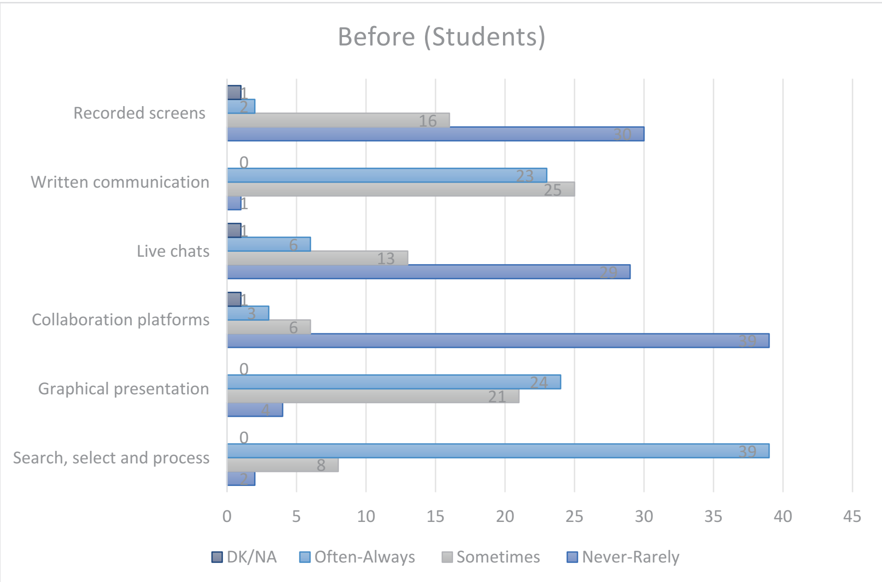


Fig. 5 The frequency of using ICT before COVID-19 by students

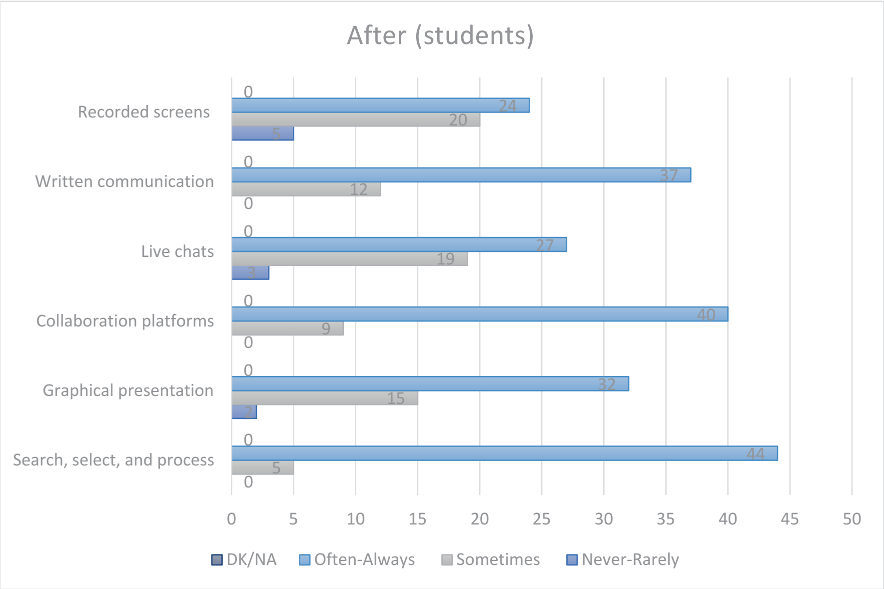


Fig. 6 The frequency of using ICT after COVID-19 by students

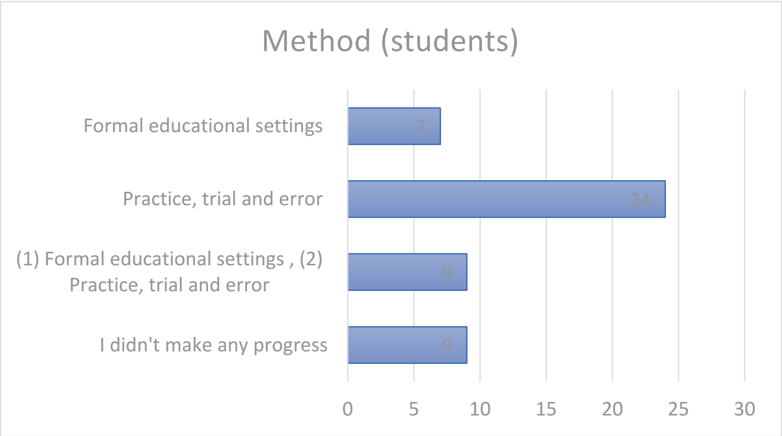


Fig. 7 Method of ICT adoption (students)

Discussion

The goal of this chapter is to elaborate on the importance of addressing the digital divide in education, particularly during the COVID-19 pandemic. COVID-19 has swiftly revolutionized the world and is redefining how teaching and learning activities happen all around the world (Liu, 2021). For many academics, this has meant a quick introduction and shift to ICT tools. There is an additional notion that reduces the quality and effectiveness of education and training as can be expected with such a radical shift in methods. Although the number of academics who stated this was low compared to those who supported that positive results were obtained, this concern was still expressed in open-ended questions. In particular, the subject of low level of students' concentration, which has been addressed a few times, should be underlined. The visual separation between professors and students can result in less immediate feedback and, as a result, a lack of tone, pace, or material alterations by the academic. This may help to explain why learners get disinterested and distracted (Hassell et al., 2021).

The majority of the digital divide study is built on quantitative data collection and attempts to present the big picture of the situation. Although this generates a significant number of correlations, it is also critical to bring forward the insight of the associated group (van Dijk, 2006). As an outcome, this research was a beneficial study in presenting academics' experiences and different viewpoints on the topic of education-related ICT tools. On the other hand, the research has limitations for instance, the sample size. The research participants were limited, to lessen the possibility of receiving multiple answers from a single person, and/or to avoid including non-academic people in the study. The questionnaire was completed after return to face-to-face education, allowing respondents to review all the experiences in the process without bias.

Even when social distancing constraints restrict face-to-face instruction individually and in groups, dedication to the educational objective appears to have not diminished (Hassell et al., 2021). The challenge necessitates a thorough evaluation of the effectiveness of ICT-based teaching and learning methods. Academics should obtain training sessions to completely master and maximize the utilization of these tools. It must be acknowledged that ICT has become an instrument for education and will continue to be in the future. As a result, even if it is only used as a supplement, it can be utilized for a variety of uses.

The study mainly focuses on academic's use ICT and the impact of COVID-19 on this process. Identifying the pattern of student's ICT use, on the other hand, provides supplemental information. To begin, because students are the foundation of education and training, their behavioral pattern has a direct impact on future instructional strategies. Another critical issue highlights the influence of the COVID-19 pandemic on students and the second-level digital divide. According to this research, students are more familiar with ICT; they essentially develop these skills on their own, and finally resulting in a minor reduction of the second-level digital divide. Additionally, this research enables to compare the ICT adoption process of academics and students. It is observed that skill development exists in both parties as a natural consequence of utilizing ICT tools. However, academic's development surpasses that of students', and as a result, the second-level digital divide is narrowing more between academics. The primary reason for this difference most likely is based on a difference in the age range.

Conclusion

Because of the recent COVID-19 pandemic, educational institutions had to adopt ICT in a quick and effective manner. Educators rapidly adjusted to the circumstances and shifted to emergency remote teaching methods. Academics encountered a variety of obstacles throughout this rapid transition. Therefore, a survey on educators' use or capability to utilize education-related digital tools before and after the COVID-19 pandemic was conducted. The open-ended and closed-ended results revealed that the academics' information and strategic skills have improved. Undoubtedly, this rapid transition period is not an ideal situation, but the anticipated improvement over the years occurred just within a few months thanks to the dedication of academics to educational objectives. As a result, the COVID-19 pandemic has played a key role in narrowing the information and strategic skills gap of academics.

Another crucial question is whether the main strategy they adopted in this adaptation process was personal learning or formal education. Throughout this period, academics demonstrated this development using both educational settings and "practice, trial, and error" methods. Given open-ended responses, academics indicate that education-related ICT tools will have a positive long-term influence and increase accessibility.

Another subject examined in this study is the behavior patterns of the students in this process and the similarities and differences with the academics. The development of naturally derived skills from the use of ICT was also observed in students. This progress, however, is far greater in academics than in students. Therefore, reducing the second-level digital divide of academics also helped to bridge the gap between how often students and academics use technological devices. In this respect, academics' greater use of ICT allows them to expand learning outside of the classroom and provide valuable learning resources to students.

It is apparent that ICT is one of the key answers of inclusive education and three level of digital divide should be eliminated for a completely accessible education. However, academics' activities have a major impact on how inclusion objectives are applied in practice. The most significant benefit of this period is that academic staff improve the quality and inclusion of their teaching based on practices and experiences observed at the beginning of the pandemic. The academics' goal was to correctly adjust the methodology in order to improve student participation and establish a more inclusive learning environment.

Educators encountered various challenges throughout this period of rapid transition. Even if face-to-face education is used, this process has offered educators to new teaching skills. In brief, through narrowing the information and strategic skills gap, the COVID-19 pandemic contributed to closing the second level of digital divide of academics, and this was a significant step forward in the direction of inclusive digital education.

References

Bapuji, H., Patel, C., Ertug, G., & Allen, D. G. (2020). Corona crisis and inequality: Why management research needs a societal turn. *Journal of Management, 46*(7), 1205–1222. https://doi.org/10.1177/0149206320925881

Cheshmehzangi, A., Tang, T., Su, Z., & Zou, T. (2021). Covid-19 and the growing digital divide in education. *OECD Podcasts*. https://doi.org/10.1787/c2609404-en

de Haan, J., & Huysmans, F. (2002). *Van huis uit digitaal: Verwerving van digitale vaardigheden tussen thuismilieu en school* [Raised digital: The acquisition of digital skills between home and school environment]. Sociaal en Cultureel Planbureau.

Deursen, A., & Van Dijk, J. (2011). Internet skills and the digital divide. *New Media & Society, 13*, 893–911. https://doi.org/10.1177/1461444810386774

Gunkel, D. (2003). Second thoughts: Toward a critique of the digital divide. *New Media & Society, 5*(4), 499–522.

Hämmerle, V., Reiner, J., Ruf, E., Lehmann, S., & Misoch, S. (2022). Beyond the digital divide: Digital skills and training needs of persons 50+. In *Proceedings of the 8th international conference on information and communication technologies for ageing well and e-health*. https://doi.org/10.5220/0011068200003188

Hargittai, E. (2002). Second-level digital divide: Differences in people's online skills. *First Monday, 7*(4). https://doi.org/10.5210/fm.v7i4.942

Hassell, L. A., Peterson, J. E., & Pantanowitz, L. (2021). Pushed across the digital divide: Covid-19 accelerated pathology training onto a new digital learning curve. *Academic Pathology, 8*, 2374289521994240. https://doi.org/10.1177/2374289521994240

Hoffman, D. L., Novak, T. P., & Schlosser, A. (2006). The evolution of the digital divide: How gaps in internet access may impact electronic commerce. *Journal of Computer-Mediated Communication, 5*(3). https://doi.org/10.1111/j.1083-6101.2000.tb00341.x

Liu, J. (2021). Bridging digital divide amidst educational change for socially inclusive learning during the COVID-19 pandemic. *SAGE Open, 11*(4), 215824402110608. https://doi.org/10.1177/21582440211060810

Lythreatis, S., Singh, S. K., & El-Kassar, A.-N. (2022). The digital divide: A review and future research agenda. *Technological Forecasting and Social Change, 175*, 121359. https://doi.org/10.1016/j.techfore.2021.121359

McChesney, J., & Bichsel, J. (2020). *The aging of tenure-track faculty in higher education: Implications for succession and diversity* (Research Report). CUPA-HR. https://www.cupahr.org/surveys/research-briefs

Mossberger, K., Tolbert, C. J., & Stansbury, M. (2004). Virtual inequality: Beyond the digital divide. *The Library Quarterly, 74*(2), 217–220. https://doi.org/10.1086/382851, Georgetown University Press.

Samancioglu, N., Nuere, S., Suz, A. A., & Olalla, F. S. (2021). The role of IoT in migration to emergency remote teaching during the confinement of COVID-19. In L. Daniela (Ed.), *The internet of things for education*. Springer. https://doi.org/10.1007/978-3-030-85720-2_3

Selwyn, N. (2004). Reconsidering political and popular understandings of the digital divide. *New Media & Society, 6*(3), 341–362. https://doi.org/10.1177/1461444804042519

Shackleton, L., & Mann, R. (2021). Covid-19 and the digital divide in Higher Education: A commonwealth perspective. In *Libraries, digital information, and COVID* (pp. 149–158). https://doi.org/10.1016/b978-0-323-88493-8.00015-x

Soomro, K. A., Kale, U., Curtis, R., Akcaoglu, M., & Bernstein, M. (2020). Digital divide among higher education faculty. *International Journal of Educational Technology in Higher Education, 17*(1). https://doi.org/10.1186/s41239-020-00191-5

Steyaert, J. (2000). *Digital skills, literacy in the information society*. Rathenau Instituut.

Sun, M., Mao, Y., Hua, W., Chen, Y., Li, L., & Xiong, L. (2022). Digital divide in online education during the COVID-19 pandemic. *Frontiers in Public Health*, 103–112. https://doi.org/10.3389/fpubh.2021.796210 van Dijk, J. (2005). *The deepening divide: Inequality in the information society*. https://doi.org/10.4135/9781452229812

van Dijk, J. A. G. M. (2006). Digital divide research, achievements and shortcomings. *Poetics, 34*(4–5), 221–235. https://doi.org/10.1016/j.poetic.2006.05.004

van Dijk, J. A. G. M., & Spoorenberg, L. (1999). *The network society: Social aspects of new media*. Sage Publications.

van Dijk, J., & Hacker, K. (2003). The digital divide as a complex and dynamic phenomenon. *The Information Society, 19*(4), 315–326. https://doi.org/10.1080/01972240309487

Wei, K.-K., Teo, H.-H., Chan, H. C., & Tan, B. C. (2011). Conceptualizing and testing a social cognitive model of the digital divide. *Information Systems Research, 22*(1), 170–187. https://doi.org/10.1287/isre.1090.0273

Yu, L. (2006). Understanding information inequality: Making sense of the literature of the information and digital divides. *Journal of Librarianship and Information Science, 38*(4), 229–252. https://doi.org/10.1177/0961000606070600

Towards an Inclusive Digital Learning Environment in Higher Education: Opportunities and Limitations Gleaned from Working Students' Remote Learning Experiences During COVID-19

Dita Nīmante, Daiga Kalniņa, and Sanita Baranova

Introduction

One of the United Nations' sustainable development goals is "quality education," which aims to ensure equal access to all levels of education for all (United Nations, 2020). The use of information and communication technologies (ICT) in education has increased enormously at all levels of education in the last couple of years, ensuring wider education accessibility for all. University staff and students benefit greatly from using ICT in the teaching and learning process. Online education in higher education has proven to be a path to making higher education more accessible for all students. The successful use of technologies opened up the opportunity to study for many more disadvantaged groups of students than before, for example, students with refugee experience (Halkic & Arnold, 2019).

During the COVID-19 pandemic, the global shift to remote learning by all higher education institutions opened more opportunities for higher education students in the digital and remote online learning process than had been considered before. Despite some predictions, students saw more opportunities than barriers (Kalniņa et al., In press) in the remote simultaneous learning process. The remote study process helped them to combine their study, work, and home responsibilities.

Various studies conducted during COVID-19 have examined the experiences of the remote online learning processes in higher education. Particularly in Latvia, the research has explored such processes, barriers, and opportunities in higher education from students' perspectives (Baranova et al., 2021; Lāma & Lāma, 2020; Nimante, 2021). This chapter aims to carry on such research and to study whether the online remote learning process during COVID-19 provided benefits and ensured

D. Nīmante · D. Kalniņa · S. Baranova (✉)
University of Latvia, Rīga, Latvia
e-mail: sanita.baranova@lu.lv

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_14

higher accessibility for those students who combined working and studying, thus ensuring a more inclusive learning environment for all students. Therefore, the questions posed in this chapter are the following:

- Were there any differences between the three groups of students (students working part-time, students working full-time, and full-time students) in the digital online remote learning process during COVID-19?
- Were there any differences between different groups of students in accessing digital learning environments?
- Were there any differences between different groups of students in overcoming difficulties during the remote online learning?

Theoretical Background

Digital learning environments in higher education are an important scientific research topic. The potential of digital technologies to enhance student learning has been acknowledged and discussed for a long time. There are many benefits to them, including equity of access and diversity, ensuring inclusive higher education practices, and providing support and educational opportunities for all learners (Kümmel et al., 2020).

In addition to diverse needs such as disability, gender, and ethnic/cultural/migration background, European universities pay significant attention to diverse areas such as students' socio-economic background, caring responsibilities, and educational background (alternative pathways, lifelong learners) (Claeys-Kulik et al., 2019).

Nowadays, there are many students in higher education who work at least part-time. Students spend less time studying and more time working (Nonis & Hudson, 2006). Comparable statistics of work and study in the 23 countries/regions participating in the 2012 Survey of Adult Skills (PIAAC) show that, on average, 39% of students work across these countries, an incidence that ranges from about 15% in Italy to over 60% in the Netherlands (OECD, n.d.). In 2020, 18.4% of people aged between 15 and 24 years in the EU were in education and employed at the same time (Eurostat, 2021).

In recent years, there has been a general increase in the employment of students in Latvia: 62% of college students, 50% of bachelor's students, and 83% of Master's students have a paid job during the semester. Between 2009 and 2017, the share of students in paid employment increased from 45% to 61% (Koroļeva et al., 2017).

In the theoretical literature, we can find many different reasons why students work. For some students, it is important to support their families, earn extra money, increase their disposable income, or save up for the benefit of a future career (Masevičiūtė et al., 2018). There is also a widely supported view that combining work and study helps young people develop the skills needed in today's job market and make smooth and shorter transitions from higher education institutions to work (Billett et al., 2018; Quintini, 2015; OECD, n.d.). Students obtain valuable knowledge and skills by working while studying (Schoffstall & Arendt, 2014), and it can have positive effects on labor market insertion, especially if the experience of work while at university is related to the student's studies (Sanchez-Gelabert et al., 2017).

The Bologna Process has contributed to redefining the concept of employability in higher education policies. The countries of the Bologna Process are characterized by a higher education professionalization movement, developing various internship opportunities in the study process (Bonnard, 2020) or even work-based higher education (Graf, 2017). Although employability in the Bologna Process applies to graduates, it encourages the employment of students. The early employability of students is becoming more and more important in the context of demographic and socio-economic change in society too as labor shortages are promoting student employment on a global scale through early entry into the labor market.

At the same time, the literature argues that employment can affect the quality of education (Metcalf, 2003). For example, working and studying can harm marks (Triventi, 2014), and students may miss classes and postpone their study work. Research conducted in the USA finds no evidence that students' grades harm marginal work hours, but students working full-time complete fewer credits per term when increasing work (Darolia, 2014). Another research work indicates that academic progression is negatively affected not only by high-intensity workers but also by the low-intensity work experience (Triventi, 2014). It has direct and significant effects on two factors: end-of-year average grade and participation in university societies (Humphrey, 2006). At the same time, the results of another study suggest that it is not so simple; students' performance can be influenced by various individual factors, not necessarily only work experience (Nonis & Hudson, 2006). An important equality issue, and one particularly relevant to widening participation, is that of enabling access not only to university as such but also to a quality student experience, including providing the time to engage fully in academic life (Moreau & Leathwood, 2006). Negative outcomes of working while in college may include increased anxiety due to work pressures (Mounsey et al., 2013), scheduling conflicts, reduced class choice options (Orszag et al., 2001), increased stress, and decreased attendance and study time (Schoffstall & Arendt, 2014). Students who work experience stress caused by conflicting priorities (Lowe & Gayle, 2007). This can have some negative effects on studying, and its implications for equity risk reinforcing and exacerbating inequalities.

Before COVID-19, online learning, distance learning, and digital technologies were already present in higher education institutions. Although they were not fully transforming the nature of university teaching (Henderson et al., 2017), they were perceived as a way to expand access for students (Volery & Lord, 2000), to help working students overcome the challenges they are facing (Black et al., 2020; Kotoua et al., 2015; Pozdnyakova & Pozdnyakov, 2017), and to attract more students into tertiary education (Skvorcovs et al., 2018). Online courses were purposely designed to meet working students' needs (Black et al., 2020), and due to online learning, students were better able to combine their academic work with professional commitments and family life. Online learning, however, was perceived by many university teachers as the second-best option after face-to-face teaching.

Research suggests that online teaching faces many challenges: a lack of a sense of community, time constraints, difficulty in understanding the objectives of the online courses, etc. (Song et al., 2004).

During COVID-19, all higher education institutions experienced a rapid shift to online learning, and it became an “online global era” of higher education (Guo et al., 2020). The unique experience of COVID-19 became an important ground for studies. The results, however, are somewhat contradictory. There is some evidence that online education results in poorer student learning and worse outcomes than face-to-face education in general (Altindag et al., 2021). Other findings are more optimistic, arguing that the quality of remote teaching is comparable to that of face-to-face teaching (Van Maaren et al., 2022). Many more argue that higher education will never be the same as before, as these new experiences will bring solid and permanent changes into the sector (Ewing, 2021). This chapter will contribute to the existing research specifically by exploring whether the online remote learning process during COVID-19 provided benefits and ensured higher accessibility in higher education for those students who combine working with studying.

Methodology

Data Collection

A 109-item questionnaire was developed by the research authors and approved by the University of Latvia (UL) to explore the impact of COVID-19 on the provision of education. The questionnaire was developed based on a review of the literature (Baranova et al., 2021) and on a follow-up study (Nimante, 2021). It consisted of three main question blocks: demographic questions, questions related to the organization of the study process in remote learning, and open-ended questions. In this chapter, we will analyze 33 items that are related to the research questions.

Students were asked to rate each question on a 5-point Likert scale, where 1 = Completely disagree, 2 = Mostly disagree, 3 = Can’t say/Not applicable, 4 = Mostly agree, and 5 = Completely agree. The questionnaire was uploaded to the QuestionPro survey platform and distributed in three ways: by sending a link to the survey to all student governments of all UL faculties, by sending a link to all UL students listed in the UL information system with the help of the university’s administrative departments, and by a boosted Facebook post. All ethical research standards under the General Data Protection Regulation were implemented in the survey.

Participants

This study used the principles of probability sampling, which is the easiest method for collecting data quickly and efficiently, to provide an insight into how UL students broadly perceived the situation. The total number of students at UL in 2021 was 15,260, and 742 questionnaires were fully completed in Spring 2021 (within 2 weeks of May 8, 2021). Students from 13 faculties and all study levels (from college (short-cycle programs) up to doctoral level) were invited to express their views on the remote learning process at UL voluntarily and anonymously.

The majority of respondents were from the bachelor's (66.98%) and Master's study levels (19.49%). Overall, the respondents represent all 13 faculties and all study levels at UL. The sample generally matches the typical student distribution among faculties and study levels at UL: 81.4% of respondents were women, 17.8% were men, and 0.8% indicated another gender; 38.8% of respondents were full-time workers, 24.9% were part-time workers, and 32.1% were unemployed. We excluded those on parental leave from further data analysis (see Table 1).

When describing themselves by their employment status, 286 students indicated that they were full-time workers and 184 that they were part-time workers, but 253 indicated that they were only studying, and thus were full-time students. The results show that 65% of participants work either part-time or full-time. The results generally match those previously reported on the employment rates of students in Latvia (Koroļeva et al., 2017).

Reliability of the Survey

Cronbach's alpha was used to assess the internal consistency of the questionnaire, as the responses for all items were obtained from a Likert scale. The internal consistency of the questionnaire is good ($\alpha = 0.851$), and the survey is therefore reliable.

Table 1 Characteristics of respondents by study level and employment status (%)

		Study level						
		First level (College) (ISCED 5)	Bachelor level (ISCED 6)	Second professional level (ISCED 6–7)	Master's level (ISCED 7)	Doctoral level (ISCED 8)	Residency (ISCED 7)	Total
Do you work in parallel with your studies?	No	6	219	13	14	0	1	253
	Yes, student working part-time	14	128	7	32	3	0	184
	Yes, student working full-time	29	141	9	91	16	0	286
Total		49	488	29	137	19	1	723

Data Analysis

The study used a quantitative research design in which we used a survey to explore the challenges and opportunities for UL students concerning remote learning during the second wave of COVID-19 in Latvia (Spring 2021).

To analyze the data, the survey responses were first downloaded into an IBM SPSS Statistics 28 file for reliability checks. Cronbach's alpha was used to test internal reliability. Second, a Kolmogorov–Smirnov test was conducted. This indicated that the results did not follow a normal distribution ($p < 0.05$). Descriptive statistical analyses were conducted to answer the research questions, and a Kruskal–Wallis H test was conducted to test the differences between student groups.

Main Results

Differences Between Student Groups and in the Digital Online Learning Process During COVID-19

To answer the first research question about whether there are any differences between the three different student groups in the digital online learning process during COVID-19, three aspects were analyzed: the organization of the remote studies, the effect on learning outcomes, and grades.

Our first finding after applying the Kruskal–Wallis H test showed that there is no statistically significant difference in the assessment of the organization of remote studies in UL between different student groups ($\chi^2(2) = 1.926$, $p = 0.382$). The mean rank in the question *How do you generally assess the organization of remote studies in the context of the COVID-19 pandemic at the University of Latvia* was 350.61 for full-time students, 359.60 for students working part-time, and 374.83 for students working full-time.

When analyzing the other questions, the Kruskal–Wallis H test showed that there is a difference between student groups in relation to the statement *My learning outcomes are not affected by remote learning* ($\chi^2(2) = 29.686$, $p < 0.001$), with a mean rank of 321.56 for full-time students, 338.89 for students working part-time, and 411.94 for students working full-time. We also found differences between the student groups in relation to the statement *My assessments in study courses are not affected by remote learning* ($\chi^2(2) = 27.708$, $p = 0.001$), with a mean rank of 320.68 for full-time students, 341.18 for students working part-time, and 408.59 for students working full-time.

The majority (67%) of students working full-time agreed that their learning outcomes were not affected by remote learning, while less than half of full-time students (45%) and students working part-time (46%) agreed with this statement.

The results show that the differences between the groups are in the way students access their learning outcomes and assessments. Students working full-time are also more optimistic about their learning outcomes and assessment.

Differences in Accessing Digital Learning Environment by Different Groups

To answer the second research question about whether there were any differences between the different groups of students when accessing the digital learning environment, the following environmental aspects were considered: connecting to the online lectures, problems during online learning, learning habits during online learning, such as taking screenshots and photos, taking records, the need for lecture recording, ordering study books and visiting a library, and using digital library resources.

Our analysis reveals that there is a statistically significant difference ($\chi^2(2) = 7.067$, $p = 0.029$) in relation to the statement *I always connect to online lectures*, which has a mean rank of 353.92 for full-time students, 340.84 for students working part-time, and 384.00 for students working full-time; 92% of full-time students and 91% of students working part-time connect to simultaneous online lectures, but only 64% of students working full-time do so.

The results show that students working full-time connect to online lectures on fewer occasions and thus spend less time in online lectures than full-time students and students working part-time.

There is also a statistically significant difference in relation to the statement *Access to remote learning does not cause problems* ($\chi^2(2) = 11.224$, $p = 0.004$), which has a mean rank of 392.16 for full-time students, 354.32 for students working part-time, and 341.73 for students working full-time. The results show that full-time students are more positive and say they have no problems accessing remote learning, but students working full-time or part-time experience more problems in this regard.

The results indicate that there is no statistically significant difference in how students working part-time or full-time and unemployed students are engaged in the study process. The answers to the statement *I usually take screenshots and photos of slides* do not show a significant difference ($\chi^2(2) = 2.586$, $p = 0.274$), with a mean rank of 370.89 for full-time students, 342.48 for students working part-time, and 369.28 for students working full-time. In all groups, almost half of the students take screenshots, and almost half do not. Answers to the statement *I usually keep records during remote lectures* do not show a difference either ($\chi^2(2) = 5.371$, $p = 0.068$), with a mean rank of 373.06 for full-time students, 334.09 for students working part-time, and 372.76 for students working full-time; 77% of students keep records during the remote online lectures. There is no difference between student groups in relation to their need to record online lectures ($\chi^2(2) = 3.243$, $p = 0.198$), with a mean rank of 367.14 for full-time students, 341.54 for students working part-time, and 371.94 for students working part-time; 83% of students expressed the need that lecturers to record online lectures to access them later.

Our results reveal that there is a statistically significant difference in answering the statement *I order books in the library and visit the UL library when performing study tasks* ($\chi^2(2) = 10.427$, $p = 0.005$), with a mean rank of 349.33 for full-time students, 333.90 for students working part-time, and 391.00 for students working full-time. There are also differences in answers to the statement *I only use the library's digital resources when performing study tasks* ($\chi^2(2) = 4.185$, $p = 0.123$), with a mean rank of 348.19 for full-time students, 352.52 for students working part-time, and 381.50 for students working full-time. We conclude that students working full-time prefer to visit the library than use the library's digital resources.

Differences in Overcoming Difficulties During Remote Online Learning

To answer the third research question, we analyzed a group of 23 different factors that help students to overcome COVID-19-related challenges in the study process (Kalniņa et al., In press). Our results showed that the most respondents indicated that they agreed with the following statements: *Classes are held according to the lecture schedule, Study materials are available on e-learning platforms, The lecturers are responsive and welcoming, The lecturers have good digital skills, I have successful e-communication with other students, My course mates are responsive and friendly*, and *I have good digital skills*. Differences between groups were found in the following statements:

- *Good digital skills of the lecturer* ($\chi^2(2) = 11.336$, $p = 0.003$), with a mean rank of 337.17 for full-time students, 337.66 for students working part-time, and 386.29 for students working full-time.
- *Self-control and planning skills for your own time* ($\chi^2(2) = 14.349$, $p = 0.001$), with a mean rank of 324.13 for full-time students, 357.63 for students working part-time, and 387.49 for students working full-time.
- *I have successful e-communication with the program director* ($\chi^2(2) = 12.612$, $p = 0.002$), with a mean rank of 324.57 for full-time students, 360.33 for students working part-time, and 384.03 for students working full-time.
- *I have successful e-communication with the branch manager* ($\chi^2(2) = 18.460$, $p < 0.001$), with a mean rank of 324.88 for full-time students, 348.86 for students working part-time, and 392.34 for students working full-time.
- *I have successful e-communication with the administrative worker/study methodologist* ($\chi^2(2) = 26.557$, $p < 0.001$), with a mean rank of 316.58 for full-time students, 343.24 for students working part-time, and 403.07 for students working full-time.

The answers show that 83% of students working full-time and 80% of students working part-time agreed that their self-control and planning skills helped them, 10% more than for full-time students. Successful e-communication with the program director, branch manager, and administrative worker/study methodologist is valued higher by students working full-time, while full-time students stated this was not applicable to them.

In addition, working students assess self-management skills (self-control and planning) as being more relevant to them than full-time students do. They use those soft skills to solve problems by successfully employing e-communication with the program director, branch manager, or administrative worker/study methodologist.

Discussion

The results of our study raise several questions. First of all: Why are students working full-time more optimistic about their learning outcomes and assessment in remote online learning compared with full-time students and students working part-time? Could it be because they have higher confidence or more study-related job experience, which makes them feel more confident about their learning outcomes? Could it be because those students working full-time had to balance their work and study life even before the remote online learning period? In this case, they would have already had better self-directed time management and self-learning skills, so they assumed that remote studies would be beneficial to them. Could it be that students working full-time have lower expectations concerning both their learning outcomes and assessments, and therefore they are more optimistic? Could it be that students experience some kind of new remote learning illusion? As has been explained, remote learning opportunities can sometimes create the illusion for students that studies and work can be successfully combined (Black et al., 2020; Triventi, 2014), especially if the work can be done entirely or partially remotely. In the end, however, it is not good for one's health or productivity. In those circumstances, students' skills to plan their time and their ability to learn in a self-directed way are crucial. Ultimately, can this be considered a realistic self-assessment? As we know from previous research in Latvia, students' assessment of different aspects of themselves can be rather high and contradict the reality (Lāma & Lāma, 2020), as students report problems related to their lack of skills and technological problems with integrating into the remote study process (Grinberga Zalite & Zvirbule, 2020). We can only hypothesize about the reasons behind such results. To understand them fully, we need to correlate their self-assessments with other data, for example, with the actual grades of students working full-time.

Second, our results show that students working full-time connect to online lectures on fewer occasions and thus spend less time in online lectures than full-time students and students working part-time. Thus, we must raise the following question: Does this mean that the remote learning opportunities provided do not fully resolve the study accessibility problem for students working full-time? Our research indicates that students working full-time are less likely than full-time students and students working part-time to attend simultaneous online lectures. This means that in order to reach the same learning outcomes, they have to spend more time studying independently. The importance of students participating in the learning process by participating in lectures and seminars is well-documented. Absence from lectures can negatively affect students' learning results and grades (Darolia, 2014; Schoffstall & Arendt, 2014). At the same time, our results show that the remote learning experience is very helpful to students working part-time, as they participated in the online learning process almost as much as full-time students.

Third, the research results show that students working full-time are those who experience more problems accessing online remote learning. This also applies, to a lesser extent, to students working part-time. Is this because they lack digital skills, even if they think that they have a high level of digital skills (Lāma & Lāma, 2020)? Is it connected to the fact that they spend less time doing online learning? Or is it connected with the higher level of stress experienced by working students (Schoffstall & Arendt, 2014)? As we know from previous research in Latvia, a lack of experience with distance education can cause feelings of anxiety and concerns regarding the education process and learning results (Pozdnyakova & Pozdnyakov, 2017). This could also be connected with students working full-time giving preference to visiting the library than using digital library resources. This is probably because students have not acquired the necessary competencies to use digital library resources effectively or prefer to spend time at the university.

Overall, the results do not indicate that the three different groups of students assess the organization of remote studies in the context of the COVID-19 pandemic at UL differently; their assessments of most of the learning habits employed during online remote learning do not differ either. At the same time, they reveal that online remote learning is not entirely solving the problem of working students' access to learning as it is more helpful to students working part-time than to students working full-time.

Finally, our results show that full-time students and working students employed the same abilities to help them to overcome difficulties in remote learning during COVID-19, with some exceptions. Self-control and planning skills were rated higher as helpful tools in remote learning by students working full-time. Successful e-communication with administrative workers such as the program director, branch manager, or study methodologist was also more useful for working students compared with full-time students.

The results lead us to a discussion of the impact of full-time work on studies' process and quality. If a student works mainly for socio-economic reasons, the university should take into account that in such cases, the student may have the challenge of combining studies with work. Work may interfere with their studies (fatigue, overload), even if remote online learning is provided. Despite the illusion students have about remote online learning, in the long term, the digital study environment and remote learning most probably will not provide them with the opportunity to fully achieve the learning outcomes. An increase in the number of state-funded study places at UL would be a solution for working students. Another solution to the issue of providing working students with an inclusive digital learning environment is to develop work-based study opportunities in cooperation with employers and workplaces when the workload is balanced and more coordinated between stakeholders.

All in all, we have to consider the new reality, where more than half of students (65% in our research) will combine their studies with work. Thus, we can observe the paradigm shift from the approach that students only study full-time during their degrees (especially in bachelor's programs) to the approach that more and more students are gaining work experience in parallel with their studies. Higher education institutions should think about the ways in which they incorporate this diverse student body and productively involve their work experience in the study process. We can say that the remote learning experience has made it easier to understand the existing opportunities and limitations of both studying and working, as well as to understand that both opportunities and limitations change with the context and according to a set of diverse influencing factors. Therefore, higher education institutions should constantly analyze these factors and offer support to both students and academic staff so that they can take full advantage of the opportunities. This analysis should be carried on in future research.

Conclusion

In conclusion, we can say that more and more students (in our research, 65% of all respondents) choose to combine their work and studies for different reasons. By analyzing differences between three groups (full-time students, students working part-time, and students working full-time), we have found that there are no significant differences in how they assessed the organization of remote studies in the context of the COVID-19 pandemic at the University of Latvia. Students in all groups employed the same learning habits and used almost the same means to overcome difficulties during online remote learning.

However, we have revealed the contradiction that although students working full-time spend less time in simultaneous online lectures, they assess their learning outcomes and assessments higher than full-time students and students working part-time.

Our results also reveal that students working full-time experienced more problems accessing online remote learning; they preferred to visit the library instead of using digital library resources. At the same time, we conclude that the remote learning experience was very helpful to students working part-time, as they participated in the online learning process almost as much as full-time students, even if they have many more accessibility problems to online learning than full-time students.

Self-control and planning skills seem to be very helpful to students working full-time. Successful e-communication with administrative workers such as program directors, branch managers, and study methodologists helped students working full-time to overcome study difficulties encountered during the online learning process.

Finally, we can say that there are some benefits and challenges to remote online learning, and thus it is currently only partly promoting an inclusive digital environment for working students. Simultaneous remote online lectures and seminars are probably not well-organized enough, and a more flexible schedule and learning opportunities for working students should be considered. Flexibility is considered to be the most beneficial solution (Buffer and AngelList!, 2020) and the most appreciated by those who work remotely. Yet, what is most concerning is the accessibility of qualitative studies for students working full-time, as these students have the challenge of combining their studies with work; work may interfere with their studies, even if remote online learning is provided. This means that there is a need to look for further individualized and systematic solutions to ensure an inclusive digital learning environment for everybody. While working has its benefits, students may need additional support from their institution to increase the benefits of working and decrease the drawbacks.

References

Altindag, D. T., Filiz, E. S., & Tekin, E. (2021). *Is online education working*? NBER Working Paper Series. https://www.nber.org/system/files/working_papers/w29113/w29113.pdf

Baranova, S., Nīmante, D., Kalnina, D., & Olesika, A. (2021). Students' perspective on remote online teaching and learning at the University of Latvia in the first and second COVID-19 period. *Sustainability, 13*(11), 11890. https://doi.org/10.3390/su132111890

Billett, S., Cain, M., & Le, A. H. (2018). Augmenting higher education students' work experiences: Preferred purposes and processes. *Studies in Higher Education, 43*(7), 1279–1294. https://doi.org/10.1080/03075079.2016.1250073

Black, D., Bissessar, C., & Boolaky, M. (2020). The missing HEROs: The absence of, and need for, PsyCap research of online university students. *Open Learning: The Journal of Open, Distance, and e-Learning*. https://doi.org/10.1080/02680513.2020.1855133

Bonnard, C. (2020). What employability for higher education students? *Journal of Education and Work, 33*(5–6), 425–445. https://doi.org/10.1080/13639080.2020.1842866

Buffer and AngelList! (2020). *State of remote work 2020*. https://lp.buffer.com/state-of-remote-work-2020

Claeys-Kulik, A. L., Jørgensen, T. E., & Stöber, H. (2019). *Diversity, equity and inclusion in European higher education institutions*. European University Association.

Darolia, R. (2014). Working (and studying) day and night: Heterogeneous effects of working on the academic performance of full-time and part-time students. *Economics of Education Review, 38*(C), 38–50. https://doi.org/10.1016/j.econedurev.2013.10.004

Eurostat. (2021). *Young people in education and the labor market in 2020*. https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210902-1

Ewing, L. A. (2021). Rethinking higher education post COVID-19. *The Future of Service Post-COVID-19 Pandemic, 1*, 37–54. https://doi.org/10.1007/978-981-33-4126-5_3

Graf, L. (2017). Work-based higher education programmes in Germany and the US: Comparing multi-actor corporatist governance in higher education. *Policy and Society, 36*(1), 89–108. https://doi.org/10.1080/14494035.2017.12788

Grinberga Zalite, G., & Zvirbule, A. (2020). Digital readiness and competitiveness of the EU higher education institutions: The COVID-19 pandemic impact. *Emerging Science Journal, 4*(4), 297–304. https://doi.org/10.28991/esj-2020-01232

Guo, F., Hong, X., & Coates, H. (2020). Accelerated transformation: Designing global online higher education. *Higher Education Research & Development, 39*(7), 1322–1326. https://doi.org/10.1080/07294360.2020.1824209

Halkic, B., & Arnold, P. (2019). Refugees and online education: Student perspectives on need and support in the context of (online) higher education. *Learning, Media and Technology, 44*(3), 345–364. https://doi.org/10.1080/17439884.2019.1640739

Henderson, M., Selwyn, N., & Aston, R. (2017). What works and why? Student perceptions of 'useful' digital technology in university teaching and learning. *Studies in Higher Education, 42*(8), 1567–1579. https://doi.org/10.1080/03075079.2015.1007946

Humphrey, R. (2006). Pulling structured inequality into higher education: The impact of part-time working on English university students. *Higher Education Quarterly, 60*(3), 270–286. https://doi.org/10.1111/j.1468-2273.2006.00317.x

Kalniņa, D., Nīmante, D., Baranova, S., & Oļesika, A. (In press). Remote learning during the Covid-19 pandemic: Opportunities in higher education. In A. Visvizi & L. Miltiadis (Eds.), *Moving higher education beyond covid-19: Innovative and technology-enhanced approaches to teaching and learning*. Emerald Publishing.

Koroļeva, I., Trapenciere, I., Aleksandrovs, A., & Kaša, R. (2017). *Studentu sociālie un ekonomiskie dzīves apstākļi Latvija* [Social and economic living conditions of students in Latvia]. https://www.izm.gov.lv/lv/media/3943/download

Kotoua, S., Ilkan, M., & Kilic, H. (2015). The growing of online education in sub Saharan Africa: Case study Ghana. *Procedia, Social and Behavioral Sciences, 191*, 2406–2411. https://doi.org/10.1016/j.sbspro.2015.04.670

Kümmel, E., Moskaliuk, J., Cress, U., & Kimmerle, J. (2020). Digital learning environments in higher education: A literature review of the role of individual vs. social settings for measuring learning outcomes. *Education Sciences, 10*(3), 78. https://doi.org/10.3390/educsci10030078

Lāma, G., & Lāma, E. (2020). Remote study process during Covid-19: Application and self-evaluation of digital communication and collaboration skills. *New Trends and Issues Proceedings on Humanities and Social Sciences, 7*(3), 124–129. https://doi.org/10.18844/prosoc.v7i3.5241

Lowe, J., & Gayle, V. (2007). Exploring the work/life/study balance: The experience of higher education students in a Scottish further education college. *Journal of Further and Higher Education, 31*(3), 225–238. https://doi.org/10.1080/03098770701424942

Masevičiūtė, K., Šaukeckienė, V., & Ozolinčiūtė, E. (2018). *Combining studies and paid jobs. Thematic review*. https://www.eurostudent.eu/download_files/documents/TR_paid_jobs.pdf

Metcalf, H. (2003). Increasing inequality in higher education: The role of term-time working. *Oxford Review of Education, 29*(3), 315–329. https://doi.org/10.1080/03054980307447

Moreau, M., & Leathwood, C. (2006). Balancing paid work and studies: Working (-class) students in higher education. *Studies in Higher Education, 31*(1), 23–42. https://doi.org/10.1080/03075070500340135

Mounsey, R., Vandehey, M., & Diekhoff, G. (2013). Working and non-working university students: Anxiety, depression, and grade point average. *College Student Journal, 47*(2), 379–389.

Nimante, D. (2021). COVID-19 difficulties in the remote learning process and opportunities to overcome them: The perspective of future teachers. In L. Daniela (Ed.), *Human, technologies and quality of education, 2021 = Cilvēks, tehnoloģijas un izglītības kvalitāte, 2021* (pp. 165–179). University of Latvia. https://doi.org/10.22364/htqe.2021

Nonis, S. A., & Hudson, G. I. (2006). Academic performance of college students: Influence of time spent studying and working. *Journal of Education for Business, 81*(3), 151–159. https://doi.org/10.3200/JOEB.81.3.151-159

OECD. (n.d.). *Students at work*. https://www.oecd.org/statistics/students-at-work.htm

Orszag, J. M., Orszag, P. R., & Whitmore, D. M. (2001). *Learning and earning: Working in college*. Upromise, Inc.

Pozdnyakova, O., & Pozdnyakov, P. (2017). Adult students' problems in the distance learning. *Procedia Engineering, 178*, 243–248. https://doi.org/10.1016/j.proeng.2017.01.105

Quintini, G. (2015). *Working and learning: A diversity of patterns*. OECD Social, Employment and Migration Working Papers No. 169. OECD Publishing.

Sanchez-Gelabert, A., Figueroa, M., & Elias, M. (2017). Working whilst studying in higher education: The impact of the economic crisis on academic and labour market success. *European Journal of Education, 52*(2), 232–245. https://doi.org/10.1111/ejed.12212

Schoffstall, D. G., & Arendt, S. W. (2014). Benefits and challenges encountered by working students. *26, Journal of Hospitality & Tourism Education*(1), 10–20. https://doi.org/10.1080/10963758.2014.880614

Skvorcovs, A., Titareva, T., & Graurs, I. (2018). The development trends of the main drivers for attracting students into the tertiary education sector in Latvia – Distance learning and internationalization. In *4th international conference on higher education advances (HEAd'18). Universitat Politecnica de Valencia, Valencia*. https://doi.org/10.4995/HEAd18.2018.801

Song, L., Singleton, E., Hill, J., & Koh, M.-H. (2004). Improving online learning: Student perceptions of useful and challenging characteristics. *The Internet and Higher Education, 7*(1), 59–70. https://doi.org/10.1016/j.iheduc.2003.11.003

Triventi, M. (2014). Does working during higher education affect students' academic progression? *Economics of Education Review, 41*, 1–13. https://doi.org/10.1016/j.econedurev.2014.03.006

United Nations. (2020). *Policy brief: Education during COVID-19 and beyond*. https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2020/08/sg_policy_brief_covid-19_and_education_august_2020.pdf

Van Maaren, J., Jensen, M., & Foster, A. (2022). Tutoring in higher education during COVID-19: Lessons from a private university's transition to remote learning. *Journal of College Reading and Learning, 52*(1), 3–22. https://doi.org/10.1080/10790195.2021.2007175

Volery, T., & Lord, D. (2000). Critical success factors in online education. *International Journal of Educational Management, 14*(5), 216–223. https://doi.org/10.1108/09513540010344731

Higher Education Students' Training Toward Inclusion; Virtual Reality Introduces Socially Assistive Robots Technologies for Digital Inclusion

Sofia Pliasa, Lefkothea Kartasidou, and Nikolaos Fachantidis

Introduction

An increasing number of children around the world are with autism spectrum disorders (ASD) (Hume et al., 2021; Wong et al., 2015). According to the Autism Developmental Disabilities Monitoring Network (ADDM) report, the prevalence of children in the spectrum is 1 in 59 children (Baio et al., 2018).

Children with the autism spectrum may experience life with different, mild, or severe expressions of the disorder. Some may have a normal or high IQ, while others may have a level of mental disability. They also tend to respond impulsively to sensory stimuli, interact with objects in strange ways, and are attached to them (Feinstein, 2011).

According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-V), the diagnostic criteria for the autism spectrum are found in the following:

1. Deficits in communication and social and emotional reciprocity.
2. Restricted or repetitive patterns of behavior, interests, or activities.

"Autism spectrum disorder" is divided according to the severity of the symptoms into three levels:

- Level 3 – "Need for particularly enhanced support" (serious socialization and flexibility difficulties)
- Level 2 – "Need for enhanced support" (significant difficulties)
- Level 1 – "Need for support" (difficulties)

S. Pliasa (✉) · L. Kartasidou · N. Fachantidis
Department of Educational & Social Policy, University of Macedonia, Thessaloniki, Greece
e-mail: spliasa@uom.edu.gr; lefka@uom.edu.gr; nfachantidis@uom.edu.gr

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_15

The wide range of the spectrum requires various methods to be adopted by the teachers to assist children not only to improve their social skills about also to succeed their inclusion.

Inclusion is a system that accepts diversity, as a rule, providing high-quality education in the terms of curriculum, effective teaching, and supportive systems, for each student, in an individualized approach based on the needs of each one. Successful inclusion can be achieved in environments that promote social interaction and provide opportunities for socialization, which encourage children to engage in joint activities and to act in a socially acceptable manner (Goodman & Williams, 2007). Teachers differentiate their methods in ways that help each child feel comfortable and form positive relationships in the classroom and thus feel included in it (Emam & Farrell, 2009).

The successful inclusion of children with ASD presupposes that they should be able to:

- Participate more in joint activities and interact socially
- Be accepted and provided with social support
- Have friendship networks
- Achieve more advanced educational goals than children attending special schools (Fryxell & Kennedy, 1995).

Interventions directed to children with ASD are addressing the particular interests, weaknesses, and capabilities of every individual should be flexible and respect the time and space each individual needs to respond and progress. The final goal is to help children with ASD become more independent, be included, and thus improve the quality of their lives (Koegel et al., 2012).

In an attempt to support children with ASD in the various areas of their deficits, interventions have been carried out, which utilize the benefits of Socially Assistive Robots (SARs) (Huijnen et al., 2016). Research utilizing Socially Assistive Robots (SARs) has been carried out in an effort to support children with ASD in many aspects of their deficits (Huijnen et al., 2016). According to those, engaging children with ASD with SAR has significant benefits in terms of improving their social skills and promoting their inclusion (Pennisi et al., 2016).

Socially Assistive Robots and ASD

SAR aims to develop effective interactions with humans, but with the primary goal of providing assistance and measurable human progress in learning, rehabilitation, skills development, etc. (Feil-Seifer & Mataric, 2005). SARs target various segments of the population, differing in age, deficits (physical/social), and need for support.

SAR is a technology that uses interactions such as speech, facial expressions, and gestures to deliver support. It is a powerful interactive tool that aids users in social rather than physical interactions (Tapus et al., 2007). With the minimum direct involvement of a skilled professional, the robot can engage in activities with the user, complete clinical roles, and provide simultaneous feedback (Feil-Seifer & Mataric, 2005). SARs are equipped with motivational, social, pedagogical, and therapeutic capabilities, allowing them to provide tailor-made interventions and rehabilitation to large groups of people such as the elderly and children with social and developmental problems, thereby improving their quality of life (Matarić & Scassellati, 2016).

Due to their social deficiencies, children with ASD must deal with a variety of social settings and must be exposed to a wide range of emotions (Baron-Cohen et al., 1985). SAR is an exciting tool that creates engaging, often playful, settings of interactions and communications that pique children's interest while also focusing their attention on the intervention's goals. They mediate interventions that motivate children with ASD to engage and involve in shared activities that improve their social skills (Abbasi, 2018,) and assist them to comprehend and express their own feelings and to recognize and accept others' emotions (Cabibihan et al., 2013).

SAR applications aim at four basic elements, according to a review of clinical use of robots for people with ASD:

- The response of children on the autism spectrum to robots compared to their response to humans
- The activation of behaviors
- Providing feedback on children's performance
- Teaching or practicing a skill (Aresti-Bartolome & Garcia-Zapirain, 2014). Robots interact with verbal and nonverbal ways and with special sensors can also respond to them. Nonverbal interaction is especially important, as children with ASD often have speech developmental delays (Kim et al., 2013). Robots create a safe environment and many opportunities for interaction by providing, if necessary, repetitive instructions with less complexity than humans, respecting the personal time each child needs to adapt and respond to the new stimuli (Thill et al., 2012).

Children with ASD can work more calmly in planned actions that imitate real-life social settings that respond to their interests, thereby lowering certain stressors and avoiding meltdowns (Pliasa & Fachantidis, 2019a, b, c). Also, as SARs are programmable, they can be designed to be simpler and more predictable than humans, making it easier for children to follow instructions, to engage in group activities, thus making the entire communication process easier (Pliasa & Fachantidis, 2019a, b, c).

From the above, it is concluded that SAR is a significant tool for children with ASD inclusion. HE students in the field of special education are accustomed to the importance of the SAR-mediated interventions, but there is a huge gap between the theoretical knowledge they receive and the opportunity to see the numerous available SAR in action, and to learn how to operate them in order to deliver interventions. According to a research, the end-user perceptions on SAR are crucial because if they do not believe they have the capability and/or expertise to operate the technology, they will never use it (Roldan et al., 2021) However, getting acquainted with SAR is not always easy as the variety of proposed robots is significant. Universities rarely have a sufficient number and plethora of SAR for their HE students' training. In addition, it is pretty demanding work to design and develop software for the wide variety of SARs' educational applications and organize hands-on training. For this reason, in an Erasmus+ project, VR technology was proposed and utilized to present robots and introduce analytical methods on how to use SAR through detailed scenarios, such as the detailed description of the outlined ARRoW method.

VR in Higher Education

Research on VR in education suggests that there is a current opportunity to (1) educate university students on how to program numerous SAR to deliver interventions, and (2) present methods and specially designed scenarios for the implementation of the interventions.

VR could be of great assist for teachers, therapists, and students to learn about the plethora of SAR and their special features, functions, and ways to employ them at their sessions, classrooms in their inclusive practices (Slavova & Mu, 2018). VR has progressed in several ways, becoming increasingly resemblant to the actual world. There are two types of virtual reality: nonimmersive and immersive. The first is a computer-based environment-simulating locations in actual or imagined worlds; the second takes the concept a step further by creating the sensation of being physically present in a nonphysical world (Cherni et al., 2020).

The environment is viewed through the use of a virtual reality headset or helmet. By mimicking as many senses as possible, such as vision, hearing, and touch, it is feasible to create a realistic environment. Three basic principles are fundamental for VR: immersion, interaction, and user involvement with the environment and narrative, and those aspects could be of great potential in education (Freina & Ott, 2015).

Because of its potential for stimulating engagement (Roussou, 2004) and motivation (Ott & Tavella, 2009), VR is frequently employed in the sectors of education and training (Leite et al., 2010). It also provides a perfect way for those who prefer a visual, aural, or kinesthetic learning style to approach, study, and recall new information (Freina & Ott, 2015).

With the introduction of the Metaverse, VR has garnered more attention as an educational tool, and many think that it is destined to affect educational practices. VR is frequently utilized in adult vocational training in all those sectors where the authentic environment or tools and methods cannot be used for practice due to a lack of access, because of the high cost, or sometimes could be extremely risky (Duan et al., 2021).

VR has a lot of benefits for learning: it gives us a direct experience of objects and events that are physically out of our reach, it allows us to train in a safe environment while avoiding real-life dangers, and it increases the learner's involvement and motivation while expanding the range of learning styles supported thanks to the game approach. (Freina & Ott, 2015).

The potential of VR to change education has been widely discussed in the academic world as it has become more accessible in recent years. For higher education, there are already a variety of instructional activities and training processes based on VR for many disciplines (Hamilton et al., 2021). By offering a learning atmosphere that is difficult to recreate or accessible in real life, using VR as an educational tool enables novel forms and ways of visualization and presentation, motivates students' learning, and stimulates their interest (Nissim & Weissblueth, 2017).

Scenario on SAR and ASD for HE Students

In order to provide a solution to the difficulty faced by universities to equip themselves with several different robots, and to have the expertise to program them, VR technology was utilized. and a scenario was created, utilizing the Daisy Robot, that it was designed to meet the characteristics of children with ASD. The scenario was addressed to HE students that were studying to become special education teachers. Before the scenario, HE students were given a presentation on SAR and specifically on the benefits interventions with robots have on children with ASD improvement of social skills. Moreover, the ARRoW method was outlined. They were also introduced to the VR technology and how it can be integrated into the learning process to bring significant benefits to teachers and students as well.

Subsequently, they were shown the scenario, which had five steps as its design was based on the ARRoW method. ARRoW method is a prototype method that combines the two inclusive strategies of prompting and peer-mediation interventions, with the aim of assisting children to improve their social skills toward their inclusion.

The "Daisy Robot" (Fig. 1) is a robotic flower (a flower-like robot) with anthropomorphic characteristics, created to assist children that face difficulties in communication and cooperation due to social skills and language deficiencies, such as children with ASD, attention deficit hyperactivity disorder (ADHD), etc.

It is a tool suitable for usage at schools, treatment centers, and at home, helping children develop the ability to understand verbal and nonverbal cues of communication, express themselves, and also improve their social relations with peers and other family members. The robot speaks phrases, moves its petals in different motives, makes sounds, and performs facial expressions (Pliasa & Fachantidis, 2019a, b, c).

The following elements are incorporated into the robot and the majority of them were demonstrated through the VR scenario.

Pedagogical-educational aspects

- Verbal and nonverbal communication (face expression, body movements)
- Functions that allow a teacher to interact with children through the robot and achieve personalized learning.

Fig. 1 Daisy Robot

- Personalized learning and treatment, since the teacher/carer can incorporate its own material (robot's vocabulary, expressions, exercises, etc.) based on each child needs and characteristics
- Child-friendly robot
- User-friendly interface for teacher/carer/parents.
- Multi-modal interactivity
- Ease of updating and adding content (texting or dictating)
- Multimedia content
- Multiple users' support
- Holds the learner's interest
- Proper for dyadic, triadic, and other types of cooperative approaches

Social aspects

- Implementation of socially assistive robotics' principles
- Flower-like robot with anthropomorphic characteristics and functions
- Huggable (proper dimension and material)
- Face expressions
- Body (body language)
- Work in a personal manner, without educator/trainer presence intervene the "safe zone" of the child (eye contact, tone of voice, dressing style, smell, body dimensions, etc.)
- Increase children's motivation
- Huge impact on individual's, relatives', and community's life
- Technological aspects
- Implementation of robotic technologies
- Interchangeable skin (proper for special needs)
- Interaction with the environment (presence detection, proper face direction, stem and petals motion, tactile sensing, voice sensing, etc.)

- Text to speech
- Speech to text (speech recognition)
- Remote communication
- Wireless communication (Bluetooth, WiFi)
- Internet of things
- Mobile technologies
- Open architecture
- Light and transferable
- Long-life operation

Before the activity, HE students were introduced to the five steps ARRoW method (Fig. 2) which consists of the following five steps (Pliasa & Fachantidis, 2019a, b, c).

Subsequently students were delivered VR headsets and were presented with the intervention that was delivered with the ARRoW method. They were to observe the features of Daisy Robot, its movements, facial expressions, and sounds that were produced, also to pay attention to the five steps of the method, and overall to the outcome of the intervention.

Scenario

In the script of five steps that was incorporated in the VR, an elementary school classroom was presented, with the Daisy Robot placed on a classroom desk. During the first step, George a child with ASD – Level 1, attending the third grade of elementary school, entered the room. We watch him approach and observe the robot until he stands in front of Daisy and starts talking to it. The robot starts asking questions to the child and we notice that the child gradually trusts the robot and enjoys the interaction. The robot then asks George to play some games, guiding the child's actions on a tablet. During the game, Daisy Robot provides George with prompts and reminds him of the game rules. When the game is finished the first step of the intervention is also completed.

In the second step a teacher accompanies the child-robot team to form a triad during the interactions. The robot sets the instructions of the games and promotes

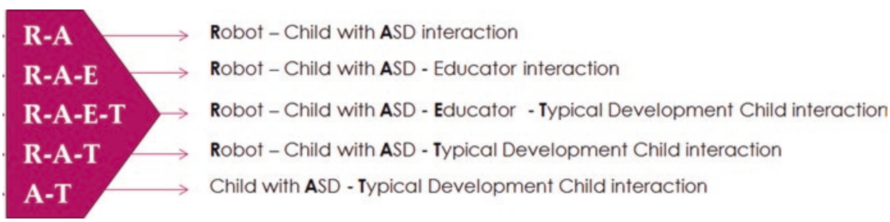


Fig. 2 ARRoW method

the dialogue as in step 1. After the conversation, George and his teacher proceed in playing the game, during which all instructions, reminders, guidance, and prompts to both are given exclusively by the robot. The robot takes on the role of educator-instructor and the teacher the role of a team mate.

During Step 3, students through the VR witness a child of typical development joining the team of the previous step. Both children and the teacher interact under the guidance and prompts of the robot as in the previous steps, George needs to adapt to the new requirements – a dialogue and a game with three people requires upgraded skills in cooperation, learning sequence and communication. As in Step 2, the robot is the coordinator; it is the one that has set the rules and reminds the players of them, the one that determines the turn of the players, and gives reinforcements and rewards.

In Step 4, the person of reference for the child with ASD (the teacher) is not present. What is interesting for this step, is for the students to see whether the cooperation and communication skills that George achieved in Steps 1, 2, and 3 are maintained, but with the minimal supportive presence, and if not, how the robot intervenes.

In Step 5, the robot waives the lead role. It retires, declares that it is tired, and remains as a simple observer of the interaction between the two children. Students are asked to note whether the skills acquired by the child with ASD in Steps 1–4 can be applied and managed in a context of equal coexistence, without guidance from a significant other, but simply through communication and cooperation with the team mate, and thus whether the whole intervention was successful.

Students' Experience

After the presentation, students were asked to describe the scenario and answered questions on the potential benefits of SAR and VR technology. Students were first asked on the script's content to determine their level of comprehension of both the robot's operation and functioning and of the method that structured the intervention. They were also asked if they believed that the VR technology had provided them with adequate data on the goal of the intervention, on the characteristics of the child with ASD, and on the role that the teacher and the child development took on.

The HE students described the specific characteristics of the Daisy Robot and justified why those are suitable for ASD. They also described the ARRoW method and the sequence of its five steps, and if they believed that VR technology efficiently assisted them to understand the capabilities of the robot, the reasoning behind the ARRoW, and whether they felt confident enough to utilize them.

The majority of the HE students admitted that VR was an effective way to demonstrate how the robot operates, its functionalities, and how it interacts with children. They indicated that they felt like they were a part of the process and that the only thing they wished for was physical contact with the robot, which virtual reality did not deliver. All of the HE students reported that they comprehended the intervention's content and that it fulfilled the steps of the ARRoW method.

They noted that they were given the opportunity to see the script's steps multiple times in order to properly understand its various features, each time from a different perspective. They felt as if they could wander around the classroom, and be present while observing the expressions of every participant. Most of the HE students said that this whole experience made them feel confident that they themselves can now carry out their own interventions utilizing Daisy.

The degree of understanding of the robot, its functionality, or how to utilize it with the ARRoW method was notably similar to that of HE students who had previously been exposed to the intervention, but with a physical demonstration of the robot, a detailed description of the method and examples of interventions.

HE students stated that they were able to identify the two inclusive strategies of prompting and peer-mediated that ARRoW combines, and agreed that it determined the role of Daisy as a mediator, facilitating the child's attachment to it, which assisted in the improvement of George's social skills toward inclusion.

All the students express their wish for more scenarios to be produced, but with more detailed descriptions of how to program the robots.

Conclusion

To summarize, with the delivered scenario, VR as a technology has proven to be successful in engaging HE students to observe Daisy's intervention with great anticipation. It is deemed necessary to incorporate examples of SAR utilization and operation into virtual reality technology and present them to each of those HE students who would later carry out interventions in the ASD population. SAR has shown its value in improving the social skills of children with ASD, and it has been portrayed as a technology capable of assisting in the inclusion of children.

Since it is pretty demanding work to develop software for the wide variety of SARs', to design educational applications and to organize hands-on training, virtual reality seems a proper tool to help institutions that lack resources and tech labs, by demonstrating the various SARs, executing actions that employ methodologies and strategies for the successful inclusion of children with ASD.

References

Abbasi, J. (2018). In-home robots improve social skills in children with autism. *JAMA, 320*(14), 1425–1425.

Aresti-Bartolome, N., & Garcia-Zapirain, B. (2014). Technologies as support tools for persons with autistic spectrum disorder: A systematic review. *International Journal of Environmental Research and Public Health, 11*(8), 7767–7802.

Baio, J., Wiggins, L., Christensen, D. L., Maenner, M. J., Daniels, J., Warren, Z., et al. (2018). Prevalence of autism spectrum disorder among children aged 8 years—Autism and developmental disabilities monitoring network, 11 sites, United States, 2014. *MMWR Surveillance Summaries, 67*(6), 1.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a "theory of mind". *Cognition, 21*(1), 37–46.

Cabibihan, J. J., Javed, H., Ang, M., & Aljunied, S. M. (2013). Why robots? A survey on the roles and benefits of social robots in the therapy of children with autism. *International Journal of Social Robotics, 5*(4), 593–618.

Cherni, H., Métayer, N., & Souliman, N. (2020). Literature review of locomotion techniques in virtual reality. *The International Journal of Virtual Reality, 20*, 1–20.

Duan, H., Li, J., Fan, S., Lin, Z., Wu, X., & Cai, W. (2021, October). Metaverse for social good: A university campus prototype. In *Proceedings of the 29th ACM international conference on multimedia* (pp. 153–161).

Feil-Seifer, D., & Mataric, M. J. (2005, June). Defining socially assistive robotics. In 9th International Conference on Rehabilitation Robotics, 2005. ICORR 2005. (pp. 465–468). IEEE.

Fryxell, D., & Kennedy, C. H. (1995). Placement along the continuum of services and its impact on students' social relationships. *Journal of the Association for Persons with Severe Handicaps, 20*(4), 259–269.

Emam, M. M., & Farrell, P. (2009). Tensions experienced by teachers and their views of support for pupils with autism spectrum disorders in mainstream schools. *European Journal of Special Needs Education, 24*(4), 407–422.

Feinstein, A. (2011). *A history of autism: Conversations with the pioneers*. Wiley.

Freina, L., & Ott, M. (2015, April). A literature review on immersive virtual reality in education: State of the art and perspectives. In *The international scientific conference elearning and software for education* (Vol. 1, No. 133, pp. 10–1007).

Goodman, G., & Williams, C. M. (2007). Interventions for increasing the academic engagement of students with autism spectrum disorders in inclusive classrooms. *Teaching Exceptional Children, 39*(6), 53–61.

Hamilton, D., McKechnie, J., Edgerton, E., & Wilson, C. (2021). Immersive virtual reality as a pedagogical tool in education: A systematic literature review of quantitative learning outcomes and experimental design. *Journal of Computers in Education, 8*(1), 1–32.

Huijnen, C. A., Lexis, M. A., Jansens, R., & de Witte, L. P. (2016). Mapping robots to therapy and educational objectives for children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 46*(6), 2100–2114.

Hume, K., Steinbrenner, J. R., Odom, S. L., Morin, K. L., Nowell, S. W., Tomaszewski, B., et al. (2021). Evidence-based practices for children, youth, and young adults with autism: Third generation review. *Journal of Autism and Developmental Disorders, 51*(11), 4013–4032.

Kim, E. S., Berkovits, L. D., Bernier, E. P., Leyzberg, D., Shic, F., Paul, R., & Scassellati, B. (2013). Social robots as embedded reinforcers of social behavior in children with autism. *Journal of autism and developmental disorders, 43*(5), 1038–1049.

Koegel, L. K., Vernon, T. W., Koegel, R. L., Koegel, B. L., & Paullin, A. W. (2012). Improving social engagement and initiations between children with autism spectrum disorder and their peers in inclusive settings. *Journal of Positive Behavior Interventions, 14*(4), 220–227.

Leite, W. L., Svinicki, M., & Shi, Y. (2010). Attempted validation of the scores of the VARK: Learning styles inventory with multitrait–multimethod confirmatory factor analysis models. *Educational and Psychological Measurement, 70*(2), 323–339.

Matarić, M. J., & Scassellati, B. (2016). Socially assistive robotics. In *Springer handbook of robotics* (pp. 1973–1994). Springer.

Nissim, Y., & Weissblueth, E. (2017). Virtual reality (VR) as a source for self-efficacy in teacher training. *International Education Studies, 10*(8), 52–59.

Ott, M., & Tavella, M. (2009). A contribution to the understanding of what makes young students genuinely engaged in computer-based learning tasks. *Procedia-Social and Behavioral Sciences, 1*(1), 184–188.

Pennisi, P., Tonacci, A., Tartarisco, G., Billeci, L., Ruta, L., Gangemi, S., & Pioggia, G. (2016). Autism and social robotics: A systematic review. *Autism Research, 9*(2), 165–183.

Pliasa, S., & Fachantidis, N. (2019a). Mobile technologies serious games for the development of social skills in children with autism spectrum disorders, in enhanced with socially assistive robots interventions. In *Interactive mobile communication, technologies and learning* (pp. 618–628). Springer.

Pliasa, S., & Fachantidis, N. (2019b, September). Can a robot be an efficient mediator in promoting dyadic activities among children with autism spectrum disorders and children of typical development? In *Proceedings of the 9th Balkan conference on informatics* (pp. 1–6).

Pliasa, S., & Fachantidis, N. (2019c). Using daisy robot as a motive for children with ASD to participate in triadic activities. *Themes in eLearning, 12*(12), 35–50.

Roldan, W., Li, Z., Gao, X., Kay Strickler, S., Marie Hishikawa, A., Froehlich, J. E., & Yip, J. (2021, June). Pedagogical strategies for reflection in project-based HCI education with end users. In *Designing interactive systems conference 2021* (pp. 1846–1860).

Roussou, M. (2004). Learning by doing and learning through play: An exploration of interactivity in virtual environments for children. *Computers in Entertainment (CIE), 2*(1), 10–10.

Slavova, Y., & Mu, M. (2018, March). A comparative study of the learning outcomes and experience of VR in education. In *2018 IEEE conference on virtual reality and 3D user interfaces (VR)* (pp. 685–686). IEEE.

Tapus, A., Mataric, M. J., & Scassellati, B. (2007). The grand challenges in socially assistive robotics. *IEEE Robotics and Automation Magazine, 14*(1), 1–7.

Thill, S., Pop, C. A., Belpaeme, T., Ziemke, T., & Vanderborght, B. (2012). Robot-assisted therapy for autism spectrum disorders with (partially) autonomous control: Challenges and outlook. *Paladyn, 3*(4), 209–217.

Wong, C., Odom, S. L., Hume, K. A., Cox, A. W., Fettig, A., Kucharczyk, S., et al. (2015). Evidence-based practices for children, youth, and young adults with autism spectrum disorder: A comprehensive review. *Journal of Autism and Developmental Disorders, 45*(7), 1951–1966.

Reconstruction of the Phenomenon of Social Inclusion Within ICT in Academia – Voices from Europe

Joanna Leek and Anna Jarkiewicz

ICT in Academia – Theoretical Framework

Learning with digital tools describes learning where technology mediates the learning process via the Internet. Research literature abounds with overlapping, inconsistent, and confusing terminology and definitions of what learning with digital tools is (Guri-Rosenblit, 2005), involving many different features and models of practice (Cavanaugh et al., 2015). In a university environment, this kind of learning is now referred to by different names such as learning via the web, online learning, digital learning, e-learning (Ullah et al., 2017), virtual, online, flexible, open, digital, virtual and distance learning, computer-based training, or web-based learning (Guri-Rosenblit, 2005; Cavanaugh et al., 2015). A digital learning environment can be developed in form of blogs, e-portfolio (Tan & Loughlin, 2014), and interactive activities, that is, games (Minović et al., 2016), to enrich cooperation with others within the learning environment (Wenger, 1998). In this chapter, all forms of learning with ICT tools (sometimes also called digital tools) are referred to as "learning with digital tools," this term being used for the purposes of reconstructing this phenomenon of social inclusion within ICT in academia.

Hanson et al. (1997) noted that profiles of students that used e-learning in the 1990s were like the profiles of those that took part in traditional distance education. What has been noticeable recently is the shift in digital learning students' profiles toward younger students that are self-motivated and socially oriented in their digital learning (Gros & García-Peñalvo, 2016). The contemporary digital learner is not only young and using the digital environment for knowledge and skills development, but as Dabbagh (2007) emphasizes, is motivated to learn independently in a

J. Leek (✉) · A. Jarkiewicz
University of Lodz, Lodz, Poland
e-mail: Joanna.Leek@now.uni.lodz.pl; Anna.Jarkiewicz@now.uni.lodz.pl

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_16

digital environment, has a concept of themselves within academia, and is competent to use online environment, that is, communication and collaborative technologies. For Stöter et al. (2014), the online learner possesses a disposition for learning and digital competency, directs their own learning independently, and uses learning tools online without problems. Guri-Rosenblit (2005) claims that the impact of ICT on educational institution operations, particularly in relation to the ways knowledge is generated and transformed, "will grow in the future, but most of their applications will take place in the framework of campus based universities and not in distance or virtual settings" (p. 472). Unquestionably, the impact of ICT on higher education will affect all fields of academic activity from research into teaching and learning to the bodies that govern education (Guri-Rosenblit, 2005).

Definitions of learning in a digital environment depend on the context and milieu of its operationalization. Definitions emphasize that this kind of learning integrates technology or that it serves as a substitute for distance education, which is supported by using the Internet (Bertea, 2009). E-learning and distance education are, however, not synonymous. Distance education can be traced back to ancient times, whereas e-learning, which has its origins in distance education, is a relatively new phenomenon associated with the development of the Internet in the 1990s (Nichols, 2003).

The use of the digital learning environment in Higher Education Institutions is emerging as an effective way of engaging students with education (McConnell, 2006). Existing studies are emphasizing the positive influences of digital learning on collaborative dimensions of interactions with other students (Littlefield & Roberson, 2005). In relation to social work, online discussions support students who are involved in social work placements (Quinney, 2005). Negatives experiences of learning in a digital environment that have been cited include (Sweeney et al., 2004) the difficulty caused because of the substantial time commitment required to complete computer work. Also the lack of feedback from teachers and technical difficulties have been described by students as frustrating as they limit students' learning.

Theoretical and Methodological Frameworks of Our Study

In most European countries, it is mostly women who choose to enter some field of education. Here we are dealing with a phenomenon that is opposite to that found in IT – over-representation of women, which we have connected with the process of internalization of gender expectations as to what is "appropriate" male and female behavior in their gender ideology and gender educational choices (Alon & DiPrete, 2015; Hyde & Mertz, 2009). It is also commonly believed that those that decide to study in the field of educational sciences at HEI have fewer technological skills but favor interpersonal skills. At the same time, those who graduate and become educators, start to teach young people about the world and the social role' expectations. Therefore, we recognized the topic of students of educational sciences and the importance of both IT as a factor in social inclusion and the importance of counteracting the disproportion in the numbers of women working in IT. We perceive the role of educators as crucial in addressing the issue of social inclusion in IT for at least two reasons. First, it is the teacher who educates young people, encourages them to use specific solutions (including technological). Therefore, we consider their attitude, knowledge, skills and competencies in IT significant for social inclusion in IT in order to counteract, that is, gender, disability inequality in this sector (Atkinson et al., 2005). We claim that the abovementioned elements should be developed through the curriculum in HEI in the field of educational studies. The second argument in favor of the importance of the teacher's role in the issue of social inclusion in IT (Mitra & Steffensmeier, 2000) is related to the goal of his or her professional work itself. In the educational process, students' predispositions are discovered, their interests are shaped, which, at a later time, may be important in their choice of future career path. During this process, some options may also be limited or not sufficiently used, for example, a teacher showing a lack of skills/abilities in IT may discourage less convinced students from developing this knowledge with their attitude, and consequently reproduce stereotypes about IT and escalate the existing disproportions. The teachers and their gender ideology "can affect educational choices by influencing (1) how adolescents evaluate their competence in certain subjects (competence beliefs), (2) what they find important in a future occupation (occupational values) and (3) what school subject they prefer right now" (Van der Vleuten et al., 2016).

We make a link between the importance of the teacher's role and the process of socialization. In this chapter, we want to emphasize that a key mechanism that shapes the importance placed by individuals on different work choices is socialization (in our study – in educational institutions). Socialization is the process through which an individual internalizes a set of values, beliefs, and preconceptions about specific roles (Berger & Luckmann, 1967) that guide his/her decision-making and behavior (Cable & Parsons, 2001). Based on the assumption of Berger and Luckmann (1967), people construct knowledge based on experiences that are gathered in the process of socialization; in our study – during the process of learning. These experiences of learners are for us empirical data that we gather and analyze. Also, those experiences build an intersubjective vision of the world that supports digital learning.

The theoretical and methodological basis of this study is interpretive paradigm (Wilson, 1973) with special reference to the critical approach (e.g., Fook et al., 2015). It is essentially an interpretive paradigm "with *a structural analysis in that the links between the individual and the social are made explicit through analysis of how language and social practices are constructed*" (Ife, 1997, p. 134). Critical perspective is that which emphasize the broader environment when constructing problem definition (Morley, 2003). The issue of gender inequality in IT from a critical perspective, for example, is understood as being direct consequences of the ways our educational/ labor market is structured, rather than attributed to an individual woman's inability to use IT and work in IT.

In this chapter, we are following the understanding of Barron (2006), where physical or virtual spaces provide opportunities for learning. Learning is based on individual configuration of tasks, and actions, resources, and interactions. Learning and the way knowledge is constructed connect learners, teachers, and resources, and these components are perceived as deriving from critical dialogue interactions. Knowledge is constructed *bottom-up* from personal knowledge networks.

Methodology

Research Questions

The main aim of the study is to explore experiences of educational science students which they think may have contributed to their feelings or caused them to act in a certain way, and to explore the implications of these experiences in a broader structural context.

Specifically, this chapter responds to the main question: *What is the significance of the digital learning environment in higher education?* To answer this question, we conducted questionnaire study and focus groups with university students.

Regarding our survey study, the following research questions were formulated:

1. What opportunities exist within digital learning within mobility for students?
2. What is the function of digital tools in higher education learning?

Regarding group interviews (GI), to examine the perspectives and experiences of *students* the following research questions were formulated:

1. What is the perspective of students towards learning with digital tools at HEI?
2. What experiences of learning with digital tools have students had so far?
3. In the context of social inclusion, what opportunities do students see in digital learning?
4. In the context of social inclusion, what limitations do students see in digital learning?

Methods

In our qualitative study, we incorporated (1) qualitative questionnaire (160 HE students from 16 countries, involved in digital learning during their mobility) and (2) group interviews (40 HE students of educational sciences from one European country – Poland).

About Questionnaire Study

The questionnaires were used to select thematic blocks on experiences of social inclusion within digital learning and mobility that were relevant from students' perspective. The research data were collected using a questionnaire made up of close-ended and open-ended questions, where we focused on identification of experiences and expectations toward learning in a digital environment during international mobility (exchange).

The questionnaire study served a diagnostic purpose, aiming to identify both the experiences of students and the causes, sources, circumstances, and determinants of students' learning with digital tools. The questionnaire consisted of three close-ended questions and six open-ended questions. For the purpose of investigating expectations and experiences with digital tools within mobility program in HEI, the close-ended questions aimed to find out in what kind of mobility did students take part so far, what did students expect from learning within mobility program, and what students perceive as benefits of mobility program. The close-ended questions were developed first with an exploratory aim to get to know reasons, aims and motivations for learning with digital tools, also what opportunities exist within mobility that support learning with digital tools, second to obtain indicators (answers represented by most of respondents) for further use in focus group interviews. In the open-ended questions, we asked how did students practice digital tools in learning, what was the motivations to take part in mobility with digital tools, and to what extent they perceive digital tools as beneficial. The study was anonymous and each student response received a number in our analysis.

One hundred and sixty students took part in this part of our study: 57% females (91) and 32% males (52). Other than female or male gender was declared by 11% (17) students; 90% of survey participants were 19–24 years of age, and 10% were more than 24 years of age (Table 1). Students were studying social sciences (education, sociology), art, modern languages, human recourses management, philosophy, and international relations.

Seventy four percent (118) came from a Higher Education Institution (HEI) located inside Europe, 26% (42) – from outside Europe. All universities chosen for the study were part of Erasmus Charter for Higher Education (Table 2).

Table 1 Gender of participants (questionnaire study)

Gender of participants		
Female	91	57%
Male	52	32%
Other	17	11%
Total	160	100%

Table 2 Location of university (questionnaire study)

Location of university		
Inside EU	118	74%
Outside EU	42	26%
Total	160	100%

Table 3 Gender of participants – GI

Gender of participants		
Female	22	55%
Male	18	45%
Other	0	0%
Total	40	100%

Group Interviews

Group interviews (GIs) were conducted with BA students (n = 40 ranging from 21 to 23 years age, both genders M = 18 and F = 22) that had already participated in digital learning (Table 3). The GIs were conducted online. Students were divided into 4 groups (10 participants in the group). The GIs were conducted in October 2020 using TEAMS. The group interview approach with students was adopted to achieve in-depth responses and better understand their experiences within digital learning and social inclusion issues in IT.

The thematic analysis was focused mainly on the opportunities, challenges, and limitations of using the digital learning in the context of social inclusion.

All participants of GI were students of educational sciences; 45% (18) of them were male but all of them were students of sport education, which was characterized by being over-represented by men. This is a phenomenon among educational sciences; 55% of participants were female. The study is as follows: 1 – Sport education, 6 – Adult education; 5 – Care and therapy education, and 10 – Resocialization (Table 4).

We selected both groups of our respondents based on their experience with mobility and digital learning (at least 18 months), study level (Bachelor' Degree), and experience with digital tools at university (2 years and more).

Our study employed a comparative methodology. This means that the effectiveness of learning with digital tools is based on the comparison between traditional face-to-face teaching and online learning, to analyze the digital environment of learning at university. Another comparison we made was aimed at finding out about the experiences of students who had taken part in international mobility programs and those who had never participated in such activities or studied in the field of educational sciences. In other words, the background for studying learning in a

Table 4 Field of educational study – GI

Field of educational study		
Sport education	19	25%
Adult education	6	27.5%
Care and therapy education	5	25%
Resocialization	10	22.5%
Total	40	100%

digital environment in academia was (1) in a questionnaire study – international mobility experience with learning in a digital environment, and (2) in group interviews – studied field. In adopting a comparative approach to the students' backgrounds regarding learning with digital tools, we followed the advice of Noesgaard and Ørngreen (2015) who claim that the effectiveness of learning in a digital environment can be approached in different ways, depending on the aim of the e-learning. In the questionnaire study, the digital learning environment was used to gain international experience while students were studying at university (vertical differentiation of learning background – learning experiences gained at another university) and in focus group interviews – to gain knowledge and skills to work in an educational environment (horizontal differentiation of learning background – study field). What combines these two groups is participating in learning with digital tools (university courses) and experience or plans to participate in learning within international mobility programs with usage of digital tools, with cooperation between peers and flexible structure of work that is being conducted by student with interactive and engaging content (Siemens, 2014).

Results of Questionnaire Study

With the first part of the study using questionnaires, we wanted to find out what opportunities exist within mobility that support digital learning. It should be pointed out that the experiences students had with learning with digital tools occurred at the same time that the COVID-19 pandemic started (this part of study was conducted between April and June 2020). Some of our respondents were participants of traditional mobility programs, and because of the lockdowns imposed on university premises, HEI were forced to turn the traditional, face-to-face courses into online courses. Those students had the opportunity to start their mobility in the traditional way; however, the lockdown imposed by government policy decisions resulted in their mobility being moved over into a digital learning environment. The other group of students who were practicing digital learning within their mobility were students that finished their mobility programs before the COVID-19 outbreak and were participating in mobility and digital tools at their home university. For both groups, the digital learning environment was incorporated into their traditional mobility programs and was perceived as part of traditional mobility.

Examples of students' comments:

> Student [18]: Most of our learning involve digital tools, like I use this kind of tools to study at my university and it wasn't any different to going abroad and taking courses at my university.
>
> Student [64]: I had lectures at my home university and I had online course.
>
> Student [69]: I was involved in a 1-year long training programme in my country which included both learning via digital platforms and learning with my peers together at short trainings requiring physical presence.

Students told us that the digital environment of students' mobility might be useful for different reasons, for example, family matters like looking after family members.

Examples of students' comments:

> Student [41]: It is a solution for a classmate of mine who can't leave home and go abroad because she is looking after her mother.
>
> Student [72]: I know someone who would take online courses during mobility, this person is a university student and a young mother and I know she would not go abroad for mobility with her child.

When considering experiences with blended learning during their mobility time, in the opinion of students, learning with digital tools requires skills; in particular, good time management, motivation to learn and focus on what is being expected from students to participate in the course. Digital learning can be experienced as less interesting than traditional learning because of the lack of interactions with teachers and peers. Students also pointed out the need to include methods of teaching (project group work) that support interactions with peers.

Examples of students' comments:

> Student [39]: Not having feedback from the teacher, and having limited feedback from fellow students.
>
> Student [56]: Teachers should always take attendance because if they didn't, I would not attend personally and some teachers refused to record the sessions and online learning can be more distracting than physical attendance that's why recording is important.

We asked students about the motivations, focusing on benefits they noticed of mobility with digital tools. Four most popular benefits marked by students referred to the development of digital skills and knowledge in the study field (number of students that choose this answer 28), followed by international experience (22), communication in a foreign language (17), and improved career opportunities (8). We also asked students if there would be an opportunity to take part in learning with digital tools what would be their motivations to take part in such learning, the most represented answer was gaining knowledge (35), focus on program of training (26), and to try to learn only in virtual environment (21) gaining digital skills (14).

Looking at the respondents, we noticed a strong focus on the study field, development of digital tools for learning purposes and gaining international experience in learning by participating in courses at a foreign university. The digital learning environment did not benefit students in terms of finding friends, building network with peers in learning, developing motivation in learning, or dealing with stress within learning.

Results of Group Interviews

Experiences of Students with ICT at HEI

In the second part of the study, the background for experiences with learning in digital tools within academia was the specific field of study in question, that is, educational science.

Students asked about their experiences with ICT at HEI divided time into "the time before the COVID-19 pandemic" and "during the COVID-19 pandemic." All participants of the GI agreed that "before" their use of ICT at HEI was very limited. ICT using was reduced for paper preparation or preparation of PowerPoint presentation.

> Student [2]: Before the pandemic, we didn't really use ICT. All group work was done face to face, no one even thought of meeting on TEAMS, at most, we had a group on Messenger and there we set a deadline, or sent a file. Also, teachers didn't take advantage of it.

At the same time, GI participants indicated that they did not lack ICT at the HEI, and even perceived it as a natural consequence of their choice of field of study. Below are the responses of selected participants:

> Student [10]: I was never good at maths and I never even imagined that I could study IT. I chose pedagogy, and here, completely different knowledge, skills are important.
>
> Male Student (MS): I study Sports Education. I expected sport classes, maybe such things related to the human body. If I had to learn computer science here, I would probably never make it to the second year.

It is also worth noting that 80% of GI participants (both gender) declared that their ICT competencies were limited. Students claimed that their use of technology within HEI was narrowed down to writing papers, preparing presentations, and using instant messaging. In contrast, in non-university activities, they used IT mainly to watch YouTube and use social media. Discord also emerged among male students as a platform they described as typical for gamers. The 10 students whose family members are abroad also mentioned Skype as the communicator they use to keep in touch with their relatives. The following statement made by one of the students may serve as an empirical example:

> Student [15]: I have never been attracted to IT. Yes, I use it like everyone else, but it probably doesn't mean that I have any great competencies.

Students were also asked for their opinion on why IT (prior to the pandemic outbreak) was not used in education in their field of study. Most of them pointed out the type of studies, which is the opposite of technical studies. They emphasized that people who choose to study educational studies have different skills and are more socially oriented, which determines their choice of teaching methods and tools. Most of the participants pointed out that most likely, no one had considered before that teaching at their faculty could be done with the use of IT technologies. Below is the statement of one of the students:

> Student [8]: If you want to study IT, you go to a technical university. If you want to work with people, you go into education. I think that the teachers at our faculty have similar knowledge and IT skills to us. Sometimes maybe even less. So, how can we learn about IT and its use, when teachers also have such poor knowledge in this area.

Another student, drew attention to the teaching priorities of her faculty, which are related to the development of interpersonal skills and, therefore, the importance of practical classes, whose task is to prepare students for future professional work.

> Student [6]: It's important for us to get along with other people. So we have a lot of internships that give us a chance to get in touch with others.

One of the participants mentioned a subject called "IT in Education," which in his opinion was a second-class subject, and nobody, including the teacher, attached much importance to it.

> Student [3]: It was a kind of a subject to fill a hole. We were supposed to do some project or something, but it was a total failure. Nobody cared about it.

It is worth noting that all students passed the course and only the remark of one of the classmates reminded them of this subject.

> Students [4]: Ah yes, actually, there was something like that, but I don't even remember what it was about.

There was consensus among GI participants that the COVID-19 pandemic changed everything for ICT at HEI. According to them, the timing of the pandemic was a turning point in the use of ICT in their faculty. One student described the situation this way:

> Student [15]: Since we had no experience, I think both students and teachers - no one knew what to do at first. We got some emails, jobs to do, but it was a total failure. Then TEAMS came in. It was hard at first too, but after almost a year we got used to it.

All of the students had similarly bitter feelings about the beginnings of teaching through technology. After a few months of experience, opinions about this form of teaching were somewhat more varied. About 80% of participants mentioned among the advantages, the opportunity to develop their IT skills, including the most frequently mentioned: "getting used to IT." An empirical example is provided by two participants.

> Student [20]: In the beginning, the vision of studying on TEAMS, really stressed me out. Anyway, after a few months, I got used to it and started to wonder why I was afraid of it in the first place.
>
> Moderator: Why do they stress you out?
>
> Student [20]: Well, I think the hardest thing is to understand the instructions. This language is so unintelligible, for ordinary people.
>
> Student [19]: Through all this I had to learn technology somehow. Now I feel more confident.

Half of the participants in the interviews (20 people) pointed out that the classes were made more interesting by having teachers from foreign universities teaching and having the opportunity to test their language skills. Below is a statement from one of the students:

> Student [10]: Thanks to the fact that we had online classes, the instructor invited guests from abroad to give us a lecture. It was an interesting experience that I didn't have before. It convinced me that I am able to understand more scientific English.

In addition, four persons noted that the previously mentioned lectures in English emboldened them to apply for participation in the International Days organized online by the foreign university. Two people reported that they had already participated in something similar in October 2020, also in the online version. The students who participated rated the meeting as interesting, but at times difficult. The difficulty was mainly in not knowing people from another university, which, they emphasized, was rather intimidating and made them afraid to speak. It is also worth noting that none of the above persons had previously considered a learning abroad due to family commitments. The chance for international experiences during their studies, paradoxically, came at a time of reduced physical travel and increased use of digital tools in the learning process.

Challenges for IT at HEI

Despite the expanding list of advantages of using IT, students highlighted difficulties that they believe continue to pose challenges to the use of IT.

First, participants mentioned integration and social inclusion. Many of them pointed out that contact via the Internet is not able to replace face-to-face contact. Most of the participants, in the initial stage of the transition from traditional to online learning, declared experiencing feelings of loneliness. The words of one of the students may serve as an illustration:

> Student [24]: when you're at a lecture, you can always look to your left or right and there's someone sitting there. And here there's nobody.

According to the students, the feeling of loneliness is compounded by the fact that people have their cameras turned off during online classes. Therefore, if they did not have the opportunity to get to know someone beforehand, they may not even know who makes up the "group" with them. In turn, the lack of knowledge about the other participants in the class, according to students, limited their participation in the class, for example, they are less bold when speaking in public, they do not want to turn on the camera when others do not, etc.

> Student [18]: I have a problem with speaking up, and I think it's because I don't know others that stops me from expressing my opinion.

Another issue highlighted by the participants was the constraints on the development of skills relevant to their discipline of study. Here, they returned to the issue of interpersonal skills.

> Student [14]: it's very important how well you learn to react to situations, and to talk to pupils when you don't have personal contact with them.

Five students pointed out the lack of access to technology, which limited their ability to participate in classes.

> Student [13]: Well, my laptop just broke down, and then it was a tragedy.

After that remark, another person pointed out the difficulties experienced by children from less affluent environments:

> Student [30]: In the future I'm going to work mainly with people with various problems, including economic problems; I can imagine that many of them don't have a computer. So it's hard to think about using IT in education for good without giving students access to IT.

All participants pointed out that the basic challenge for IT in HEIs is to ensure the quality of contact with other people. Creating this kind of working conditions in which individual members of the group will identify with it and its goals. When asked how, in their opinion, this can be achieved, among the possible solutions they most often mentioned was changing the orientation of the activity from individual to group. Below are statements of two students:

> Student [22]: this is a difficult task, but maybe more group work instead of individual work. Then the chance for integration grows.
>
> Student [27]: It was great when we presented something for the exam during one of the classes and the whole group, and especially those who listened to us, were very supportive. They responded to our questions, joined the quizzes. I think that teamwork is a solution in such situations.

The Future of IT at HEI in the Field of Educational Studies

The last question that was asked to the participants concerned the possibility of using IT at HEI in the future. From the perspective of all participants, use of IT in their discipline should be increased in the future. According to them, the outbreak of the pandemic made them and also the teachers realize that regardless of the type of study, technological/digital skills should be developed in everyone, at least in the basic variant. One of the students commented on this issue as follows:

> Student [19]: We thought we didn't have to do anything about IT. The pandemic opened our eyes. For it turns out that the lack of computer skills at that time was crucial.

The GI participants pointed out that the previous neglect of IT education in their faculty, although fully understood by them up until the outbreak of the pandemic, should no longer be allowed to continue in the post COVID-19 period. According to them, IT education in pedagogical studies should be given more importance, not only in order to be prepared for the circumstance of another epidemic outbreak, but mainly because of the alignment of education standards with modern trends.

Students also highlighted new opportunities that come with the technologization of education. Ten of them drew attention to the possibility of increasing the internationalization of education, increasing the attractiveness of classes. Below are some of their statements:

> Student [24]: Imagine a geography lesson. Students could meet online with someone from that area and ask him/her directly what something means, e.g. rainy season.
>
> Student [26]: Foreign Language Lessons. You could create duos of students from our school and some foreign school. The students would learn to talk with them, not this hopeless grammar, where you can't say a word when you have someone to talk to.

For years, traditional student mobility has been associated with going abroad on the Erasmus program to study at a European university to gain international experience. Traditional student mobility has been viewed in terms of lack of social inclusivity, being the preserve of young people from privileged backgrounds (Murphy-Lejeune, 2002). Studies of Recchi and Favel (2009) and Roeder (2011) show that transnational cooperation, mobility exchange, going abroad to study for some time abroad foster European identity (Oborune, 2013), and these support international experiences of learning rather than social inclusion. In other words, students from less affluent socio-economic backgrounds have fewer opportunities to have experiences abroad before or during their study by not participating in an international mobility program (Kuhn, 2016).

Conclusions and Discussion

In the questionnaire study, we wanted to find out what opportunities exist within mobility that support digital learning and what are functions of digital tools in higher education learning. Looking at recent Erasmus+ mobility policies (European Commission, 2020), the current Erasmus+ with its focus on digital environment of students learning is expected to be more inclusive for disabled students with physical, mental, or health-related conditions, and it follows our findings about the potentially inclusive character of digital tools within academia. Our study shows that function of digital tools within academia is inclusion into international learning of those students that were not able to take part in a mobility exchange due to obligations such as looking after a family member. By incorporating digital tools into the students' mobility program, international experience can be gained by a wider group of students, often by those that were excluded from such learning experience (we call this inclusive function of digital tools). Assuming that digital tools within mobility exchange do have the inclusive features mentioned above (there is potential to include wider groups of students with personal obligations), digital tools offer students' courses that they would not participate into during their university education. We also found confirmation of this conclusion in the responses of GI participants who, thanks to HEI technology, including teaching mobility, decided to participate in international events organized by foreign universities. This gives us reason to claim that the use of digital tools will include and encourage students, who previously, due to the various reasons mentioned above, did not consider this option, to expand their knowledge, skills, and competencies in the international arena. Studies on social inclusion within HEI show that the academic success of students is dependent on university provision of services (i.e., counselling) or extended processing times (Bartz, 2020). Due to the incorporation of digital tools, institutional factors do not play a priority role in the success of a university.

Existing studies provide information that mobility program functions in aiding students to enhance their personal development or learning to communicate in a new language (Van Maele et al., 2016). Also studies on abroad experiences of students show that the motivations to take part in mobility exchange aid in improvement of language skills or cultural awareness. Focus on the study field or professional development seems to be less motivating in traditional mobility (Holicza & Kata, 2018). Our study shows that digital tools change this function in that way that students when participating in online courses want to develop mainly their knowledge by focusing on course content and digital skills. The reason for it is because students believe that international experience and digital environment of learning will develop their digital skills what will be beneficiary for career development after graduation from university. In other words, the function of digital tools in learning within mobility is expansion of career opportunities that are offered through digital tools by learning within courses at foreign HEI (we call this career-oriented function of digital tools).

In the GI study, we wanted better to understand the students' perspectives on digital learning. The students participating in the interviews were students of educational studies, which are mostly perceived as the opposite of IT studies. Those who took part in the interviews confirmed this belief. Considering that students career choice requires them to acquire social skills, interpersonal skills, communication skills, etc., instead of technical/digital skills. Many authors point out the contribution of gender ideology to the socialization process, which is a determinant for students' educational choices (Charles and Bradley, 2009; Pinxten et al., 2013). Our research confirmed previous findings. It is worth noting that in the GI conducted, the percentage of males (45%) was slightly lower than females (55%). However, this empirical evidence does not contradict typical, from the perspective of gender ideology educational choices because the male students who participated in the study were Sport Education students, which is considered in the category of typical "masculine choice" (Perra and Ruspini, 2013). The participants in our interviews declared limited knowledge, skills and competencies in IT, in favor of soft or transversal skills, which is also confirmed by previous research results (i.e., Pereira & Costa, 2017). However, the results of our study may suggest that the limited skills in this area may be conditioned by the respondents' previous limited intentional experiences in this area, which can be understood as the effect of predispositions attributed to them by significant others (e.g., family, teacher) as well as role expectations internalized in the socialization process, but also the internalized interpretive pattern according to which educational sciences is a non-technologized area of learning and practice (we call this academic function of digital tools). These issues have also been highlighted by Hyde and Mertz (2009) whose research showed up the limited importance of aptitude or ability in students' educational choices. These same studies have highlighted the importance of socio-cultural conditioning and the social expectations that exist within it that shape the self-image of the future. We argue that changes in the social pattern of interpreting who is "fit" for a certain type of role can significantly affect the social inclusion of groups not represented in IT. Changes would need to be made to HEI curricula, which currently provide little opportunity to explore forms of education using digital tools, thereby reinforcing the common perception of the educational sciences as a non-technologized field of study. In addition, the issue of social inclusion through digital is still a major challenge, as illustrated by the statements of students. The global crisis related to the COVID-19 pandemic has forced representatives of the educational sciences to use digital tools. This situation has already drawn their attention to the importance of digital tools in education and increased their sense of empowerment by using IT. At the moment, it is worth continuing to develop skills and to think about future educational opportunities in HEI in the field of educational sciences using digital tools.

References

Alon, S., & DiPrete, T. A. (2015). Gender differences in the formation of a field of study choice set. *Sociological Science, 2*, 50–81. https://doi.org/10.15195/v2.a5

Atkinson, T., Cantillon, B., & Nolan, B. (2005). *Social indicators. The EY and social inclusion*. Oxford University Press.

Barron, B. (2006). Interest and self-sustained learning as catalysts of development: A learning ecology perspective. *Human Development, 49*, 193–224. https://doi.org/10.1159/000094368

Bartz, J. (2020). All inclusive?! Empirical insights into individual experiences of students with disabilities and mental disorders at German universities and implications for inclusive higher education. *Education Sciences, 10*(9), 223. https://doi.org/10.3390/educsci10090223

Berger, L. P., & Luckmann, T. (1967). *The social contruction of reality: A treatise in the sociology of knowledge*. Anchor Books.

Bertea, P. (2009). Measuring students attitude towards e-learning A case study. Proceedings of the 5th standing conference on e-learning and software for development held in Bucharest from 09-10 April 2009. *Bucharist Romania*, 1–8.

Cable, D. M., & Parsons, C. K. (2001). Socialization tactics and person–organization fit. *Personnel Psychology, 54*(1), 1–23. https://doi.org/10.1111/j.1744-6570.2001.tb00083.x

Cavanaugh, C. E., Petras, H., & Martins, S. S. (2015). Gender-specific profiles of adverse childhood experiences, past year mental and substance use disorders, and their associations among a national sample of adults in the United States. *Social Psychiatry and Psychiatric Epidemiology, 50*(8):1257–66. https://doi.org/10.1007/s00127-015-1024-3

Charles, M., & Bradley, K. (2009). Indulging Our Gendered Selves? Sex Segregation by Field of Study in 44 Countries. *American Journal of Sociology, 114*(4), 924–976. https://doi.org/10.1086/595942

Dabbagh, N. (2007). The online learner: Characteristics and pedagogical implications. *Contemporary Issues in Technology and Teacher Education, 7*(3), 217–226.

European Commission. (2020). *Erasmus+ mobility programme*. https://ec.europa.eu/programmes/erasmus-plus/opportunities/individuals/physical-mental-conditions_en

Fook, J., Collington, V., Ross, F., Ruch, G., & West, L. (2015). *Researching critical reflection. Multidisciplinary perspectives*. Routledge.

Gros, B., & García-Peñalvo, F. J. (2016). Future trends in the design strategies and technological affordances of E-learning. In M. Spector, B. B. Lockee, & M. D. Childress (Eds.), *Learning, design, and technology. An international compendium of theory, research, practice, and policy* (pp. 1–23). Springer International Publishing. https://doi.org/10.1007/978-3-319-17727-4_67-1

Guri-Rosenblit, S. (2005). 'Distance education' and 'e-learning': Not the same thing. *Higher Education, 49*, 467–493. https://doi.org/10.1007/s10734-004-0040-0

Hanson, D., Maushak, N. J., Schlosser, C. A., Anderson, M. L., Sorensen, C., & Simonson, M. (1997). *Distance education: Review of the literature* (2nd ed.). Association for Educational Communications and Technology.

Holicza, P., Kata, T. (2018). *Erasmus student exchange: Key motivations and future expectations of participants*. https://www.researchgate.net/publication/325763530_Erasmus_Student_Exchange_Key_Motivations_and_Future_Expectations_of_Participants

Hyde, J. S., & Mertz, J. E. (2009). Gender, culture, and mathematics performance. *Proceedings of the National Academy of Sciences, 106*(22), 8801–8807. https://doi.org/10.1073/pnas.0901265106

Ife, J. (1997). *Rethinking social work: Towards critical practice*. Longman.

Kuhn, T. (2016). The social stratification of European schoolchildren's transnational experiences; a cross-country analysis of international civics and citizenship study. *European Sociological Review, 32*(2), 266–279.

Littlefield, M. B., & Roberson, K. C. (2005). Computer technology for the feminist classroom. *Affillia, 20*(2), 186–202.

McConnell, D. (2006). *E-learning groups and communities*. Open University Press.

Minović, M., García-Peñalvo, F. J., & Kearney, N. A. (2016). Gamification in engineering education. *International Journal of Engineering Education (IJEE), 32*(1B), 308–309.

Mitra, A., & Steffensmeier, T. (2000). Changes in student attitudes and student computer use in a computer-enriched environment. *Journal of Research on Computing in Education, 32*(3), 417–433. https://doi.org/10.1080/08886504.2000.10782289

Morley, C. (2003). Towards critical social work practice in mental health. *Journal of Progressive Human Services, 14*(1), 61–84. https://doi.org/10.1300/J059v14n01_05

Murphy-Lejeune, E. (2002). *Student mobility and narrative in Europe: The new strangers*. Routledge.

Nichols, M. (2003). *A theory for online learning*. Retrieved 11 Oct 2020. www.ifets.inf/journals/6_2/1.pdf

Noesgaard, S. S., & Ørngreen, R. (2015). The effectiveness of e-learning: An explorative and integrative review of the definitions, methodologies and factors that promote e-learning effectiveness. *Electronic Journal of e-Learning, 13*(4), 278–290.

Oborune, K. (2013). Becoming more european after erasmus? The impact of the erasmus programme on political and cultural identity. *Epiphany, 6*(1), 182–202. https://doi.org/10.21533/epiphany.v6i1.60

Perra, M., & Ruspini, E. (2013). Men who work in 'non-traditional' occupations. *International Review of Sociology, 23*, 265–270. https://doi.org/10.1080/03906701.2013.804288

Pereira, P., & Costa, A. (2017). The importance of soft skills in the university academic curriculum: The perceptions of the students in the new society of knowledge. *International Journal of Business and Social Research, 7*(3), 25–34. https://doi.org/10.18533/ijbsr.v7i6.1052

Pinxten, M., Fraine, B., Damme, J., & D'Haenens, E. (2013). Student achievement and academic selfconcept among secondary students in Flanders: Gender and changes over time. *Irish Educational Studies, 32*, 157. https://doi.org/10.1080/03323315.2012.749058

Quinney, A. (2005). 'Placements online': Student experiences of a website to support learning in practice settings. *Social Work Education, 24*(4), 439–450.

Recchi, E., & Favel, A. (2009). *Pioneers of European integration: Citizenship and mobility in the EU*. Edward Elgar.

Roeder, A. (2011). Does mobility matter for attitudes to Europe? A multi-level analysis of immigrants' attitudes to European unification. *Political Studies, 59*(2), 458–471.

Siemens, G. (2014). *Digital Learning Research Network (dLRN)*. Retrieved from http://www.elearnspace.org/blog/2014/11/18/digital-learning-research-network-dlrn/

Stöter, J., Bullen, M., Zawacki-Richter, O., & von Prümmer, C. (2014). From the back door into the mainstream: The characteristics of lifelong learners. In O. Zawacki-Richter & T. Anderson (Eds.), *Online distance education: Towards a research agenda*. Athabasca University Press.

Sweeney, J., O'Donoghue, T., & Whitehead, C. (2004). Traditional face-to-face and web-based tutorials: A study of university students' perspectives on the roles of tutorial participants. *Teaching in Higher Education, 9*(3), 311–323.

Tan, E., & Loughlin, E. (2014). Using 'Formally' informal blogs to reate learning communities for students on a teaching and learning programme: Peer mentoring and reflective spaces. In F. J. García (Ed.), *Online tutor 2.0: Methodologies and case studies for successful learning* (pp. 163–175). IGI Global.

Ullah, O., Khan, W., & Khan, A. (2017). Students' attitude towards online learning at tertiary level. *PUTAJ–Humanities and Social Sciences, 25*(1–2), 63–82.

Van der Vleuten, M., Jaspers, E., Maas, I., & van der Lippe, T. (2016). Boys' and girls' educational choices in secondary education. The role of gender ideology. *Educational Studies, 42*(2), 181–200. https://doi.org/10.1080/03055698.2016.1160821

Van Maele, J., Vassilicos, B., & Borghetti, C. (2016). Mobile students' appraisals of keys to a successful stay abroad experience: Hints from the IEREST project. *Language and Intercultural Communication, 16*(3), 384–401.

Wenger, E. C. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge University Press.

Wilson, T. P. (1973). Normative and interoretative paradigms in sociology. In J. D. Douglas (Ed.), *Understanding everyday life. Toward reconstruction of sociliogical knowledge* (pp. 57–79). Routledge & Kegan Paul.

Psychogeography and Digital Technologies: Inclusive Creative Experiences in an Academic Environment

Agnes Papadopoulou and Iakovos Panagopoulos

Introduction

Various places populated with buildings, structures, monuments, etc., are designed purposely to affect how people interact with, occasionally to encourage them to re-evaluate their relationship with the surrounding environment, as monasteries and churches salve fears with the promise of an afterlife (Ellard, 2015, p. 16) and to exert power and authority over visitors' behavior. The way places are designed influences people's mind. People often seek out particular spaces precisely because they want to experience these influences. Particularly, in schools, universities, and other learning institutions, it is important to students to ask themselves if they have a feeling suitable for the specific place, the classroom, where sometimes they have an interesting and long history. When students are at a younger age, they do not have a clear understanding of the gap of time that separates them from the time that the learning space was firstly established and especially the historical steps and human inhabitants that existed, lived, and functioned over the years in it. University students can realize the range of changes that took place over the years.

University students can use their knowledge to examine and understand if the habitants of any space give attention to places' characteristics, what they are, and whether they are pleasant or not. People feel and respond on an emotional level, and although their feelings influence them how they behave and act, usually they do not pay much attention or analyses their everyday reactions to place. The proposed

A. Papadopoulou
Department of Audio & Visual Arts, Ionian University, Corfu, Greece
e-mail: a.papadop@ionio.gr

I. Panagopoulos (✉)
Panteion University Department of Political Science and History, Athens, Greece
e-mail: info@iakovospanagopoulos.com

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_17

project pushes students to observe the place, film it, and reveal perplexed relationships between them in place gained experiences and place itself. Students from the Department of Audio & Visual Arts of Ionian University utilize both theory and digital technologies to explore these relationships.

Space, Place, and Landscape: It Is All About the Experience

Place is conceived as a common experience. Place connects with memories, collectivity, and shared experience. The term "landscape" means to suggest a cultural definition of the place, which in the simplest case, is limited to the perception and interpretation of it, while in the most complex cases, it includes the structural and constructive intervention. So, the landscape, although it presupposes the self-existent place, evidently transcends it. It is composed of cultural sense, social activities that are multiple and intertwined, whether they refer at first to the place or end up in it, as a final projection of participants' conceptions. Landscape is not a strictly geographical concept, but it is an interdisciplinary concept (as the subject of humanities studies, architecture, etc.) which can potentially be a "platform" for collaboration between habitants, scientists, artists, cultural, artistic, and environmental associations for human-space interactions. Rubenstein (2016) states that geographical scientists ask where and why, while historians ask when and why. All converge to a living area conception with an easier and more convenient way. Also, he offers a definition about a mental map that "*is a personal representation of a portion of Earth's surface. A mental map depicts what an individual knows about a place, and it contains personal impressions of what is in the place and where the place is located*" (Rubenstein, 2016, p. 8). He also refers to world's longest place name, in New Zealand that it is translated from the Maori language as "*The summit where Tamatea, the man with the big knees, the climber of mountains, the land-swallower who travelled about, played his nose flute to his loved one*" (Rubenstein, 2016, p. 14). So, morphological and physical features define a place, but the importance, the value of the place, and the way it is approached are characteristics that are not defined on an absolute basis.

If humans want to define and interpret the surrounding environment, they analyze and describe the experience they have with this area. It is a three-dimensional area occupied by a body or many coexisting bodies. The experience of the space is personal. In this project, we are intending students to shape an image of the space as a personal cinematic recording and capture. The image, the story of cinema images, serves to challenge the relationship between the power of words and the power of the visible, with a new measure called sentence-image, since the sentence is not what it says and the image is not visible. According to Rancière, with the term "sentence-image" we come to the union of two functions that must be defined aesthetically, that is, by the way in which they negate the typical relation of the text with the image (Rancière, 2009). For the strength of descriptions, Rancière (2003) states that the sentence always carves into flesh and defends no longer the freedom of representation but the suspension of representation. The suspended relationship is also the nonplace of the poem itself (Rancière, 2006, p. 101). He continues by saying that "*the tension between the 'images that speak for themselves' and the words that make them speak, is when all is said and done, the tension between the idea of the image and image matter. The real issue has nothing to do with the technical apparatus, but is still a matter of poetics*" (Rancière, 2006, p. 170). This is what we asked from the participating students in this project – their experience with the space, a new look about that. The fragmentary nature of the student's experience with space is negated, due to their own particular look and its cinematic capture. They function as consciously acting subjects, but in poetic terms, seeking interaction with the whole, through their own view, through their intervention.

Perec states that life is about moving from one place to another, trying (as much as someone can) not to stumble (Perec, 2000, p. 14). So, we aim to study not so much the history of the space of the former psychiatric hospital, now university campus, as students create their own roles in this place. This does not mean that the previous narratives do not matter in order to understand the place, but it is necessary to create a way of contact of the student with the space, beyond the specific use of this university space. Every space can share commonly perceived messages, but it also has to promote authentic, interpersonal relationships. According to Perec, "*space is a doubt: I must constantly mark it, name it; it is never mine, it has never been given to me, I must constantly conquer it*" (Perec, 2000, p. 128). He himself meticulously tried to extract specific memories from the void, to leave somewhere a trace, a mark, and some stigmas.

Audiovisual depictions extend beyond the projected space. They highlight relationships that can be associated with a large number of different social practices by connecting the scattered members of an invisible audience (Jackson, 1989). The transcription of reality through the actions of the acting subjects creates actions so remarkable when the link between the action and the actor is an original relationship that offers the ability of oneself expression (Ricoeur, 1992; Downes, 2020). The transfer of reality through the camera aims to highlight different ways of approaching the space. Specifically, in that psychiatric hospital, patients were locked in cells, taken out to the central area, the yard, and kept under observation. Students usually report and insist on this fact. Foucault (1980, 1995) uses the term "Panoptisme" for the situation of constant surveillance, referring more to the area of the prison, not accidentally of course, but constructing it based on an eighteenth-century term that shaped the nature of prison: this is the "Panopticon," the proposal of the British philosopher and theorist John Bentham for the construction of prisons. In 1785, Bentham conceived an architectural system based on the idea of a single guardian being able to monitor all prisoners in cells in a circular building (Bentham, 1995). It is worth taking into account if it is possible an "analogous transfer" of that close observation in this campus. Students need to ask themselves if they remain closed in their space and communication being difficult, and while they are closed, they are constantly connected to sources of confusing information, which information does not reveal the truth to them. This confuses them more than clear things up.

The aim of this project is to prevent student dropouts. Discussions with students about how they experience the university space lead to the role of the university, which complies with three functions: research, education, and self-cultivation. Research is not only about useful knowledge, but the ability of students to acquire the necessary knowledge and/or skills on their own initiative, and this ability is acquired through familiarity with research methods. Universities as institutions are engaged in the search for truth that belongs to the whole society. They are the only institutions that ought to remain faithful to their duty to prevent the society from a potential misuse of research and knowledge. Universities have the privilege of seeking the truth on behalf of society, away from simplistic opinions on various issues and independent of the interests and influences of various factors. The dynamics of the university space is revealed in everyday life and is reflected as a reality in the minds of students. They need to constantly wonder how the space could obtain stronger dynamics. This challenge acts as a driving force that triggers their thinking and urges them to participate more intensely. Their participation turns the place into a lively and creative experience, and their own originally planned stories are crucial steps onto an inclusive process.

Visualizing the cultural characteristics of a place needs the creator's sense of familiarity. Otherwise, they are simple descriptions, leading everyone to isolate his thinking, in contrast the students wandering around the space and filming is like a ceremony that brings the group together. Ricoeur (2008) states that descriptions, written texts, move the members of a community away from the ceremonies that bring it together. The sense of belonging closely in university space through the filming also functions as a way of managing the frustrating reality and targets students who tend to drop out of their studies. Students being and reacting within the university space, their critical perception and creative conception of this current reality, become a psychogeographical combination of experiential "readings" and personal interpretations, in idiosyncratical and aesthetic terms. The students' audiovisual depictions change the space and transform it, defining the place differently in aesthetic terms.

Place Is Specific, Although Psychogeographically Transformed

The place where Ionian University Departments is located is a special place, within its own history. It literally and figuratively contains the transformation. From the first psychiatric hospital in Greece, founded in 1838, almost a century and a half later, buildings were gradually granted to house administrative services and teaching classrooms of the Ionian University Departments. The buildings have been renovated, although they are the same buildings. According to Heidegger (1999) the building makes the place. Malpas says: "*Heidegger does in his later thinking is to think being through place, and if the structure that is set out in essays like 'Building Dwelling Thinking' is the structure of place, then this seems to me to force us to recognize the way in which what is given here is indeed a structure that is* *constituted through the mutual interplay of multiple elements, a structure that encompasses the entities and elements that appear within it rather than underlying them, a structure to which belongs a unity that is given only in and through the mutual relatedness of the elements that make it up*" (Malpas, 2012, p. 40).

In the chapter The Rejection of Alberti's Window, of the book *The Eyes of the Skin,* Pallasmaa notes: "*we tend to interpret a building as an analogue to our body, and vice versa. Paul Cézanne aspires to make visible how the world touches us. Land artists fuse the reality of the work with the reality for the lived word, and finally, artists such as Richard Serra directly address the body as well as our experiences of horizontality and verticality, materiality, gravity and weight*" (Pallasmaa, 2012, pp. 38–39). Each place has multiple readings. This space may for some students be seen as a silent landscape, an isolated landscape that once was or be commented as it is now, a landscape of noise, due to the gathering of many students. Noises, non-silence interferences, are many and varied. Silence is one, but it can still have multiple "shades" created from the other elements of the space. It is understood that space is experienced in combination with all the senses and not only with vision (so there is an acoustic landscape, an olfactory landscape, etc.). The visual images, the sounds, the touch, the humidity, the dryness, and the imaginary readings emphasize this possibility of multiple reading of the space (Pocock, 2014). Each student can have a different view and perception of the space, that is, to perceive the elements that compose it according to their personal experiences and codes of aesthetics. According to Debord "*psychogeography is the study of the specific effects of the geographical environment whether consciously organized or not on the emotions and behavior of individuals*" (Debord, 2006b, p. 51). The place is not limited to real experience, but it is creatively enriched with imaginary and symbolic images, based on personally accepted myths (Tso, 2020). Texts, photographs, emotions, and verbal events are elements of an artistic creation, where the historical-geographical identity of the place is perplexed with the psychogeographical images of the students (Debord, 2006a, pp. 24–30).

Bachelard's Phenomenology and Philosophy of Imagination: Construct Images from Reality That Transcend Reality

Bachelard calls fantasy the ability of humans to cover with images their instincts and the conflicts that are created in their soul, as well as the fears and desires that they carry as a primitive heritage. Bachelard analyzes the meaning and representation of the four cosmic elements: fire, water, air, and earth. He stresses that some poetic works are better understandable, if a psychological complex is recognized, since a poetic work can acquire its coherence only from a complex, while if it is missing, the work seems cut off from its roots and does not communicate with the unconscious complexes (Bachelard, 2007, p. 81).

He focuses on various poetics and gives primacy on imagination, receiving images in a sort of transcendental acceptance of gifts (Bachelard, 1971, p. 65), discussing images of space, and his phenomenology of soul or phenomenology of the imagination does not aim to produce a theory of knowledge, but it is an immediate activity. Bachelard distinguishes his phenomenological method from psychology and psychoanalysis because the latter seeks to understand conceptually. Phenomenology, on the other hand, goes beyond the limits of causality and manages to capture the essence of poetic imagination, it means the study of the phenomenon of the poetic image, as it emerges in consciousness as a direct fruit of the heart, of the soul of human existence in the given moment (Bachelard, 2014, pp. 6–7). The poetic images express the creativity of the creator. He argues that it has a cross-subject value and as it is transmitted from one soul to another, it escapes the research of causality, since "causal beliefs" such as psychology or psychoanalysis are not able to determine the ontology of poetry.

It gives a triple character to the imagination: formal, material, dynamic, recognizing the possibility of constructing images from reality that transcend reality and also the ability to distort the images that come from perception (Bachelard, 2014, p. 8). The imagination functions poetically, as a source of poetic images and illuminates the consciousness of the subjects, who face these images. Equally important with the explained reality, as defined by psychoanalysis, is the accepted non-reality, while the cooperation of these two functions of the human mind grounds the poetic imagination, since a rhythm analysis is offered by the poem that weaves up real and unreal and gives dynamism with its dual activity of signaling and poetic expression.

Imagination is considered as a superior force of human nature that produces images, which are not equated with memories (Bachelard, 2014, pp. 24–25). In such a process, which is governed by poetic logic, the imagination, as a dream reality, proves to be more powerful than reality and common sense. The work of art is creation of life, not a continuation of the creator's life, because daydreaming transports the creators/artists to another world, transform them into other human beings, which are copies of themselves. Creators live intensely in the moment of their dream, and they have no past. Even time does not exist as a duration. The past is lost, the present is an archetype, which sleeps in the unconscious. The poetic image is not an echo of the individual's past, but awakes "primitive images." This applies to both the creator and the recipient/reader and viewer. The creative will of the creator is expressed, but the creator and the recipient are involved in a common daydreaming and the space is capturing them (Bachelard, 2014, pp. 11–12). Because students see each other's work and comment it, they don't function as a critic who is usually remote and in a certain distance from the artwork, but according to Bachelard "happy reading" can only exist as soon as students have no distance from the object of reading and their gaze is enthusiastic and at the same time creative. They are not passive recipients, they live the "poetic resilience."

Topo-analysis: An exploration of Students' Relationship to Those Spaces That Are Meaningful to Them

Bachelard argues that we must keep returning to a nascent state. The poetic image is a primitive dream, a result of consciousness. In his book *The Poetics of Space*, Bachelard proposes a new form of phenomenological approach to poetic images, the "topo-analysis," which is a systematic psychological study of the sites of our intimate lives (Bachelard, 2014, p. 27). The phenomenological reading of poetic imagination focuses on the study of the specific image, the words that describes it, the verse or sometimes the stanza in which the poetic image radiates, forming of a language that only a topo-analysis is entitled to study.

The students in this project, influenced by Bachelard, are guided by simplicity and immediacy of the senses. They focused on a small window, on the bars of the window cells, on the door to the laundry area of the psychiatric hospital, etc., detaching them from all the perceptible things that the students face inside the specific space. These became privileged objects, where their vision was selectively focused and mysteriously attracted the students' attention, despite all the other objects they indiscriminately glanced at. Rancière states: "*The moment arrives when the call of the void has an effect but no longer makes sense. The time to connect, explain, and heal has passed. Now something else is at stake: to repeat the event, go look somewhere else, see for oneself. This is how one falls into the unrepresentable, into a universe that is no longer the society sociologist and politicians talk about. For there are a finite number of possible statements, of credible ways of putting together a discourse or a set of images about society. And the moment arrives when the border is crossed and one enters into what makes there be sense, which for that very reason does not itself make sense, so that one must continue to walk under the sign of interruption, at the risk of losing the way*" (Rancière, 2003, p. 117).

The signified, that is, what used to be the Corfu Psychiatric Hospital and now the Ionian University Departments is not an immediate target of the project. Students' perceptions vary according to their beliefs and needs they value. The signified, that is, the meaning of the sign, can have a literal or even associative meaning. For example, the space of the psychiatric hospital is scary, sad, etc. In order to communicate with others, the signification is metaphorical, but not concerning only the individual. It is crucial to be understandable by a wider social field. Hence, students are dealing with how phenomena of importance are systematized. A first form of systematization is classification. In the field of the city history, what did the existence of the psychiatric hospital mean and what this implies brings the need to study archives, texts, essays, and reports. However, in this project, every reference concerning the existing space is followed by emotional reactions.

It helps to observe the place by noting the time, date, weather, and whatever remarkable is happening. They need to know how to distinguish the remarkable. If someone finds nothing impressive or interesting, then there is a notion that one does not know how to decode what one sees. Therefore, someone needs to observe thoroughly (Anderson, 2021), distinguishing buildings, signs, written walls, the people who move in the space, where they come from and where they go, if they are hurried or layabouts, if there are any animals in the space, are there any trees, if birds are heard, the orientation of the space, etc. Perec states that the wind blows from the sea and smells of the cities are pushed to the east in Europe and to the west in America (Perec, 2000, p. 85).

At the first stage of similar projects, descriptions about the space could be as neutral as possible and later, and descriptions about the space have to come from memory. Students are suggested to observe the space tactically, for example, in different seasons. Descriptions and photos from the space can be saved and exchanged among students, followed by discussions. From discussions, questions arise about how the space becomes lively. Usually, they propose the organizing of events, theatrical performances, musical concerts or because of a public gathering with specific requests. It is of great importance to create common experiences within this space in a physical presence. As Kwon (2002) points out, public artworks provide multiple engaging experiences that result from the physical presence of each spectator, in a sensory immediacy of spatial extension and duration, rather than momentarily perceived in a flash of inspiration by a bodiless "eye."

Widening Students' Participation via Sensing Differently Supports an Inclusive Environment

A fundamental purpose of education is to lead students think critically and freely. Therefore, they have to cooperate by developing further the knowledge using their own powers by creating content. Schools empower students with knowledge and skills, but they also awaken student's curiosity, in order to regain their strength by shifting their gaze. Lewis claims that "*to be intelligent is to experience the unsettling effects of curiosity on and in our bodily capacities. Rancière's disagreement with Freire becomes clear: the latter emphasizes the consciously directed and deliberate work of education to awaken curiosity and connect it with proper objects and proper goals while the former emphasizes the contingencies of an embodied curiosity to pull and be pulled in unforeseen directions that escape the conscious intentionality of the subject. In short, thinking accurately changes to sensing differently, and the educational goal shifts from consciousness-raising to perceptual alternation*" (Lewis, 2012, p. 102). This particular project is close to Ranciere's logic.

When students are in a space and their gaze is unable to be fed due to deterrent reality (in cases where due to various reasons lead to students drop out) their silence is indirectly imposed. Students adopt focusing on refusal strategies. University space operates as a different world from the "out there," where the out there can be inhospitable, because of the cities tiring living routines. But, also, "in here" could be accepted by a forced way, when students are not happy with the number, the variety of courses, and when they judge that course offered by the University

Department where they study are not properly oriented to their expectations. All these considerations matter and affect their gaze, and the use of their camera lenses, if they focus from the inside out, at the open horizon or vice versa.

The positive stance of a person in a work environment is based on two factors: (a) the "satisfaction" earned of the individual from environment, that is, the internal assessment of the individual as to whether the environment meets his needs and (b) of satisfactoriness, that is, the external evaluation of whether the individual can meet the requirements of the environment in which he lives/works (Dawis & Lofquist, 1993). In the first case, the individual's internal assessment of whether the environment meets his needs determines to a significant extent the individual functionality and, consequently, his positive adaptation to the environment. The external evaluation of when the individual (the student in this case) can meet the requirements of the environment in which he lives/works is also specified by the standards according to which the social context determines what behaviors the individual must display in order to be considered successfully adapted (Mahoney & Bergman, 2002). One behavior that is expected, for example, is for students to complete their assignments by the due dates.

Student dropout is associated with financial, family, social, educational, and personal difficulties. The combined effect of causes of student dropout is also possible. In relation to educational causes, there is the academic environment that has a decisive influence. The surrounding academic atmosphere, the role of culture and how it wishes to influence, to shape the student's identity is a factor that dictates attitudes and behaviors. In our public University Institutions, the institutional level takes care of and supports its students, thereby weakening causes of social exclusion that result in student dropout. Students can simply enroll in a department at the beginning, but not attend or they can interrupt their studies after a while and it can be a temporary interruption (possible attempt to take advantage of an opportunity) and then return to their studies or drop out permanently. Many students leave to contribute to the family income. Still, many drop out of school to enroll in another University Department following a different program or direction. There are also students who are thinking of leaving, but are reluctant to decide (would-be-leavers or reluctant stayers) because they feel that they did not find what they expected, and they did not find the right conditions. This project is addressed intendedly to reluctant stayers.

The effect of an unfriendly environment acts as a driving force in student dropout. Failure to form friendships, as feelings matter, is a factor that adversely affects. Their involvement in groups, in research activities, strengthening their relationship with other students and especially when the projects related to the university space, which acts as the reference space according to research activities, their bond becomes stronger. The participants in the specific project also attend the Special Curriculum of Pedagogical and Teaching Sufficiency of the Audio & Visual Department in Ionian University. They have been taught about the necessity of a successful revolution that establishes a new community (Goodman, 1971, 2012) and about Ward's contribution to radical pedagogy (Ward, 1995, 1996a, 2004). Ward based on the idea of using and utilizing the street of the urban environment as an educational tool influenced by Paul Goodman, but also in the teaching of Ancient

Athens, where the teacher and his students walked during the pedagogical process in the city, proposes the opening of the school in the city, the familiarization of the urban space by the children, and the use and utilization of the urban elements as pedagogical tools. Students are educated in the city and not in the restrictive and isolated space of the school. They are empowered and emancipated. No city is manageable unless it educates and develops citizens who feel it is their own (Goodman, 1964, 2010; Ward & Fyson, 1973). Projects and actions where children conduct research on their communities and communicate their findings to the public and to the authorities are necessary (Hart, 2014). The same goes for students. They need to feel familiar with the space (Ward, 1989), to function and develop within a particular space (Ward, 1996b), where they can envision a future society, where as citizens and workers, they will help to change any framework shaped and predetermined by others. The goal is to take action and form a spatial and temporal framework of freedom and creativity, by making good use of self-guided thinking. In this project, students realize that they do not have to depict reality involuntarily being disciplined to preselected ways of expression, and there is always the possibility of a different approach/view to envision their decisions' implementation. Their own gaze, towards the university space, as creators and also as spectators towards the other colleagues' works and how they imagined and depict the space empower students and connect them in a creative and interesting way with the university people and place.

Psychogeography Experiment in Audio & Visual Arts Department in Ionian University

We decided to apply some of the above principles as a part of the Pedagogical Sufficiency Program of the Department of Audio & Visual Arts of the Ionian University. The goal of this experiment was to use these techniques as a way to tackle university dropout. We realized that the second-year students of the Department of Audio & Visual Arts had just met the university space for the first time since they spent their first year under learning because of the COVID-19 pandemic. This specific focus group is extremely interesting since they are feeling completely detached from the physical space of the university. They have not used the classrooms, the laboratories, they have not met their professors, and they have not met their classmates. Even though they are in their second year, they are in the middle of the introduction process to the whole environment.

The space plays a really important role in this specific experiment. The Department of Audio & Visual Arts is based in the former psychiatric hospital of Corfu. This hospital was one of the first institutions in Greece with the first inmates since 10 March 1836 under the British Governor Sir Edward Douglas. As stated in the article entitled "*Hospitalization in the psychiatric hospital of Corfu in 19th century*": "*…on 18th November 1836 the President of the City Council submitted a* *draft certified to the Council for installation of Lunatics Foundation inside the Fortress of Saint Rocco (space occupied until today by the psychiatric hospital). On 2th July 1838 in the Official Gazette of the Ionian State was published the Statutes Ordinance and the Regulation for the establishment of the Bedlam of Corfu. The inauguration took place on 4 July 1838 when the first eight psychopaths were hospitalized. The majority of them was chronic, destitute and had severe mental illnesses*" (Lambrini et al., 2014).

This institution played a really crucial role to Corfu since it gathered patients from all the region and was working as an independent society. In Triantafilloudis's PhD thesis, there is an in-depth analysis on the socio-political aspects of the creation of the psychiatric hospital of Corfu (Triantafylloudis, 2017). He states that the hospital was working as a society with different social contracts and even the hospital staff spent most of their everyday life there. This reality created a "heterotopia," as Foucault characterized these places (Panagopoulos et al., 2021). As Foucault states: "*Utopias are sites with no real place. They are sites that have a general relation of direct or inverted analogy with the real space of Society. They present society itself in a perfected form, or else society turned upside down, but in any case these utopias are fundamentally unreal spaces. Heterotopias are probably in every culture, in every civilization, real places—places that do exist and that are formed in the very founding of society—which are something like counter-sites, a kind of effectively enacted utopia in which the real sites, all the other real sites that can be found within the culture, are simultaneously represented, contested, and inverted. Places of this kind are outside of all places, even though it may be possible to indicate their location in reality. I believe that between utopias and these quite other sites, these heterotopias, there might be a sort of mixed, joint experience, which would be the mirror. The mirror is, after all, a utopia, since it is a placeless place*" (Foucault, 2005).

This former "heterotopia" created the perfect location to organize our experiment with a very unique focus group. It is really important to state that the university campus is still the house of some offices of the psychiatric hospital where patients can collect their medicines. The students that participated in this project were 29 second- and first-year undergraduate students. The first stage of the data gathering of this experiment was to divide them into couples where they would have to interview each other with their mobile phone. They had to ask each other three questions:

- What is your first memory of this space?
- What kind of feeling this space provides you?
- What is your favorite memory of this space?

They uploaded all the interviews and the following data to a private Facebook group we created for this purpose, which is entitled *Avarts Psychogeography Experiment*. Most of the students described events associated with their first day in the university or memories with their classmates. It is quite interesting to note that almost all of them did not expect to study in this kind of location. Most of them felt that the space was quite bizarre. Also, many of the students said that they did not feel so connected with the space since they have not spent much time because of the

COVID-19 pandemic. This first information of the student's background and their experience with this space is really important for us, since it provides a better understanding of the focus group. For the second stage of this experiment, the participants would have to wander for 45 min inside the premises of the campus and record with their mobile phones evidence of its former use. They could either shoot a video or take a photo, but they would also have to support it with a short text. The data collected on this stage were extremely interesting with really powerful evidence of the location's former use.

For the next stage of the experiment, the participants had to underline these traits of the location's former use in the campus's top-view map that was printed for this purpose. The students were able, as a group, to locate all these traits that were collected by each of them and discuss the whole experience as well as to ask questions and find out more information about the space.

The next stage was to divide the students into three groups where they would have to create a short story with two basic characters. The only requirement was to place the story inside this location. The students created three stories in less than 30 min:

1. The first group created a story about a couple that faced a car accident outside the university location really late in the evening and they try to find some help because one of them is really injured.
2. The second group created a period story about two characters, a doctor and a patient in the psychiatric hospital of Corfu where the patient explains his past to the doctor during a therapy session and things go the wrong way.
3. The third story is placed during the period when the university co-existed with the psychiatric hospital. The story is about a university student who is filming his graduation film and his topic is an inmate of the clinic who was a serial killer.

These stories, even though they were completed in less than 30 min, were really interesting and also represented the way that the previous stages helped the students to understand the space and to provide more ideas about their stories. It is really important to note that this was the first time that the majority of the participants created a story. During the ideation process, all the students were really active and they really enjoyed the process. Also, in order to make their stories more accurate they were searching on their mobile phones, information regarding the hospital, the university, and the history of the space.

The last stage was when the students had to interview each other once again explaining how they felt about this whole process and if something changed about their connection with this space. This stage is really essential for the whole experiment, since it provides vital information about the student's final impact. Most of them described that they really enjoyed the experience and they felt that it was something quite unique and original. The most important aspect was that the vast majority of the participants stated that they felt more connected with the space and that now they understand more elements around its history and past.

Conclusion

The use of the above methodology helped the students to connect with their space and learn about its past and history. Students are intermingled with place and buildings that produce imagination and perception. Also, the key role of emotion that guides their behavior have a great impact on their understanding of how university campus influences them and their psychogeography. This creative process helped them to develop their own stories and works of art. The final impact we got from the participants' interviews was really important and helped us to understand the necessity of this process. The space that we used for this experiment was ideal, because of its rich history and past, but also because of the diversity of its use. Also, this specific focus group had all the elements that we needed since it was the first group of students that just started using the university space because of the COVID-19 pandemic.

Bibliography

Anderson, J. (2021). *Understanding cultural geography*. Routledge.

Bachelard, G. (1971). *The poetics of reverie*. Beacon.

Bachelard, G. (2007). *Water and dreams: An essay on the imagination of matter*. Hatzinikolis Publications.

Bachelard, G. (2014). *The poetics of space*. Hatzinikolis Publications.

Bentham, J. (1995). *The Panopticon writings*. Verso.

Dawis, R. V., & Lofquist, L. H. (1993). From TWA to PEC. *Journal of Vocational Behaviour, 43*, 113–121.

Debord, G. (2006a). Introduction to a critique of urban geography. In K. Knabb (Ed.), *Situationist international anthology* (pp. 24–30). Bureau of Public Secrets.

Debord, G. (2006b). Report on the construction of situations. In K. Knabb (Ed.), *Situationist international anthology* (pp. 50–81). Bureau of Public Secrets.

Downes, P. (2020). *Concentric space as a life principle beyond schopenhauer, nietzsche and ricoeur*. Routledge.

Ellard, C. (2015). *Places of the heart: The psychogeography of everyday life*. Bellevue Literary Press.

Foucault, M. (1980). Questions on geography. In E. Gordon (Ed.), *Power/knowledge: Se-lected interviews and other writings, 1972–1977* (pp. 63–77). Pantheon.

Foucault, M. (1995). *Discipline & punish: The birth of the prison*. Vintage.

Foucault, M. (2005). *The order of things: An archaeology of the human sciences* (Vol. 10). Routledge.

Goodman, P. (1964). *Compulsory miseducation*. Penguin Education Specials.

Goodman, P. (1971). *Speaking and language: Defence of poetry by Paul Goodman*. Random House.

Goodman, P. (2010). *The new reformation: Notes of a neolithic conservative*. PM Press.

Goodman, P. (2012). *Growing up absurd. Problems of youth in the organized society*. New York Review Books.

Hart, R. (2014). Children, self-governance and citizenship. In C. Burke & K. Jones (Eds.), *Education, childhood and anarchism: Talking Colin Ward*. Routledge.

Heidegger, M. (1999). Building dwelling thinking. In D. F. Krell (Ed.), *Basic writings Martin Heidegger* (pp. 347–363). Routledge.

Jackson, P. (1989). *Maps of meaning*. Routledge.

Kwon, M. (2002). *One place after another: Site-specific art and locational identity*. The MIT Press.

Lambrini, K., Basiliki, V., Mihalache, A., Panagiota, P. A., & Theologia, Z. (2014). Hospitalization in the psychiatric hospital of Corfu in the 19th century. *American Journal of Nursing Science, 4*(2–1), 22–26. https://doi.org/10.11648/j.ajns.s.2015040201.15

Lewis, T. E. (2012). *The aesthetics of education: Theatre, curiosity, and politics in the work of Jacques Rancière and Paulo Freire*. Continuum International Publishing Group.

Mahoney, J. L., & Bergman, L. R. (2002). Conceptual and methodological considerations in a developmental approach to the study of positive adaptation. *Journal of Applied Developmental Psychology, 23*(2), 195–217. https://doi.org/10.1016/S0193-3973(02)00104-1

Malpas, J. (2012). *Heidegger and the thinking of place. Explorations in the topology of being*. MIT Press.

Pallasmaa, J. (2012). *The eyes of the skin. Architecure and the senses*. Wiley.

Panagopoulos, I., Seferiades, S., & Papadopoulou, A. (2021). *Suspended spaces of memory: Heterotopic historical narratives and contentious politics in Theo Angelopoulos' work and its use on contemporary cinematic practice.* Paper presented at the digital culture & audio visual challenges interdisciplinary creativity in arts and technology, Corfu, Greece.

Perec, G. (2000). *Species of spaces and other pieces*. Ypsilon Publications.

Pocock, D. (2014). *Humanistic geography and literature. Essays on the experience of place*. Routledge.

Rancière, J. (2003). *Short vogages to the land of the people*. Stanford University Press.

Rancière, J. (2006). *Film fables (Talking images)*. Berg Publishers.

Rancière, J. (2009). *The future of the image*. Verso.

Ricoeur, P. (1992). *Oneself as another*. The University of Chicago Press.

Ricoeur, P. (2008). *On interpretation*. Erasmos Publications.

Rubenstein, J. M. (2016). *The cultural landscape. An introduction to human geography* (12th ed.). Pearson.

Triantafylloudis, I. (2017). *Dimografiki apotiposi ton nosileythenton sto psychiatriko nosokomio kerkiras (1838–200)* (PhD thesis). Ionio University.

Tso, A. (2020). *The literary psychogeography of London*. Springer.

Ward, C. (1989). *Welcome, thinner city: Urban survival in the 1990s*. Bedford Square Press.

Ward, C. (1995). *Talking schools. Ten lectures by Colin Ward*. Freedom Press.

Ward, C. (1996a). *Anarchy in action*. Freedom Press.

Ward, C. (1996b). *Talking to architects, ten lectures by Colin Ward*. Freedom Press.

Ward, C. (2004). *Anarchism: A very short introduction*. Oxford University Press.

Ward, C., & Fyson, A. (1973). *Streetwork: The exploding school*. Routledge.

Breaking the Digital Gender Gap with Inclusive Digital Education

Gema de Pablo González and Mariano Sanz-Prieto

The Gender Gap in STEAM Disciplines

In recent years, there have been serious questioning of whether our education system is entirely gender equitable and egalitarian, especially when it comes to the study of STEAM (Science, Technology, Engineering, Art and Mathematics) disciplines. According to the Spanish Ministry of Education and Vocational Training, in its annual publication "Equality in Figures" (Ministerio de Educación y Formación Profesional, 2022), inequality between boys and girls is still present, especially in terms of the choice of careers in science and, more specifically, those related to the field of technology.

The report includes the not inconsiderable figure that the percentage of early school leavers among women aged 18–24 stands at 9.7%, 1.7 points behind the European average. In 2011 the difference was 10.4 points. In contrast, early school leavers among men stand at 16.7%, which means 7 points higher than among women.

In addition, the choices made by girls in relation to the different disciplines are also analysed. Thus, girls account for 48.6% of students in Compulsory Secondary Education and 53.7% in Baccalaureate, where differences can be seen with respect to the different modalities. Thus, 47.5% in Science, 58% in Humanities and Social Sciences and 72.1% in Arts. It can be seen that the percentage of women is lower in Science.

G. de Pablo González (✉)
Universidad Autónoma de Madrid, Madrid, Spain
e-mail: gema.depablo@uam.es

M. Sanz-Prieto
Fundación Siglo22, Madrid, Spain
e-mail: msanz@siglo22.net

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_18

As for Vocational Education and Training, only 29.8% are female students in basic education, 43.8% in intermediate education, and 48% in higher education. We can also observe differences in the professional families: in Health, women account for 75%; in Textile, Clothing and Leather, 77%. In Sociocultural and Community Services, 86.6% and in Personal Image, 88.3%. However, in Computer and Communications they are only 7.7%, 4.1% in Mechanical Manufacturing, 3.5% in Electricity and Electronics and 3.4% in Transport and Vehicle Maintenance (Ministerio de Educación y Formación Profesional, 2022).

With regard to university studies, this report shows that women are in the majority among undergraduate university students, accounting for 55.7%. But it is in this environment where we can appreciate strong differences depending on the field of study: in Education, 77.9%; and in Health and social services, 71.8%. However, in Engineering, industry and construction, they are 29.1%, and in Computer Science, 13.4% (Ministry of Education and Vocational Training, 2022).

In addition, the same trend can also be observed in other documents and sources worldwide, such as the following data:

- According to UNESCO, only 35% of students enrolled in STEAM professions are female. Furthermore, female student enrolment in technology, information and communications is 3%, in natural sciences, mathematics and statistics it is 5% and in engineering, manufacturing and construction it is 8% (UNESCO, 2019).
- In the OECD report on gender equality in education, only 7% of girls see themselves in technical professions in the future (OECD, 2015).
- The United Nations at the 7th Assembly of the International Day of Women and Girls in Science warns that women represent 30% of the world's scientific researchers. Moreover, in cutting-edge areas such as artificial intelligence, only one in five professionals is a woman, equivalent to 22% (United Nations, 2022).

In addition to these data, the gender bias in the choice of STEAM careers in favour of men has been noted for several years now, as reported by Stoet and Geary (2018), who insist on the persistence of this bias and the lack of ideas to seek new approaches to mitigate it. In this regard, these authors compare international data through reports such as the PISA 2015 Report. The results show that in two out of three countries, girls are equal to or better than boys in science and are also well educated to choose STEAM studies, both at secondary and university levels (PISA, OECD Publishing, 2016). However, as the equality bar is higher in the country, the less STEAM career choice is made by women, and consequently the gender bias increases. This is what the authors call the 'educational paradox of gender equality', which means that the greater the equality, the greater the gap in STEM between women and men (Angulo, 2019). It is also significant to observe how women drop out of school less than men, but do not proportionally reach STEAM careers. In addition, there is another peculiarity which is that, although there has been an increase in women's choice of science careers, these are disciplines related to health and care.

Another study that reinforces this paradox refers to enrolment and degree completion data from Harvard and Massachusetts Institute of Technology (MIT)

Massive Open Courses, with students enrolled from 25 countries. Women enrol less than men, but the final attainment is similar. Again, there is less gender bias and greater likelihood to enrol in less developed and less gender-equal countries (Jiang et al., 2018). Specifically in Spain, in these courses, 72% are men and 28% are women. Of all those enrolled, 21.5% of women complete the course, compared to 9.36% of men (Angulo, 2019).

Moreover, some authors point out that, in general, the study of science among young people in Europe has decreased (Robles et al., 2015). There is a difficulty in generating scientific literacy among citizens and, from this perspective, Rocard et al. (2007) warn that this is due to the way science is being taught in schools. In this sense, authors such as Solbes (2011), Solbes et al. (2007), and Lozano (2012) have investigated the factors that are influencing dropout, as well as what innovative proposals could be addressed to tackle these attitudes, concluding that the solution lies in compulsory education, where it may be a key moment to motivate students towards science or improve their attitude, since they have to study it compulsorily. It would therefore be a good time to motivate students to study science.

If we add to these data the gender gap mentioned above, we find that in addition to the fact that the study of science has decreased in general terms, it is even worse for women than for men. According to different studies, it is evident that our society shows scientific knowledge distanced from women (Bian et al., 2017; López-Navajas, 2014). We can say that there is a gender stereotype where it is universally believed that women are less prepared for science, especially some branches of science. Data extracted from the Spanish Annual Report on equality figures of the Ministry of Education and Vocational Training (2021) cited in Macho (2021) show that women choose more studies related to Education (77.9%) and Health and Social Services (71.8%). However, there is less presence in Engineering, Industry and Construction (29%) and Computer Science (13.4%). In other words, the choice of careers matches, almost down to the last detail, the gender stereotypes that are poured out from socialisation in early childhood.

We must take these data into consideration, as they have the immediate consequence that the gender gap in the workplace will also increase. We are facing a present and, even more so, a future that is and will be technological. If we keep women away from these disciplines, perpetuating the gender stereotypes that have been carried over from many years ago, we will be distancing them from the future and therefore increasing their chances of impoverishment and outdatedness. It is therefore essential to tackle actions and projects that motivate and improve the level of interest in science, both in general and especially for girls and women.

Breaking Gender Stereotypes for Inclusive Schools

In the previous section, we have seen with figures how gender stereotypes seem to be perpetuating the gender digital divide. However, when does such bias begin to emerge? Where and how is it generated? It is unlikely that anyone working in education today would want such unequal and inclusive scenarios. However, it is likely that by looking at the data we can conclude that something is not being done quite right.

At an early age, boys and girls are equally interested in science, but gender socialisation begins to separate the expectations of boys and girls in terms of their abilities. According to Bian et al. (2017), in their study on gender stereotypes linked to intellectual abilities and their influence on boys' and girls' interests, girls feel less intelligent than their male peers as young as 6 years old. Popular beliefs about gendered cognitive ability refer not only to cognitive processes such as mathematical reasoning, but also to the general amount of cognitive ability. High-level cognitive ability is often associated with males (brilliance, giftedness, genius, etc.) (Bian et al., 2017).

In addition, it is from around the age of 10 that social stereotypes begin to take hold more deeply, resulting in girls moving away from science. Boys have a more positive and confident orientation towards science (Conde et al., 2019). It is therefore easy to conclude that disinterest in science at the adolescent stage, and especially in the case of girls, is due to educational factors. How it is taught and how it is perceived by students may be the key to this situation. If we take a look at the data, we see that academic brilliance and success is even higher in girls, who drop out less. However, the perception and belief among girls is the opposite, as they continue to associate brilliance with boys.

We must ask ourselves, therefore, what is the source of this bias and why does it still exist when in recent years women have expanded into other fields? We need to investigate the acquisition of the stereotype that associates 'brilliance = men' starting in early childhood, when boys and girls enter school, and how it is perpetuated throughout their academic journey, resulting in gender bias in STEAM career choices.

Throughout history, access to education has not been equal. It was boys who had access to knowledge geared towards the labour market and progress, while girls were relegated to the domestic sphere. Girls' access to knowledge was mostly related to household chores. With differences between countries, in Spain the incorporation of girls into mixed schools did not take place until the 1960s. This was a great leap forward for gender equality. Although this model has demonstrated its effectiveness in terms of increasing qualifications, there are still aspects to be polished in terms of creation of habits, values acquisition and the construction of personalities (Subirats, 2009). Perhaps, in terms of gender bias in the choice of subjects, or in the acquisition of beliefs such as the belief that science requires brilliance and that this is associated with men, it is becoming clear that schools must not only be mixed but also inclusive.

It is true that the road to inclusion, from exclusion or discrimination, is a long process that sometimes passes, or has passed, through the concept of integration which could play the role of a bridge between these two extremes. The school with girls and boys together played a fundamental role in eliminating gender discrimination or exclusion. However, only through a co-educational and inclusive model can we correct certain tendencies that perpetuate stereotypes and beliefs incorporated from popular culture and socialisation.

The role that beliefs play in education is also a relevant issue. The beliefs that teachers may hold are mental structures that serve to understand the reality of education, from how it is learned to how it is taught (Pajares, 1992). These beliefs also influence, therefore, how teachers themselves explain and justify actions and professional or personal decisions (Moreno, 2001). They therefore act as filters that affect how information received is accepted and perceived as well as how it is stored and retrieved (Marcelo, 2005; Catalán, 2011). Beliefs are acquired or configured at an early age, through the process of socialisation in a given culture, as stated by Vygotsky (2000 [1978]) in his law of double intra-interpsychological formation. These are organised into systems that are perpetuated over time and taken as indisputable truths. Moreover, there is a tendency to overcome contradictions between dissonant beliefs by ignoring information that is not part of the person's belief system (Pajares, 1992). Moreover, the belief system is not based on rationality, but on feelings, experiences and lack of specific knowledge about the subject to which they refer (Moreno, 2001).

Given this framework, we might wonder whether the belief system about gender differentiation may be responding to the bias that is still being perpetuated in the education system. It is quite likely that as a result of the belief system, expectations are generated. According to Gargantilla-Madera et al. (2016, p. 5), 'the Pygmalion effect is the process by which the beliefs and expectations of one person with respect to another affect the behaviour of the second'. The Pygmalion effect in the classroom was the title of the experiment conducted by Rosenthal and Jacobson in 1968, where it was shown that the information provided to a group of teachers influenced the academic results of their students. The experiment consisted of informing a group of teachers about the results that some of their students had obtained after having taken a test on their intellectual abilities. These teachers were told that these students had scored higher on the test and that they would therefore be the ones with the best academic results. What they did not know was that the test had not been administered and that the students were chosen at random. At the end of the course, these students actually obtained better results, confirming that the expectations that the teachers placed on their students worked in their favour. These researchers identified four factors that influence the Pygmalion effect (Rosenthal & Jacobson, 1968):

- Climate: you tend to create a warmer climate with the group you expect more from.
- Input: more is taught to the pupils about whom more is expected.
- Output: if teachers expect more from some learners, they tend to give them more opportunities to respond.
- Feedback: the more you expect from a learner, the more positive reinforcement he/she will get, and the more praise he/she will receive.

The question is therefore: What expectations will teachers have with regard to their students and scientific knowledge? Given the universalised belief system regarding gender differentiation, and given that girls as young as 6 years old associate brilliance with the male world (Bian et al., 2017), are not such differentiated expectations being projected by boys and girls in our educational system? What are the beliefs that perpetuate such differentiation?

Exploring Gender Stereotypes

Procedure

Taking into account what was developed in the previous section, this chapter focuses on how the expectations and beliefs that teachers may have about gender and science may condition women's choice of technical careers. In this sense, a questionnaire was designed to assess the beliefs of teachers in compulsory secondary education and vocational training in Spain.

As mentioned above, brilliance is associated with masculinity. But order, work and effort are also associated with femininity. For this reason, the questionnaire posed questions to assess, on a Likert scale (1–6), the skills that they associated with their female students and male students, such as the following:

- Linguistic and verbal skills
- Emotional skills
- Athletic skills
- Spatial skills
- Mathematical skills
- Technological skills
- Musical skills
- Naturalistic skills
- Artistic skills

In addition, they were also asked about aspects, both in female students and male students, on a Likert scale (1–10), such as the following:

- Maturity
- Responsibility
- Order
- Problem solving
- Assertiveness
- Teamwork

A question was also included on who they thought got better marks, the male or female students, as well as a subjective opinion on why they thought this was the case. In addition, they were asked, if they knew, which disciplines or areas of study their male and female pupils would choose or had chosen.

Finally, they were asked if they were aware of any action taken in their respective schools to equalise the choice of subjects between boys and girls and, if so, what type of action it was.

It is also important to highlight that some data were collected on the respondents, such as years of experience, degree, speciality, gender, age, course and type of work centre.

Results

The questionnaire was sent to 20 schools in Spain, to be answered by teachers from these schools. Teachers did freely decide to answer the questionnaire or not.

Seventy-nine teachers responded to the questionnaire, 29 men and 50 women, but only 54 (36 women and 18 men) completed it, being the questions where they had to assess the skills of pupils and students the ones that were not answered in their totality. Trying to see if there is any tendency in which teachers fail to answer, gender does not seem to be very relevant, since in totality there were 63.29% of responses from women, which rises to 66.67% in the case of those completed.

Age is more relevant, with 50% of respondents between 20 and 40 years of age, 70% between 40 and 50 years of age and 81.82% between 50 and 65 years of age completing the questionnaire (Fig. 1).

Regarding the years of experience, there are no concrete trends, except that those with more than 35 years of experience have answered 100%, but in the rest of the ranges it fluctuates without allowing any conclusion to be drawn in this respect (Fig. 2).

The details of the respondents are as follows (Fig. 3):

The course they are currently teaching can be seen in Table 1.

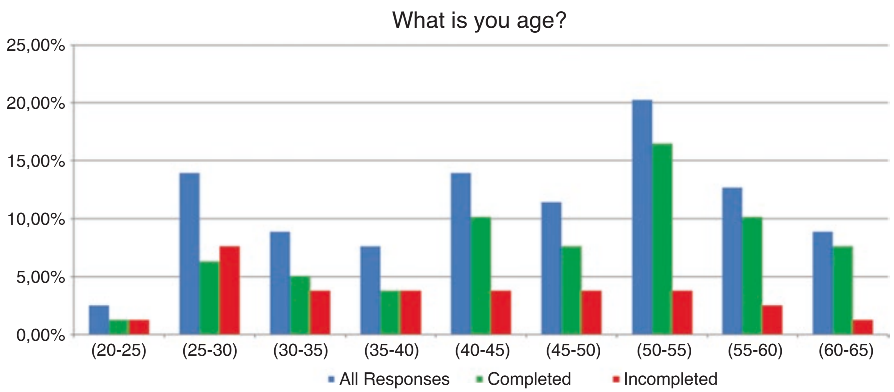


Fig. 1 Age of the participants

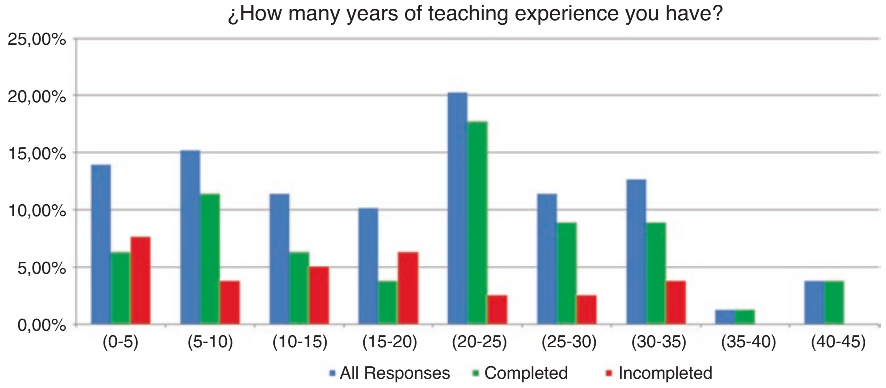


Fig. 2 Years of experience of participants

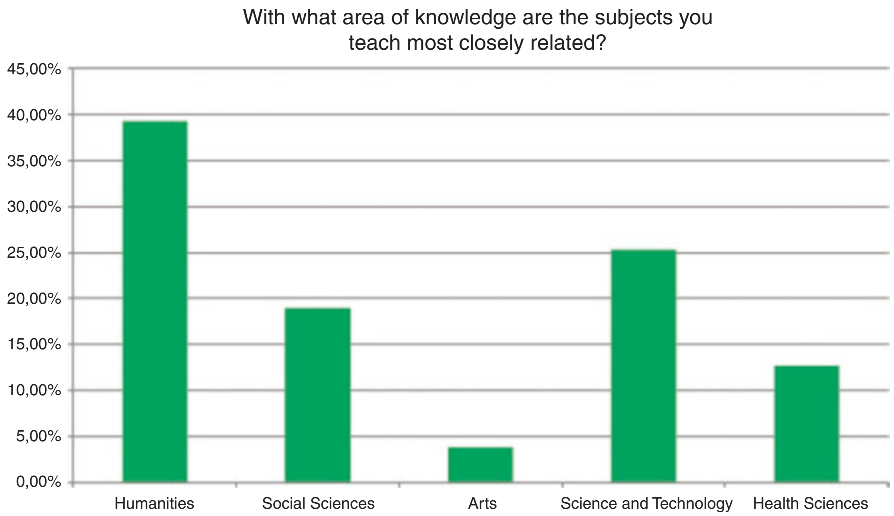


Fig. 3 Teaching area of knowledge

For the 18 teaching VET, the vocational family of studies they teach in are shown in Table 2.

Concerning the type of centre they work in, 14 work in a state school (17.72%), 39 in a state-subsidised school (49.37%) and 26 in a private school (32.91%).

And finally, concerning their own studies, they are as follows (Table 3).

Where other studies were as follows: (1) Bachelor's Degree in Business Administration + Bachelor's Degree in Advertising, (2) Specialist technician, (3) Administration Technician and (4) Degree in Economics and Business Administration.

It is when we start to ask about the skills of their pupils that there starts to be a greater variety of responses, with the number of responses decreasing. In the first

Table 1 Teaching courses

Answer choices	Responses (%)	
1° Secondary	30.38	24
2° Secondary	32.91	26
3° Secondary	41.77	33
4° Secondary	41.77	33
1° Basic VET	10.13	8
2° Basic VET	5.06	4
1° Baccalaureate	43.04	34
2° Baccalaureate	31.65	25
1° Intermediate VET	10.13	8
2° Intermediate VET	7.59	6
1° Higher VET	8.86	7
2° Higher VET	12.66	10
	Answered	*79*

Table 2 VET, vocational family of teaching

Physical activities and sports	11.11%	2
Administration and management	33.33%	6
Commerce and marketing	5.56%	1
Computers and communications	44.44%	8
Installation and maintenance	5.56%	1

Table 3 Teachers studies

Teacher training	3.80%	3
Engineering or architecture	7.59%	6
Bachelor of science	24.05%	19
Bachelor’s degree in humanities	50.63%	40
Health sciences degree	8.86%	7
Other (specify)	5.06%	4
	Answered	*79*

case, we still have 66 responses when we ask about the more academic skills and 13 who decide not to answer. The graphs show the following (Fig. 4 and Table 4):

If we look at the averages, we can see that the highest score for girls is in artistic skills (with an average of 4), followed by emotional skills (with an average of 3.95) and technological skills (with an average of 3.91) (Fig. 5 and Table 5).

In the case of boys, the highest average score, 4.27, is for athletic skills, followed by technological skills with an average of 4.03.

The difference between boys and girls is remarkable in technological skills, but also in emotional and artistic skills. Although in the graphs we can see that the trends are quite moderate, it is when we take a look at the averages that we can see the differences in beliefs in terms of skills.

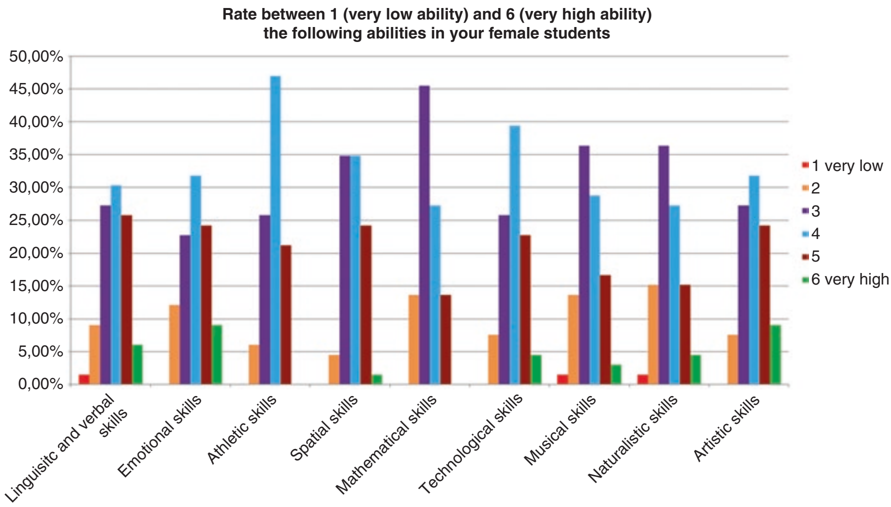


Fig. 4 Distribution of academic skills among female students

Table 4 Academic skills scores among female students

	1 (Very low) (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (Very high) (%)	Total answered	Average
Linguistic and verbal skills	1.52	9.09	27.27	30.30	25.76	6.06	66	3.88
Emotional skills	0.00	12.12	22.73	31.82	24.24	9.09	66	3.95
Athletic skills	0.00	6.06	25.76	46.97	21.21	0.00	66	3.83
Spatial skills	0.00	4.55	34.85	34.85	24.24	1.52	66	3.83
Mathematical skills	0.00	13.64	45.45	27.27	13.64	0.00	66	3.41
Technological skills	0.00	7.58	25.76	39.39	22.73	4.55	66	3.91
Musical skills	1.52	13.64	36.36	28.79	16.67	3.03	66	3.55
Naturalistic skills	1.52	15.15	36.36	27.27	15.15	4.55	66	3.53
Artistic skills	0.00	7.58	27.27	31.82	24.24	9.09	66	4.00
						Answered	*66*	

When we go on to ask about the most emotional skills, there are again 12 people who do not respond and who are added to the 13 previous ones, so that in totality 25 people do not respond (Fig. 6 and Table 6):

In the case of girls, we can observe that the scores oscillate around 6, with the highest score being 'order' followed by 'teamwork' (Fig. 7 and Table 7).

The averages for boys are around 5, except for 'teamwork' which rises to 6.04, still slightly below that of girls. Paradoxically, the lowest average is for 'order', which was the highest score for girls.

When asked directly who gets the best marks, only 9 out of 54 answers say boys, the rest say their female students (Fig. 8).

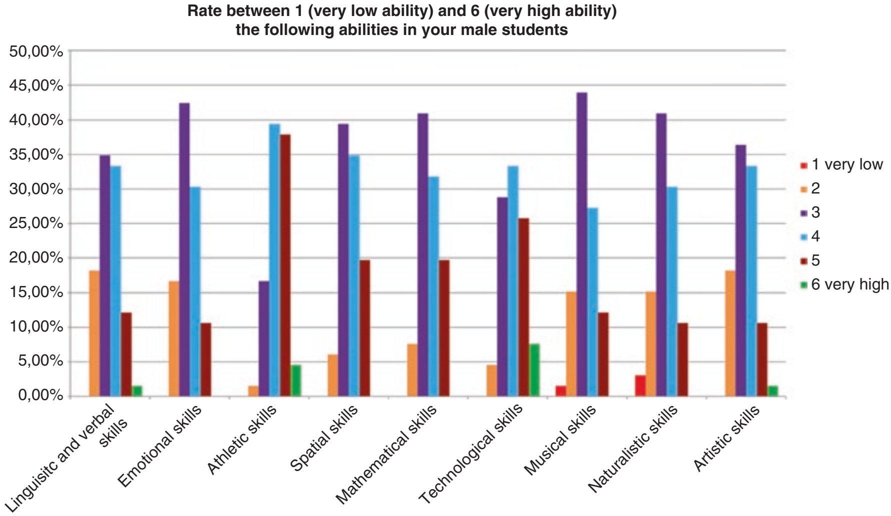


Fig. 5 Distribution of academic skills among male students

Table 5 Academic skills scores among male students

	1 (Very low) (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (Very high) (%)	Total answered	Average
Linguistic and verbal skills	0.00	18.18	34.85	33.33	12.12	1.52	66	3.44
Emotional skills	0.00	16.67	42.42	30.30	10.61	0.00	66	3.35
Athletic skills	0.00	1.52	16.67	39.39	37.88	4.55	66	4.27
Spatial skills	0.00	6.06	39.39	34.85	19.70	0.00	66	3.68
Mathematical skills	0.00	7.58	40.91	31.82	19.70	0.00	66	3.64
Technological skills	0.00	4.55	28.79	33.33	25.76	7.58	66	4.03
Musical skills	1.52	15.15	43.94	27.27	12.12	0.00	66	3.33
Naturalistic skills	3.03	15.1	40.91	30.30	10.61	0.00	66	3.30
Artistic skills	0.00	18.18	36.36	33.33	10.61	1.52	66	3.41
						Answered	*66*	

When asked why they think this happens, the most striking responses are grouped into the following reasons:

- Higher number of female pupils in some cases, in others male pupils.
- Greater responsibility, maturity and self-esteem in girls.
- Greater capacity for organisation, perseverance, effort, in girls.
- Greater listening skills in girls.
- Girls are more hard-workers and studious.

Some particularly striking phrases are the following:

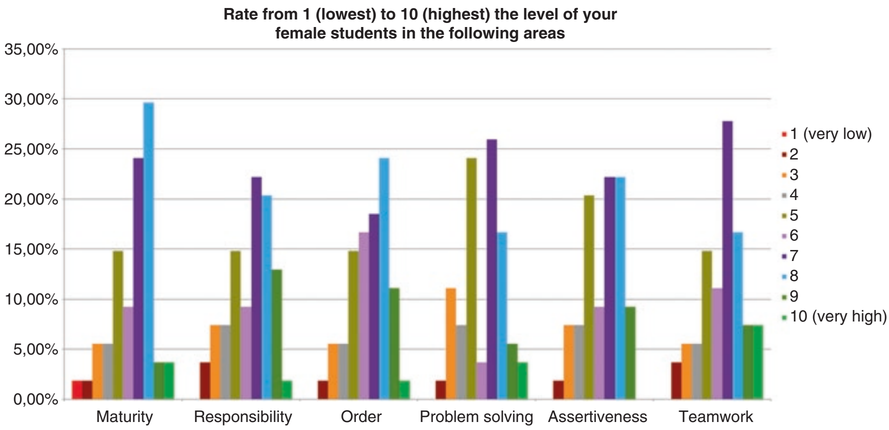


Fig. 6 Distribution of emotional skills among female students

- I think that female students are generally less involved in the learning process and therefore, possibly somewhat unconsciously, they try harder to be more visible and stand out more.
- I think that, being the same age, girls are more mature and boys are still much more childish.
- It does not always happen, but I think that female students think that they have fewer opportunities than male students in the labour market and that's why they demand better grades.
- The social environment makes it clear that they have to be more competitive.
- These are technological studies that generate more interest among boys.

The following comment reflecting that he sees no difference is also striking:

- In reality they are very much on a par, I do not see any differences. There are better and worse students but it has nothing to do with being male or female.

When asked about the choice of future studies that their pupils can pursue, the result is as follows (Figs. 9 and 10):

Looking at the averages we can see that with 3.74 points, girls choose Health Sciences, followed by Science and Technology (3.7) and Social Sciences (3.65) .

The averages for boys are different, with a clear majority choosing Science and Technology (4.17), followed by Health Sciences (3.44) and Social Sciences (3.31). Although the same disciplines are chosen by both genders, we can see that boys are well ahead of girls in Technology, and girls are ahead of boys in Health and Social Sciences (Figs. 11 and 12).

As for what other options they would choose, they were as follows: Higher Level of VET, Hotel Management and Administration for boys. For female students, Commerce and Administration.

Table 6 Emotional skills scores among female students

	1 (Very low) (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	8 (%)	9 (%)	10 (Very high) (%)	Total answers	Average
Maturity	1.85	1.85	5.56	5.56	14.81	9.26	24.07	29.63	3.70	3.70	54	6.50
Responsibility	0.00	3.70	7.41	7.41	14.81	9.26	22.22	20.37	12.96	1.85	54	6.43
Order	0.00	1.85	5.56	5.56	14.81	16.67	18.52	24.07	11.11	1.85	54	6.57
Problem solving	0.00	1.85	11.11	7.41	24.07	3.70	25.93	16.67	5.56	3.70	54	6.11
Assertiveness	0.00	1.85	7.41	7.41	20.37	9.26	22.22	22.22	9.26	0.00	54	6.30
Teamwork	0.00	3.70	5.56	5.56	14.81	11.11	27.78	16.67	7.41	7.41	54	6.56
										Answered	*54*	
										Skipped	25	

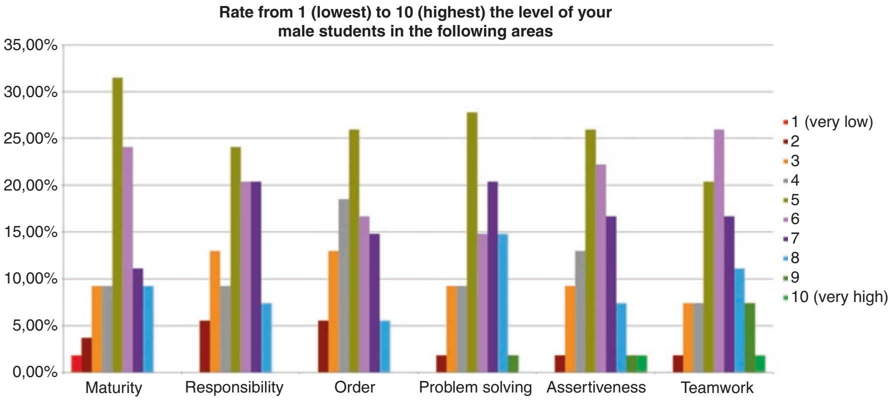


Fig. 7 Distribution of emotional skills among male students

The last question refers to whether they know if anything is done at the school to equalise the choice of disciplines between boys and girls, and what kind of actions these are.

In this respect, 17 people said that no measures are taken, 2 people said that they are and 3 said that they do not know.

Regarding the comments responding to what kind of measures or their opinion on these, we transcribe literally some of the answers because of their relevance:

- Nothing specific is done, everyone has the same option to take one pathway or another. No distinction is made between the sexes.
- There are groups that mobilise and dynamise aspects of equality. Among the students there is a lot of awareness, a feminist group.
- In my school, equality is sought in general, but particularly in the choice of disciplines, I do not know the possible actions that are carried out.
- Equal academic guidance, focusing on students' aptitudes.
- Nothing specific beyond comments in class and occasional presentations and talks.
- None in particular. But on a day-to-day basis we work on equal opportunities for everyone. Giving value to the careers of both women and men.
- We approach their education in an equitable way, we try to motivate them and encourage them according to their abilities, interests, aptitudes…
- Equal numbers in the classroom
- There is no distinction between boys and girls. Both are given the same options.
- The day of the girl scientist
- Work is encouraged for both sexes, involving them in all aspects of the subject and making them interact with each other as well as with the environment.
- Yes, days such as the day of women and girls in science and others.
- Yes. Talks, activities.
- They are informed without differentiating between the sexes.

Table 7 Emotional skills scores among male students

	1 (Very low) (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	8 (%)	9 (%)	10 (Very high) (%)	Total answers	Average
Maturity	1.85	3.70	9.26	9.26	31.48	24.07	11.11	9.26	0.00	0.00	54	5.28
Responsibility	0.00	5.56	12.96	9.26	24.07	20.37	20.37	7.41	0.00	0.00	54	5.31
Order	0.00	5.56	12.96	18.52	25.93	16.67	14.81	5.56	0.00	0.00	54	5.02
Problem solving	0.00	1.85	9.26	9.26	27.78	14.81	20.37	14.81	1.85	0.00	54	5.74
Assertiveness	0.00	1.85	9.26	12.96	25.93	22.22	16.67	7.41	1.85	1.85	54	5.57
Teamwork	0.00	1.85	7.41	7.41	20.37	25.93	16.67	11.11	7.41	1.85	54	6.04
										Answered	*54*	
										Skipped	*25*	

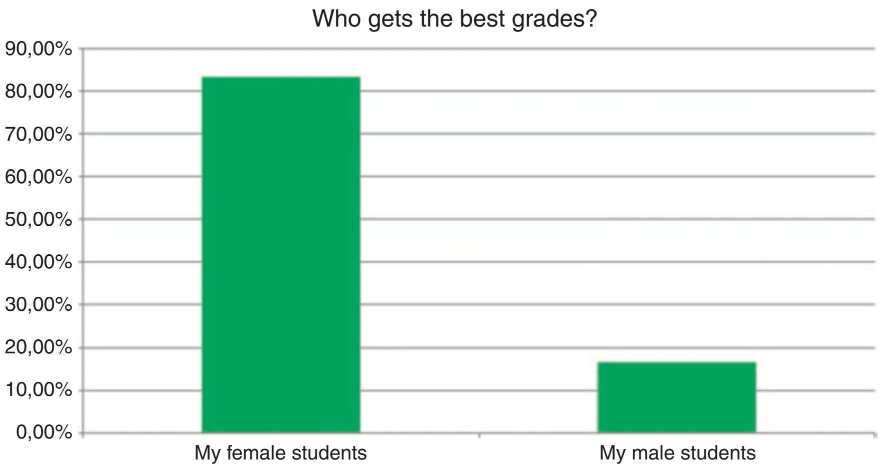


Fig. 8 Grades for female and male students

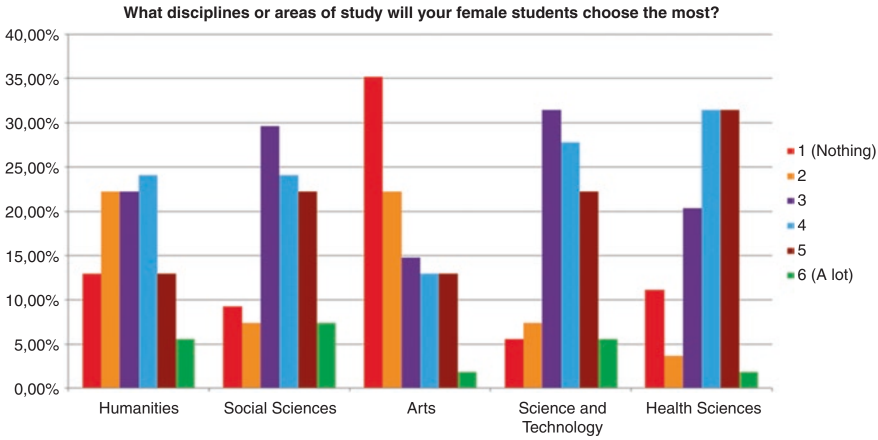


Fig. 9 Study choice preferences of female students

- The centre provides the same opportunities for men and women, and the equality department carries out frequent activities where freedom of choice is promoted.
- No. I do not think there is anything to do.
- Transversal or area projects or activities that highlight the existence of women in all fields of knowledge and professional practice.
- Not really, information is simply provided.

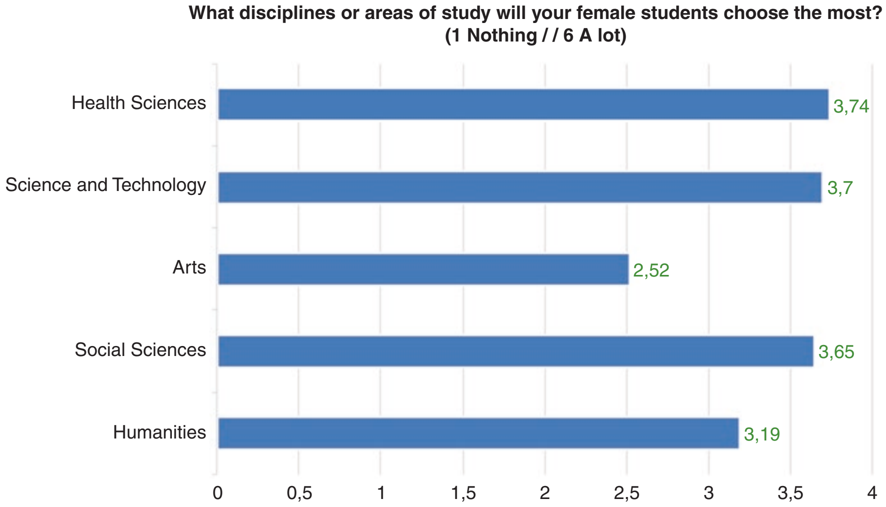


Fig. 10 Average of study choice preferences of female students

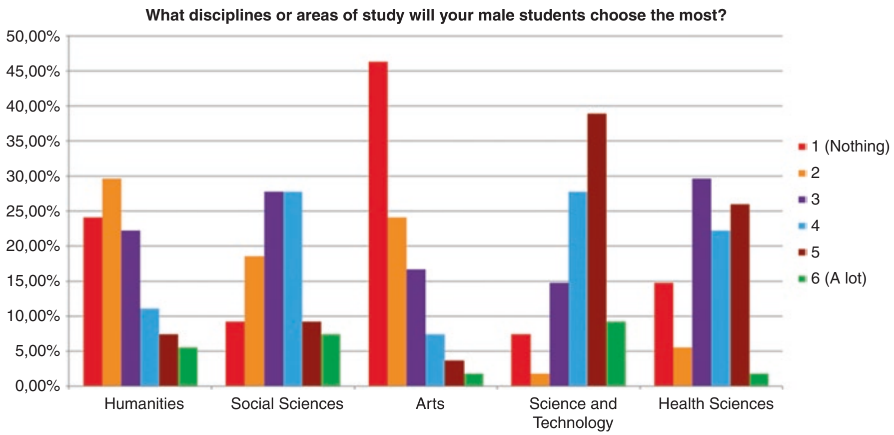


Fig. 11 Study choice preferences of male students

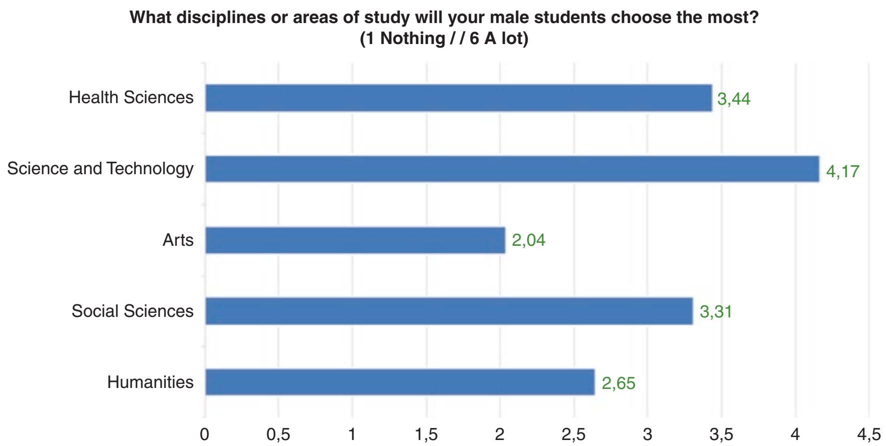


Fig. 12 Average of study choice preferences of male students

Conclusion

First of all, when concluding, we must refer to the fact that the questionnaire, answered by the teachers in this chapter, asked questions that required a subjective response. This is not a shortcoming but rather the main purpose of being able to assess the beliefs that teachers may have regarding gender bias in education and in particular with regard to the digital domain. In this regard, we noticed that several questions were not answered, which makes us suspect that perhaps they did not want to let their opinion on the subject show much.

The answer to the question on who gets better marks is particularly remarkable, as only 54 people answered this question and only 9 said boys. A large majority confirmed that girls get better grades. When asked for the reasons, the majority said that girls are more responsible, mature, hard-working and have more self-esteem.

If we look at the responses on the Likert scale with respect to these skills, we see a tendency towards equality between boys and girls. That is to say, one does not particularly stand out over the other, although we can see in the averages that girls are at the top of the 'order' (6 out of 10) compared to boys (slightly over 5 out of 10/ a half/ 50%) who are at the bottom in this skill. It is also true that girls generally have better scores in all skills (albeit slightly) than boys, and they are only similar in 'teamwork', which may make sense since working in a team, if done well, benefits everyone.

It seems that the teachers consulted did not want to highlight qualities or skills at extremes, but when asked directly, they do point out that girls have more of these skills.

Another curiosity that can be gleaned from this questionnaire is that, although the responses are once again very even, boys stand out in athletic and technological skills and girls in artistic, emotional and technological skills. These results confirm the belief that we have been highlighting in this chapter. Although both excel in technological skills, boys outperform girls. A separate mention should be made of athletic skills, where boys far outperform girls. Perhaps it would be a separate study to analyse the gender bias in physical education and the beliefs derived from the better preparation of males compared to females. Almost the same scenario is found in emotional skills, where girls significantly outperform boys.

It is a well-known belief that women are emotional and men are active, a belief that is perhaps projected onto boys and girls at school, making girls more emotional and boys more athletic.

On the subject of technology, although it is something that stands out in both sexes, as we have said, boys outnumber girls, also in line with the belief that technology is for men. In any case, and if it is true that girls are equally capable in technology, as reflected in the answers, we could then ask ourselves the question of why the careers linked to technology and the digital environment are still deserted of women.

When we look at the results on the preferred disciplines in terms of female and male students, we observe that the tendency to homogenise the answers is once again present. However, we observe that female students tend more towards Health Sciences while male students tend more towards Technology. With the exception of the Arts, female students in general are more evenly distributed among the other fields (Technology, Social Sciences, Humanities), while male students are mainly in Technology, followed by Health Sciences, with a significant drop in Humanities.

The question of disciplines has also been, and still is, a subject of belief. Traditionally, a label of intelligence, brilliance, has been attributed to the Sciences, whereas the Humanities and the Arts are generally attributed to people who are not very bright but very hard-working or studious. If we look at the averages of female students choosing the Humanities versus male students, it is significantly higher. It seems that the data again speak to beliefs about disciplines and gender. Although in the Arts both are lower, female students are still higher. We can see a clear tendency to observe how we continue to perpetuate the beliefs and expectations we project onto our students, making it seem that the digital environment and technology in general is for brighter people and, therefore, for men. This bias is a problem for the future, as the world is and will be increasingly digital. If we do not address digital inclusion at school, we will be perpetuating the existing gap, contributing to a more unequal world where women are alienated from technological careers, with the consequence of their impoverishment in a mainly digital world.

Finally, when asked about the measures taken in their respective schools to eliminate the gender gap in the STEAM areas, most of the teachers were not particularly aware of any measures, and some even denied the existence of such a gap. Those who do know of some measures, these are reduced to symbolic gestures that make women and girls visible or, in one case, a feminist group that makes the problem of gender inequality visible.

However, we believe that these measures are insufficient, as they are merely one-off gestures that improve visibility but do not address the root of the problem. If we talk about inclusive schools, and as Subirats (2009) mentioned, although achievements have been made at present (such as qualifications), a truly inclusive school should polish aspects such as the creation of habits, the acquisition of values and the construction of personalities. These aspects, as we have seen, are the most deeply rooted in people's beliefs, probably affecting teachers when projecting their own expectations, believing in turn that they do not have such a bias. Bias is not something meditated or reasoned, but remains linked to people's belief systems and emotions. If we want to reduce the gender digital gap, we must work to eliminate beliefs about academic disciplines. We must work to bring equal opportunities to all students. We must get rid of the myth of digital masculinity versus care-giving femininity. Perhaps an essential element is to break gender stereotypes through everyday actions and not only through specific and symbolic days such as 'the day of women and girls in science'. These celebrations are appropriate to make the role of women in scientific development visible, but perhaps we should also propose daily activities where boys and girls work together in all subjects, solving problems of different kinds to do away with the biased idea linked to gender.

As we have been able to see in official figures, both from organisations such as the Spanish Ministry of Education, as well as in data extracted from European reports, girls continue to access technological careers at a much lower rate than boys (47.5% choose Science for their Baccalaureate). This is particularly serious because the present and the future will be technological, which will increase the employment gap and, therefore, the wage gap as well. And it is fair to think that this starts at school, so it is essential to start talking about what should be the approaches for a more gender-inclusive school which helps to remove the digital barriers.

In this sense, it is more than likely that one essential measure will be teacher training, focusing on the elimination of pre-established beliefs and the substitution of more equitable ones that generate an educational interaction where all people are equally included. Furthermore, it will be essential to use methodologies in the classroom that generate equal opportunities for all students, such as cooperative learning. It may also be interesting to review the textbooks and the different educational materials used, where mostly male authors linked to the digital world are cited, as opposed to none or only a few women. A good measure could be to get teachers to generate their own materials, avoiding the existing gender bias. Making female authors linked to the development of the digital and technological world known has to be an emergency if we want to break with established beliefs.

There are initiatives to reduce the gender digital gap by providing training to women for their adaptation and empowerment. However, the real reduction of the digital gender gap will happen when schools address this bias from the perspective of inclusion, promoting dynamics where the beliefs that project the image that girls are not made for technology are diminished.

References

Angulo, E. (2019). Igualdad de género y elección de carreras STEM. *Mujeres con Ciencia* (Gender equality and STEM career choices. Women in Science). https://mujeresconciencia.com/2019/03/15/igualdad-de-genero-y-eleccion-de-carreras-stem/

Bian, L., Leslie, S. J., & Cimpian, A. (2017). Gender stereotypes about intellectual ability emerge early and influence children's interests. *Science, 355*(6323), 389–391.

Catalán, J. (2011). Del pensamiento al conocimiento profesional del profesor [From thinking to professional knowledge of the the teacher]. In J. Catalán & J. Redondo (Eds.), *Psicología educacional. Proponiendo rumbos, problemáticas y aportaciones* (pp. 187–216). Universidad La serena.

Conde, M. Cid, R., & López, M. (2019). ¿Tiene género la ciencia? Conocimientos y actitudes hacia la Ciencia en niñas y niños de Educación Primaria [Is science gendered? Knowledge and Attitudes towards Science in Primary School Girls and Boys]. *Revista Eureka sobre Enseñanza y Divulgación de las Ciencias, 16*(3). https://doi.org/10.25267/Rev_Eureka_ensen_divulg_cienc.2019.v16.i3.3302

Gargantilla-Madera, P., Arroyo-Pardo, N., & Madrigal, J. (2016). ¿Existe el efecto Pigmalión entre los residentes? [Is there a Pygmalion effect among residents?]. *FEM: Revista de la Fundación Educación Médica, 19*(1). https://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S2014-98322016000100002

Jiang, S., Schenke, K., Eccles, J. S., Xu, D., & Warschauer, M. (2018). Cross-national comparison of gender differences in the enrollment in and completion of science, technology, engineering, and mathematics Mass Open Online Courses. *PLoS One, 13*, E0202463.

López-Navajas, A. (2014). Análisis de la ausencia de las mujeres en los manuales de la ESO: una genealogía de conocimiento ocultada [Analysis of the absence of women in secondary school textbooks: A genealogy of hidden knowledge]. *Revista de Educación, 363*, 282–2012. https://doi.org/10.4438/1988-592X-RE-2012-363-188

Lozano, O. R. (2012). *La ciencia recreativa como herramienta para motivar y mejorar la adquisición de competencias argumentativas* [Recreational science as a tool to motivate and improve the acquisition of argumentative skills]. Universidad de Valencia.

Macho, M. (2021). Igualdad en cifras MEFP 2021. *Mujeres con Ciencia* [Women with Science]. https://mujeresconciencia.com/2021/04/07/igualdad-en-cifras-mefp-2021/

Marcelo, C. (2005). La investigación sobre el conocimiento de los profesores de aprender a enseñar: Una revisión personal [Research on teachers' knowledge of learning to teach: A personal review]. In G. Perafán & A. Adúriz- Bravo (Eds.), *Pensamiento y conocimiento de los profesores* (pp. 47–62). Nomos.

Ministerio de Educación y Formación Profesional. (2021). Igualdad en cifras MEFP 2021[Equality in figures MEFP 2021]. *Aulas por la Igualdad.* https://www.educacionyfp.gob.es/dam/jcr:8d11c459-d25f-4113-a53b-5b97a91dd8cb/cifrasmefp2021.pdf

Ministerio de Educación y Formación Profesional. (2022). Igualdad en Cifras MEFP 2022 [Equality in figures MEFP 2022]. *Aulas por la Igualdad.* https://www.lamoncloa.gob.es/serviciosdeprensa/notasprensa/educacion/Documents/2022/080322-informe-igualdad-en-cifras-2022.pdf

Moreno, M. (2001). *El profesor universitario de matemáticas: Estudio de las concepciones y creencias acerca de la enseñanza de las ecuaciones diferenciales. Estudio de casos (tesis doctoral)* [The university mathematics teacher: A study of conceptions and beliefs about the teaching of differential equations. Case study (doctoral thesis)]. Universidad Autónoma de Barcelona. https://dialnet.unirioja.es/servlet/tesis?codigo=131625

OECD. (2015). The ABC of gender equality in education. *Aptitude, Behaviour, Confidence*. https://www.oecd.org/pisa/keyfindings/pisa-2012-results-gender-eng.pdf

Pajares, M. (1992). Teacher' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62*(3), 307–332.

PISA, OECD Publishing. (2016). PISA 2015 results (Volume I). *Excellence and Equity in Education*. https://doi.org/10.1787/9789264266490-en

Robles, A., Solbes, J., Cantó, J. R., & Lozano, O. R. (2015). Actitudes de los estudiantes hacia la ciencia escolar en el primer ciclo de la Enseñanza Secundaria Obligatoria [Students' attitudes towards school science in lower secondary education]. *Revista Electrónica de Enseñanza de las Ciencias, 14*(3), 361–376.

Rocard, M., Csermely, P., Jorde, D., Lenzen, D., Walberg-Henriksson, H., & Hemmo, V. (2007). *Science education now: A renewed pedagogy for the future of Europe*. European Commission. Directorate-General for Research 2007 Science, Economy and Society https://www.eesc.europa.eu/sites/default/files/resources/docs/rapportrocardfinal.pdf

Rosenthal, R., & Jacobson, L. (1968). *Pygmalion in the classroom*. Holt.

Solbes, J. (2011). ¿Por qué disminuye el alumnado de ciencias? [Why is the number of science students decreasing?]. *Alambique, 67*, 53–62.

Solbes, J., Montserrat, R., & Furió, C. (2007). El desinterés del alumnado hacia el aprendizaje de la ciencia: Implicaciones en su enseñanza [Students' disinterest in learning science: Implications for science teaching]. *Didáctica de las Ciencias Experimentales y Sociales, 21*, 91–117.

Stoet, G., & Geary, D. C. (2018). The gender-equality paradox in science, technology, engineering, and mathematics education. *Psychological Science, 29*, 581–593. https://doi.org/10.1177/0956797617741719

Subirats, M. (2009). La escuela mixta ¿garantía de coeducación? [Mixed schools. A guarantee of cooeducation?]. *Participación educativa. Revista cuatrimestral del Consejo Escolar del Estado. La educación, factor de igualdad, 11*, 94–97. https://books.google.es/books?id=sONCBgAAQBAJ&lpg=PA94&ots=-A9bOThZO4&dq=coeducaci%C3%B3n%20y%20escuela%20mixta&lr&hl=es&pg=PA94#v=onepage&q=coeducaci%C3%B3n%20y%20escuela%20mixta&f=false

UNESCO. (2019). *Cracking the code: Girls' and women's education in science, technology, engineering and mathematics (STEM)*. https://unesdoc.unesco.org/ark:/48223/pf0000253479

United Nations. (2022, February 11). International day of women and girls in science. https://www.un.org/en/observances/women-and-girls-in-science-day

Vygotsky, L. (2000). El desarrollo de los procesos psicológicos superiores [The development of higher psychological processes]. In M. Cole, V. John-Steiner, S. Scribner, & E. Souberman (Eds.), *Lev Vygotsky: El desarrollo de los procesos psicológicos superiores* [Lev Vygotsky: The development of higher psychological processes] (3rd ed.). Crítica.

Esports: A New Frontier for Inclusion Through Competitive Game Engagement

Patrick Camilleri

Introduction

> Computers seem to be getting smarter at an alarming rate but one thing that they can't do is appreciate irony. (Mitchell, 2019, p. 6)

This quote may seem to be subjectively out of context, yet as our dependence on digital technology[1] is exponentially increasing, we as humans also need to be inspired and profit from their capabilities. In the same instances that machine autonomy such as the rise of Artificial Intelligence (AI) can potentially limit or even eliminate the need of human intervention, we need to see how best we can benefit from this digitally mediated change while actively conserving what makes us uniquely human. Technology is not only here to stay but is inexorably fading in the background and becoming the natural way through which people mediate their lives. Therefore, if we intend to remain relevant, we must facilitate the inclusion of different traits from different people.

Barriers of inclusion and integration may take different forms but there can only be one form of inclusion, that of supporting and empowering people to succeed in what they do (Abawi, 2015). In case of technology employment, adopting attractive and, I dare say, fashionable digitally mediated traits that people avail from for their mundane and personal recreation may be the way forward to reduce exclusion. Beyond enhancing communication, the shift in the Internet from the Information

[1] In this writeup whenever technology is mentioned it will pertain to digital technology that is Information Communication Technology (ICT).

P. Camilleri (✉)
Faculty of Education, University of Malta, Msida, Malta
e-mail: patrick.camilleri@um.edu.mt

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3_19

Superhighway (Sclove & Scheuer, 1996) to its fruition as a user-generated platform has encouraged people to switch from being just spectators and consumers to becoming creators of content and information. Subsequently, the medium has become a motivator for people to gain the centre stage and personalise their own learning experiences. However, Sutherland et al. (2018) also state that studies on the mediating roles and the definition of the technologies themselves are still low and vague. Thus, while Roch (2021) acknowledges the inclusive role that technology can play is at its best when it brings people together, there still is no defined consensus on neither what these mediating roles are, nor what pertains to the nature of the technologies in question. Thus, while some define or refer to technology according to the employed algorithms, others refer to them as the platform or simply the technology (Ibid., 2018).

In case of this writeup while 'the technology' is designated as the aspect of video game play in the esports[2] industry, its formalisation relies upon the physical platform that supports the activities. The platform is exemplified by robust broadband infrastructures and computers. LAN (Local Access Network) provides the support for the networking of computers to connect for play, while broadband facilitates online streaming platforms such as Twitch and YouTube for viewers. On the other hand, the events themselves that define esports and depend upon the physical infrastructure, include the players, sponsors, commentators, the live audience, and the cash prizes for winners (Bányai et al., 2019). Subsequently in this writeup, the observation of accompanying social traits within video game play are tested for elicited qualities such as the enhancement of peer acceptance, cross-group friendship, networking, and interpersonal dynamics as mechanisms for the facilitation of inclusion (Juvonen et al., 2019). Krath et al. (2021) explain how, when it comes to games, scholars distinguish between behavioural, effective, and motivational outcomes, or cognitive and learning outcomes. Along these lines and looking beyond the more obvious or visible multimedia traits, video games intrinsically incorporate other comparably and maybe even less conspicuous elements that, as will be explained, can influence behavioural change (Hussein et al., 2019) and facilitate inclusion. In context, arguments within this writeup will therefore develop as follows:

First the research question that guides the writeup, and the context in which the research was performed is presented.

Second and as part of the theoretical review the characteristics and embedded qualities that define esports, more so competitive gaming will be examined for their facilitating potential towards inclusion.

---

[2] It must be conceded that esports is best defined as an industry. It is composed of various components such as the players, the audience, the organisers of the competitions, the betting companies and all the supporting entities and people directed to sustain the gaming activity. In case of this particular paper focus will be on the video game players that publicy play in competitive game initiatives.

Third, the motivations that drive game-based activities and esports are presented as facilitators of inclusion.

This will finally be followed with a description of the adopted methodology employed, the analytical lens, and outcomes from results.

Setting the Scene

A case study approach was adopted to answer the question:

'*What embedded qualities does esports procure to facilitate and enhance inclusion?*'

In order to test the waters and therefore gauge how much inclusion is being, and, can be facilitated through esports qualities and activities, the study availed itself of interviews. Whilst not exhaustive, the designated interviews were directed to thematically individualise qualities within the local esports culture that was or could potentially enhance inclusion. Interviews were organised with volunteering individuals involved in the local Maltese esports industry. Specifically the audience chosen included founding members, organisers, and competitive video game players engaged in esports, mostly forming part of the same Maltese and internationally affiliated esports institute registered under the name of Level Academy. Level Academy happens to be a professional esports company directly affiliated with various leading foreign individuals and entities that help the academy remain innovative and at the forefront of organised activities that include training and play.

To legitimise esports as a discipline, the academy ensures that in the same instances of introducing esports, it also educates and informs participants about the qualities that in reality go beyond just video game playing. As a matter of fact, the material the academy provides in the form of formal training plans, hands-on workshops, and related pedagogical training is produced in conjunction with an international team of people holding extensive experience in esports, pedagogy, and personal training. While the academy is pitched to attract anyone who is interested in competitive video game play, it also provides training that can lead interested participants to take on esports as a professional[3] career.

[3] Gee (2007) alludes to the term 'professional' as being suggestive of an 'authentic professional'. A professional is therefore someone who through extensive experience and effort in study, work and practice has acquired special knowledge and distinctive skills that lead to deep learning about a particular subject or area.

Theoretical Review

Defining Esports

Considering how much digital technologies have permeated within our lives and the fact that the growth in the gaming industry has surpassed that of the movie industry (Raise Your Skillz, 2022) already says something, even in terms of how people are relating to games. According to ESA, the Entertainment Software Association (2017), playing video games has become one of the most popular recreational activities, not just among children and adolescents, but also among adults. So it does not make sense anymore to summon connotations of Digital Natives, Settlers, and Immigrants (Prensky, 2001) because simply said, the digital generation is us (Senior & Gyarmathy, 2021). Understandably there will always be those who will never accommodate for change. Then again as in the case of many, over the years, actively engaging with digital technology has enabled us to rewire ourselves in the ways we think and act. In context, millions of people of all ages are spending substantial amounts of money on video or digital games. But while they are also investing a lot of time to learn and master them, that same kind of dedication and perseverance is rarely seen in learning within formal educational settings (Gee, 2007).

Words such as 'motivation' and 'engagement' can have different connotations even for education. Still, an effective quality that enhances motivation is when learning is meaningful. Learning becomes meaningful when it is authentic and people can personally and socially relate to it (Jonassen et al., 2008). This therefore explains why qualities that are usually associated with video games,[4] such as the enhancement of motivation and engagement (Krath et al., 2021), are progressively being employed in a meaningful manner in schools and within traditionally game-free contexts (Albertazzi et al., 2019; Ioannou, 2019; Rachels & Rockinson-Szapkiw, 2018; Zainuddin, 2018) because people can already relate with games. However, esports adds an extra dimension to video game playing, that of competition in the presence of audiences that can literally run into millions placing players in the limelight. Indeed, even esports players differ from the casual gamer for the fact that the former do not play for fun or relaxation but in a competitive manner (Bányai et al., 2019).

Electronic sports, in short esports, also designated as cybersport, virtual sport, and competitive gaming (Hayday & Collison, 2020; Jenny et al., 2017; Witkowski, 2012) refers to organised video game play competitions and international contests that are attended and viewed by millions. Esports includes different genres of games, such as, First Person Shooter (FPS), Real Time Strategy (RTS), and Massively Multiplayer Online Role-Playing Games (MMORPGs). However, as

[4] The reference to games will solely be attributed to video games as any form of a digital game that requires the use of a screen as a play alone or group activity. Specifically, the player(s) are directly involved in a prescribed role where the requisition to progress forward in the elaborate fantasy world includes solving presented issues.

Bányai et al. (2019) confirm, Multiplayer Online Battle Arena (MOBA) games are lately becoming the most attractive popular category in esports.

Many debate if esports should be considered to be a sports like traditional sports that tends to be more physically inclined. Then again darts, snooker, and even chess competitions, where physical locomotion is limited to specific body parts, are still considered as sports (Bányai et al., 2019). Tiedemann (2020) refers to 'sports' as an activity where people voluntarily meet to compare their abilities and skills in a competitive manner and in a regulatory framework. Esports activities and tournaments like in the case of traditional sports also abide to rules. Like in the case of traditional sports, esports gamers have to be disciplined, train, and practice. So while esports is not a physically competitive activity, esports players have to compete and succeed in the organised events. Similar to traditional sports, esports players participate in leagues as single or groups of players against other persons or groups, respectively. In the eventuality of winning, they receive rewards that may include monetary prizes.

Like other sports, esports has focused on the acquisition of institutional stability and therefore recognition. In 2008, the International Esports Federation (IeSF) was founded to provide a formal worldwide legislative standardised infrastructure. Today, the federation comprises several member organisations from all over the world. The headquarters of the IeSF are located in South Korea from where esports first emerged. Incidentally, historically and according to the Harvard International Review (HIR, 2020), esports was established by the South Korean government as an initiative to save the country from a financial crisis. In the process, the development of a robust Internet infrastructure sparked the rapid creation of video gaming clubs where people could go to meet and play video games. In the end, the direct involvement of the South Korean government and the creation of the Korean eSport Association (KeSPA) saw the fruition of the ever increasing popularisation in the industry itself.

Today, esports is turning out to be a highly profitable industry. In the past few years, esports has been on the increase (Heere, 2018). Admittedly COVID-19 restrictions and related home-staying protocols may also have been instrumental for esports to experience massive growth in popularity both in terms of players and viewers (Cranmer et al., 2021). With revenues running into billions, international contests are either physically attended or remotely viewed by millions. It is also a reflection of the ongoing digitally instigated cultural evolution that I dare say has its inception within the popularisation of the Internet. From 2002 onwards, esports started to gain academic relevance (Reitman et al., 2020). The year 2014 may have been characterised with a sharp dip, but the growth on esports publications in various disciplines continued to increase from 2015 onwards (Reitman et al., 2020; Hanghøj et al., 2018). Competitive computer gaming initiatives such as esports have gained a lot of popularity even surpassing the viewership of traditional sports. However, coordinated research in the area is still fragmented and therefore limited (Cranmer et al., 2021; Heere, 2018; Reitman et al., 2020; Wagner, 2006). Regrettably it tends to be treated as an extension of existing phenomena or theories (Cranmer et al., 2021; Reitman et al., 2020). Then again, such arguments make it opportune to undertake the path less travelled, as in this writeup, where the seemingly unrelated qualities like the direct handover of responsibility to players in esports is being tested as a stimulus for inclusion.

Game Traits of Motivation, Personalisation, and Inclusion

Without confining arguments within formal educational settings, that is, schools, learning enhances the qualities of life (Gee, 2007). But unless there is some form of reward at the end of the learning journey, it is natural for people to just give up and follow the simpler easier route. Then again, the key should be that of employing anything that can motivate people to keep on pursuing a learning task. In context, one can only wonder why do video game players persist so much when playing video games especially if they repeatedly lose before they win? Esports differs from normal video game play because it also offers a structured and competitive dimension. As already expressed further up, it goes beyond elements for recreation to offer a dimension of a vocation that players may pursue as their professional career and as financial support. Still at its core, esports harnesses the element of video games (Bányai et al., 2019).

So how can video games help?

An important aspect of video games is their innate element of motivation and therefore the reason why people play. Ryan and Deci (2000) state that motivation underlines the inspiration to do something. Motivation is individual and temporal. It can vary in intensity and is therefore susceptible to the nature of attitudes and goals (Reid, 2012). Ryan and Deci (2000) also distinguish between two forms of motivation, that is, intrinsic and extrinsic motivation. In intrinsic motivation, people engage in an activity for its inherent enjoyment and satisfaction. In contrast, an extrinsic motivation explains the aspect where people are purely motivated in the performance of the task to obtain a potential reward. One form of motivation does not necessarily exclude the other and any player may have a mix of both motivations. Yet again these two forms of motivations do dictate the attitudes towards video game play. When people are playing for leisure or as a hobby and when they are playing in a structured form of competition like esports, or, if playing is their job and career, then video game play is approached differently. However, notwithstanding such explicit divergencies between intrinsic and extrinsic motivations, and, recreational and professional video game playing, researchers still claim that the presence of common drivers of motivation such as interactivity, challenge, and competition are common in all games and situations. Thus, when players interact, they are also being motivated to socialise and learn to enhance their communicative abilities with other players (Greenberg et al., 2010; Taylor, 2009; Vorderer et al., 2003). Li and Wong (2021) observe how over time, digital technology including game-based learning has been widely employed to overcome students' personal differences. Similarly, Hanhøj et al. (2018) express how a growing body of literature portrays that playing challenging games can encourage friendship and social inclusion. When it comes to the aspect of challenge, video games can potentially hold a challenge for a player or players to achieve the final goal and reward (Taylor, 2009).

In respect to competitivity, first, there are the rules, goals, and challenges that define the game. Second, there are the design elements of the game also referred to as the gamification processes where, by rewards such as points and badges (Deterding et al., 2011), players are purposefully instigated and guided forward through the levels of the game. Third, there are the game-based learning qualities that are related to the learning outcomes gained from playing the game (Krath et al., 2021). Thus, within the realms of video games, rules and content can be designed in a way to adapt to the personal capabilities and/or according to the player's preferences where, as seen in role play games, the user can choose the character to play (Karpinskyj et al., 2014) and also decide how best to persevere and proceed to win. Finally, while contextually different, the competitive motivation runs in every game (Bányai et al., 2019). While more than half of the players in esports are casual ones (Cranmer et al., 2021) then again, no matter if one is playing alone, against, or with others, the competitive element is so important (Taylor, 2009) that in line with demand and competitor marketplace even originally non-competitive games such as Overwatch have adopted elements of leagues to enhance popularity (Cranmer et al., 2021).

With all things considered notwithstanding if the video game is for a single player, cooperative with some shared goals or collaborative where players have to work as a team, it still motivates and empowers the player with the responsibility of a central role literally placing the player in the driver's seat. The outcomes of success ultimately become the responsibility of the player whose actions that revolve around decision-making, and strategies adopted will influence the outcomes of the game results. This is accentuated even further in esports where the outcomes of the game are being showcased as an entertainment for others. Ultimately when all these qualities are translated in an esports context, while a player may not learn specific content, these personalised qualities, away from any form of social or cultural inclinations, will place the same player in the limelight and therefore the centre of attention.

Methodology and Analytical Approach

A methodological approach that leaned towards open-ended interviews was taken as being most appropriate for bringing forth participants' embraced perceptions with respect to the qualities in esports that eventually would have shed light on elements of motivation for the facilitation of inclusion. Interviews based on open-ended questions may be more difficult to analyse; however, they also allow respondents to speak freely, thereby bringing forth those subtle nuances in expressive talking that only an interview can pose. Shuy (2001) communicates that the stronger aspect of interviewing is the emphasis on the freedom of speech. '[…]

face- to-face interaction compels more small talk […] non verbal communication […] in which people can more fully express their humanity' (Shuy, 2001, p. 541). Therefore, the employment of open-ended questions was effective to 'dig' into the meaningful interpretations that the different respondents have about and give on esports.

As usual, ethical measures were strictly adhered to. Thus, after carefully explaining the nature of the research to potential participants, interviewees were provided with a note that offered an explanation of what the research was all about. On agreeing to take part in the interview, the respondents were asked to sign a document that guaranteed their consent to participate. The right to privacy and protection of respondents' identity was ensured. Therefore, while all interviews were performed and recorded via ZOOM, anonymity was guaranteed in all instances. Participants were also informed that in the eventuality of their withdrawal from the research, all data procured from their side would be deleted from the research.

Nascent perceptions and interpretations were then duly analysed and interpreted. As expressed by Wellington (2006): '[…] reality is a human construct' (p. 16), Schein (2001) refers to the 'theory of organisational culture' to express how observed facts may in reality hide deeper embedded qualities. Observed beliefs and assumptions may hold deeper perceptions, which rather than being passive, are subject to recursivity and a constitutive part of the realities perceived (Holstein & Gubrium, 2005; Schein, 2001; Berger & Luckmann, 1967). Thus, sustaining the core of the research initiative, the transcripts derived from the interviews provided the groundwork for the employment of what Abawi (2012) refers to as a refractive phenomenological approach. In context, coding was employed to enable the condensation of data into key indicative words and phrases that ultimately provided insights into the norms, assumptions, and articulated and shared perceptions participants embraced with respect to esports.

Participants were classified in two categories: the coordinators and the competitive video game players. In all, six sets of ZOOM interviewing exercises were performed: three with coordinators and three with the video game players.

The Coordinators Category

The coordinators included Maltese individuals who carried active roles in the mentioned academy and the President of the Malta Esports Association. The researcher initially approached one of the founders within the academy whom after accepting to participate was instrumental in introducing the researcher to other individuals directly involved in esports within and external to the academy. Between them, participants in the coordinators group carried a wide baggage of responsibilities either as founding members of the mentioned academy and/or were directly involved in organising and coordinating competitive games activities, educational content in relation to esports, activity developers, and also referees in games. Incidentally all of the coordinators were at one point or another involved in competitive game activities themselves.

In case of the coordinators, three interviews were performed, one with each participant. Each interview lasted approximately 1 h. Five coordinators were contacted of which three accepted the invitation to participate, while two never acknowledged receipt of the invitation.

The Competitive Video Game Players Category

The competitive video game player group included nine players who were actively involved in competitive game play either intrinsically for personal leisure or extrinsically involved in semi-professional league competitions. The researcher had also contacted a professional game player via social media. This individual initially accepted to participate but then never replied to the invitation for setting a time for the interview.

Two players, whom the author personally knew to be actively involved in competitive video game play, were initially approached. The motif underlying the research was clearly explained to them. On acceptance from their side to participate in the research initiative, an information note that the participants signed as part of the formal agreement for participation was provided. The document comprised an explanation of the research initiative, a written guarantee of anonymity, and the option for the participants to withdraw from the research with the subsequent removal of disclosed information. The two players were instrumental in disseminating information regarding the research within their gaming networks. Eventually all the game players who accepted to participate were invited to sign and return a copy of the provided research document. As nine players agreed to participate, three sets of group interviews, with three participants per group were carried out.

The Nature of the Interviews

In context of the small cohort of participants but also because this research was directed to elucidate participants' perceptions towards competitive video game play, a qualitative approach was taken to be more adequate. Two sets of interviewing questions were designed. Both interviews comprised 13 open-ended questions. It was considered that as coordinators and actual game players, the way both groups perceived competitive video game playing would have been different. Thus, while the questions directed to coordinators' and gameplayers' groups were similar, they were not identical. However, both interviews were directed to elucidate the perceptions the participants in each category embraced with respect to esports and competitive video game playing.

In both instances, interviewing questions were designed to be open ended. Sjoberg and Nett (1968) consider that the use of structured interviews are more intentionally utilised on testing a set hypothesis and less concerned with discovery. On the other hand, 'The unstructured type is more useful […] for discovering the existence of possible social patterns […]' (Ibid., 1968, p. 195). Therefore, in context that the researcher sought to be neutral and approach this initiative with no preconceived outcomes or expectations of results, the nature of open-ended or free response questions was taken to be more adequate and revelational. Basically, it was considered that this would have allowed the respondents to freely express what competitive video game play evoked in them both as facilitators and also as players.

Analysis and Interpretation

While open-ended questions would have been more difficult to analyse, they offered freedom to the respondents who, unencumbered by a prepared set of replies, were justified to freely express themselves. Wolcott (1994) states that the greater issue is not attaining the data but how best to figure what to do with it. The outcomes of this research were directed to discern the potential qualities that esports and therefore competitive video game play harness in terms of inclusion. Ultimately, perceptions that different participants harboured on the issue had to be elucidated. Thus, the first part of the analysis comprised the categorisation of promising interview excerpts that could be then classified into themes or domains of categorisation. In context, the Description, Analysis, and Interpretation (DAI) method as expressed by Wolcott (1994) was employed. In this case, the 'Description' included a faithful portrayal of statements obtained from the interview. In the 'Analysis' stage, relevant traits were successively set apart from the 'noise', that is from data that was not relevant to the core question. Finally emergent patterns were 'Interpreted' in context of constructs that were suggestive to inclusion. In this case and as guided by qualities of interactivity, challenge, and competition, nascent and maybe even less obvious traits in competitive video gaming such as liaison and responsibility in team-play, decision-making management, and therefore leadership traits ultimately drove forward the notion towards the elicitation of inclusion in esports.

Summarising Results

As expected, the unbiased analysis of data that heavily leaned towards individuals' subjective perceptions was not easy. Nascent data regarding competitive game playing portrayed a rich but also contrastingly divergent opinions. Then again, probably one of the most interesting qualities that surfaced from this research initiative was the way both groups of respondents, that is, the coordinators on one side of the interviewing spectrum and the actual players on the other side of the same continuum perceived the qualities of esports, specifically the competitive gaming element. While the managers provided an encompassing overview, the players gave a more personalised experience. Yet again there were several instances where observed perceptions by both groups overlapped, reinforcing further arguments on the facilitation of inclusion through competitive gaming activities.

All of the coordinators acknowledged that while the people involved in game playing within the academy were in their majority youths, it was conceded that in general it all depended on the nature of the games themselves. Games that involved good reflexes like shooting games or car racing were more popular with the younger generation, while strategy games had a mix of different age groups to even include players in their 40s.

Incidentally, several of the youths' esports activities at the academy were sustained by their parents or guardians. Reasons for the involvement by adults were diverse but also included elements of inclusion. Parents and guardians saw the potential in esports as a means to redefine the way their children approached video games. Thus instead of just playing aimlessly and wasting time, they saw esports as an opportunity for their children to become more disciplined in terms of time management but also as an opportunity for talent development, discipline, and training to play competitively even as a career. Beyond time management, the coordinators acknowledged that there were several parents who perceived esports as instrumental in helping their shy or introverted children socialise better not just through the screen but also by meeting other people in person at the academy. This was also corroborated from the interviewed gamers themselves. All of the interviewed gamers admitted that competitive playing allowed them to make new acquaintances even with people they most probably would never meet in real person. Six out of the nine players interviewed admitted that they were quite introverts themselves. Five preferred using competitive video game playing as a mode of socialising. They disclosed how screen time during gameplay allowed them to bridge with people with similar inclinations. They even declared that most of the time they played with their cameras off and independent to how they looked, game play allowed them to connect with other people with similar inclinations. They also admitted that as the screen was itself a rich modality of communication, they even had to enhance their communication skills so as to reach a larger audience of potential friends.

One of the interviewed coordinators explained how certain games tended to be more popular within certain world regions. For instance, 'Counterstrike' was more popular in Europe but not that much in Asia. On the other hand, in the case of games like 'Overwatch' the inclusion of characters with different ethnicities ensured that the game would be attractive and identifiable with players from different parts of the world. There were instances where the players conceded that language was a barrier and playing with players that were not proficient in English proved to be very difficult. Then again, in contrast to language barriers, the fact that the design of certain games allows them to be played through handheld devices like mobile phones also enhances accessibility to those who may not afford to own a PC.

The players also expressed how competitive game playing was not always '[…] a smooth sailing experience' (Player 4). As expressed further up, all those interviewed admitted that online gaming is in fact plagued with hypermasculinity. That is gaming environments tend to be male dominated. As a matter of fact, coordinators portrayed several instances where game playing environments, even in certain instances of professional game playing in esports, the situation got toxic because certain individuals or even groups were not ready to accept females as participants. Incidentally, two of the participant players interviewed were females. They admitted that it was not the first time they chose to compete in leagues (not necessarily esports activities) where there were only female players, namely, because of being excluded from other leagues for being females.

They admitted that they experienced several instances where other male players just left when they became aware that there were girls playing or else, they as females, were either kicked out of games or bullied and at times even mistreated because of their gender. One of the coordinators admitted that yes, video game playing is still male-oriented but there are also either female-only oriented leagues or leagues like 'Overwatch' where female presence is strong. Then again, one respondent from the coordinators group declared that there are games like 'League of Legends' or 'Overwatch' where different players have diverse but equally important role play. This would therefore imply that the outcome of success was a collective activity through the employment of different skill sets, therefore establishing facilitated inclusion in team work. Thus, those who were not that quick in shooting or even because they were females, they could play a major role as healers. So while they were not liable to protect the team from enemies, they still enjoyed an important role of sustaining the well-being of the team, healing, and keeping the other members on the team alive.

Incidentally both coordinators and players expressed how such cooperative team playing contributed to a sense of 'spatiality' through liaison. As expressed by the players:

> In a group video game, you are not playing alone and for yourself. You are also playing with and for others (Player 1)

> I feel responsible that I always give the best I can so we win, or else lose with dignity (Player 3)

The players admitted that when playing in teams and especially in a competitive league, planning and strategy were very important. But they deemed it necessary to have a good and experienced leader capable of planning and assessing and coordinating strategy. This again compliments what coordinators express as the facilitation of leadership skills through esports. More than that one of the interviewed coordinators expressed how players with good leadership skills were in high demand in esports and since not that easily found were also very well paid. On a similar note, one of the female players acknowledged how competitive game playing helped her gain and eventually refine her leadership skills that even away from esports itself it instigated her to actively involve and participate on other social platforms that helped organise other student lives during their study time in post-secondary and other Higher Education institutes.

All participants acknowledged how video game playing motivates confidence. Specifically esports motivates discipline to train and work towards enhancing goals for self-actualisation. Most of those interviews portrayed how video game playing should be associated to a personal life experience. Two of the players admitted how meeting and getting to know people during video game playing, learning, and accepting to win but also lose, empowered them to gain confidence in themselves, go out more and meet people they played with, in person. One of the coordinators likened this to the popularity one gained in school or in a club by being good in football. Thus, as coordinator 3 commented:

> If a kid is good in video game playing and most if not all in the class mates like playing video games, then if he is capable of winning, he will become popular with the rest of the class. More so, he can become popular with the rest of the school if he takes part and win in an esports competition.

Conclusion

Admittedly this research initiative has been nothing less than a rewarding roller coaster ride. It is believed that the adopted inductive strategy that aligned categorisation to the subsequent thematic analysis and interpretation of nascent data proved its validity. Then again, in the same instances of having to deal with tangible negative elements related to video game play such as associated waste of time, game addiction, and as disclosed by some of the interviewees, elements of hypermasculinity, racism, and cyberbullying, I also discerned a wealth of potential qualities and opportunities for inclusion that negative deep-rooted beliefs towards video game play tend to suppress. For instance, two of the female participants declared that while playing online they did encounter various instances where once they disclosed their identity it was very common for male players to just leave the game or else ask them to leave. However, while these female participants did verify this element of male dominance on online game playing platforms, one of them expressed how the same platforms that inherently may have pushed her away also helped her to become less of an introvert. She admitted that while in person she did not feel comfortable with herself, she did make new friends through online video game play. This enabled her to develop new friendships, and there were instances where she eventually met in person the individuals she met online, including males.

Notwithstanding the stereotyped element of white male dominance in competitive video game play (Hayday & Collison, 2020), the landscape, albeit slowly, is changing. Arfasoftech, a software development company in Pakistan, portrays how the video game industry is becoming progressively diversified and more all-inclusive (Ali, 2021). While still comparably low with respect to males, the female player-base is on the rise both in live streaming, game development industry, and video game play (Leonhardt & Overå, 2021). However, inclusivity traits are also spreading beyond gender to embrace physical, cultural, and ethnic diversity. The design of game controllers or consoles for individuals with special needs has expanded the pool of game players. In addition, apart from the hardware, game genres are also intrinsically becoming more universal, ethnically and culturally sensitive and are now also taking heed of those with special needs. For instance, in the game ‘Cyberpunk 2077’, players are allowed to customise their physical appearance. This now goes beyond skin colour, body type, and even away from the male or female stereotype. Therefore, participants have full control to express their originality and project themselves in any way they want to look. Another very popular game ‘The Last of Us Part 2’ has even included over 60 different game levels that cater for audio, visual, and motor skills impaired players (Ali, 2021). Thus, while still in its initiation, change and a growing inclination towards a more encompassing inclusion in game experience is definitely taking place.

On another note, rapid technological developments have instigated the need to redefine contemporary and future skills. The Assessment and Teaching of Twenty-First Century Skills (ATC21S) Framework relates such skills to elements of creativity and innovation, critical thinking, problem solving, learning-to-learn, and metacognition (Binkley et al., 2012). Wrahatnolo and Munoto (2018) extend this further to include elements of flexibility and adaptability, initiative, and accountability and leadership. Clearly, competitive game play and more so esports is not static but is also empowering, confirming a degree of personalisation. Specifically, saying that video game role play places individuals in the driver’s seat may seem diminutive because connotations do run deep. The innate high levels of customisation within video games actively promote participants to actors’ and therefore decision-making levels. Ultimately video game play is achieving a level of personalisation that in itself enhances inclusion by instigating game players to become role players with the full responsibility of outcomes.

While the qualities of inclusion elicited from video game play, and more so in competitive ones was clearly elucidated from observed data, this research did have its limitations mainly because of the small population studied. Then again while statistically non-exhaustive and therefore maybe not procuring a conclusive portrayal of the facilitation of inclusion in esports, the players who volunteered did represent a random sample. Ultimately this was indicative of the inherent and intrinsic motivational qualities harboured in all those who want or feel the need to play and gamble with the possibility of testing their innate qualities, getting noticed, being heard, and having a shot towards popularity and the limelight.

References

Abawi, L.-A. (2012). Introducing refractive phenomenology. *International Journal of Multiple Research Approaches, 6*, 141–149.

Abawi, L.-A. (2015). Inclusion ‘from gate in’ wrapping students with personalised learning support. *InternatIonal Journal of PedagogIes and learning, 10*(1), 47–61. https://doi.org/10.1080/22040552.2015.1084676

Albertazzi, D., Ferreira, M. G. G., & Forcellini, F. A. (2019). A wide view on gamification. *Technology, Knowledge and Learning, 24*(2), 191–202. https://doi.org/10.1007/s10758-018-9374-z

Ali, F. (2021). *Inclusion in video games: The landscape is changing*. Available at https://arfasoftech.com/blog/INCLUSION-IN-VIDEO-GAMES:-THE-LANDSCAPE-IS-CHANGING. Accessed Apr 2022.

Bányai, F., Griffiths, M. D., Király, O., & Demetrovics, Z. (2019). The psychology of esports: A systematic literature review. *Journal of Gambling Studies, 35*, 351–365. https://doi.org/10.1007/s10899-018-9763-1

Berger, P. L., & Luckmann, T. (1967). *The social construction of reality. A treatise on the sociology of knowledge*. Penguin Books.

Binkley, M., Erstad, O., Hermna, J., Raizen, S., Ripley, M., Miller-Ricci, M., & Rumble, M. (2012). Defining twenty-first century skills. In P. Griffin, E. Care, & B. McGaw (Eds.), *Assessment and teaching of 21st century skills*. Springer.

Cranmer, E. E., Han, D.-I. D., van Gisbergen, M., & Jung, T. (2021). Esports matrix: Structuring the esports research agenda. *Computers in Human Behavior*. https://doi.org/10.1016/j.chb.2020.106671

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining "gamification". In *Proceedings of the 15th international academic MindTrek conference on envisioning future media environments – MindTrek, 11*, 9–15. https://doi.org/10.1145/2181037.2181040

Entertainment Software Association (ESA). (2017). *2017 economic impact report*. Available at https://www.theesa.com/resource/2017-economic-impact-report/. Accessed Mar 2022.

Gee, J. P. (2007). Good video games + good learning. In *Collected essays on video games learning and literacy*. Peter Lang Publishing Inc.

Greenberg, B. S., Sherry, J., Lachlan, K., Lucas, K., & Holmstrom, A. (2010). Orientations to video games among gender and age groups. *Simulation & Gaming, 41*(2), 238–259. https://doi.org/10.1177/1046878108319930

Hanghøj, T., Lieberoth, A., & Misfeldt, M. (2018). Can cooperative video games encourage social and motivational inclusion of at-risk students? *British Journal of Educational Technology, 49*(4), 775–799. https://doi.org/10.1111/bjet.12642

Harvard International Review (HIR). (2020). *Esports Part 1: What are esports?* Available at https://hir.harvard.edu/esports-part-1-what-are-esports/. Accessed Mar 2022.

Hayday, E. J., & Collison, H. (2020). Exploring the contested notion of social inclusion and gender inclusivity within eSport spaces. *Social Inclusion, 8*(3), 197–208. https://doi.org/10.17645/si.v8i3.2755

Heere, B. (2018). Embracing the sportification of society: Defining e-sports through a polymorphic view on sport. *Sport Management Review, 21*, 21–24. https://doi.org/10.1016/j.smr.2017.07.002

Holstein, J. A., & Gubrium, J. F. (2005). Interpretive practice and social action. In N. K. Denzin & Y. L. Lincoln (Eds.), *The SAGE handbook of qualitative research* (3rd ed., pp. 483–505). SAGE Publications.

Hussein, M. H., Hock, O. S., Cheong, L. S., Thong, M.-K., & Ebrahim, N. A. (2019). Effects of digital game-based learning on elementary science learning: A systematic review. *IEEE Access*. https://doi.org/10.1109/ACCESS.2019.2916324

Ioannou, A. (2019). A model of gameful design for learning using interactive tabletops: Enactment and evaluation in the socio-emotional education classroom. *Educational Technology Research and Development, 67*(2), 277–302. https://doi.org/10.1007/s11423-018-9610-1

Jenny, S. E., Manning, D., Keiper, M. C., & Olrich, T. W. (2017). Virtual(ly) athletes: Where esports fit within the definition of "sport". *Quest, 69*(1), 1–18.

Jonassen, D., Howland, J., Marra, R. M., & Crismond, D. (2008). *Meaningful learning with technology* (3rd ed.). Pearson/Merril Prentice Hall.

Juvonen, J., Lessard, L. M., Rastogi, R., Schacter, H. L., & Smith, D. S. (2019). Promoting social inclusion in educational settings: Challenges and opportunities. *Educational Psychologist, 54*(4), 250–270. https://doi.org/10.1080/00461520.2019.1655645

Karpinskyj, S., Zambetta, F., & Cavedon, L. (2014). Review. Video game personalisation techniques: A comprehensive survey. *Entertainment Computing, 5*, 211–218. https://doi.org/10.1016/j.entcom.2014.09.002

Krath, J., Schürmann, L., & von Korflesch, H. F. O. (2021). Revealing the theoretical basis of gamification: A systematic review and analysis of theory in research on gamification, serious games and game-based learning. *Computers in Human Behavior, 125*(2–33). https://doi.org/10.1016/j.chb.2021.106963

Leonhardt, M., & Overå, S. (2021). Are there differences in video gaming and use of social media among boys and girls?—A mixed methods approach. *International Journal of Environmental Research and Public Health, 18*, 6085. https://doi.org/10.3390/ijerph18116085

Mitchell, M. (2019). *Artificial intelligence: A guide for thinking humans*. Farrar, Straus and Giroux.

Prensky, M. (2001). Digital natives, digital immigrants part 1. The strategic planning resource for education and professionals. *On the Horizon, 9*(5), 3–6.

Rachels, J. R., & Rockinson-Szapkiw, A. J. (2018). The effects of a mobile gamification app on elementary students' Spanish achievement and self-efficacy. *Computer Assisted Language Learning, 31*(1–2), 72–89. https://doi.org/10.1080/09588221.2017.1382536

Raise Your Skillz. (2022). *Gaming industry vs. other entertainment industries*. Available at https://raiseyourskillz.com/gaming-industry-vs-other-entertainment-industries-2021/. Accessed Mar 2022.

Reid, G. (2012). Motivation in video games: A literature review. *The Computer Games Journal, 1*(2), 70–81. https://doi.org/10.1007/BF03395967

Reitman, J. G., Anderson-Coto, M. J., Wu, M., Lee, J. S., & Steinkuehler, C. (2020). Esports research: A literature review. *Games and Culture, 15*(1), 32–50. https://doi.org/10.1177/1555412019840892j

Roch, J. (2021). *Technology is best when it brings people together*. ACPE the Standard for Spiritual Care and Education. Available at https://acpe.edu/detail-pages/news/2021/05/28/technology-is-best-when-it-brings-people-together. Accessed Apr 2022.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development and well-being. *American Psychologist, 55*(1), 68–78. https://doi.org/10.1037//0003-066x.55.1.68. PMID: 11392867.

Schein, E. H. (2001). Organizational culture and leadership. In J. Shafritz & J. S. Ott (Eds.), *Classics of organization theory* (pp. 373–374). Harcourt College.

Sclove, R., & Scheuer, J. (1996). M - On the road again? If information highways are anything like interstate highways—Watch out! In M. Kaufmann (Ed.), *Computerization and controversy* (2nd ed., pp. 606–612). ISBN: 9780124150409, https://doi.org/10.1016/B978-0-12-415040-9.50131-7

Senior, J., & Gyarmathy, E. (2021). *AI and developing human intelligence: Future learning and educational innovation*. Taylor and Francis Ltd.

Shuy, R. W. (2001). In-person versus telephone interviewing. In J. F. Gubrium & J. A. Holstein (Eds.), *Handbook of interview research, context and method*. Sage Publications.

Sjoberg, G., & Nett, R. (1968). *A methodology for social research*. New York: Harper & Row.

Sutherland, W., Hossein, M., & Jarrahi, H. (2018). The sharing economy and digital platforms: A review and research agenda. *International Journal of Information Management, 43*, 328–341. https://doi.org/10.1016/j.ijinfomgt.2018.07.004

Taylor, T. L. (2009). *Play between worlds. Exploring online game culture*. The MIT Press.

Tiedemann, C. (2020). *Sport- A suggested definition*. Hamburg University. Available at http://www.claustiedemann.de/tiedemann/documents/DefinitionSportEnglish.pdf. Accessed Mar 2022.

Vorderer, P., Hartmann, T., & Klimmt, C. (2003, May). *Explaining the enjoyment of playing video games: The role of competition*. Paper presented at the proceedings of the second international conference on entertainment computing, Pittsburgh. https://doi.org/10.1145/958720.958735

Wagner, M. (2006, June 26–29). On the scientific relevance of eSports. In *Conference: Proceedings of the 2006 international conference on Internet Computing & Conference on Computer Games Development*, ICOMP 2006, Las Vegas, pp. 437–442. Available at https://www.researchgate.net/publication/220968200_On_the_Scientific_Relevance_of_eSports. Accessed Mar 2022.

Wellington, J. (2006). *Educational research. Contemporary issues and practical approaches*. Continuum.

Witkowski, E. (2012). On the digital playing field: How we "do sport" with networked computer games. *Games and Culture, 7*(5), 349–374.

Wolcott, H. F. (1994). *Transforming qualitative data. Description, analysis and interpretation*. SAGE Publications.

Li, K. C., & Wong, B. T. M. (2021). Features and trends of personalised learning: A review of journal publications from 2001 to 2018. *Interactive Learning Environments, 29*(2), 182–195. https://doi.org/10.1080/10494820.2020.1811735

Wrahatnolo, T., & Munoto (2018). *IOP Conference Series: Materials Science and Engineering, 296*, 012036. https://doi.org/10.1088/1757-899x/296/1/012036

Zainuddin, Z. (2018). Students' learning performance and perceived motivation in gamified flipped-class instruction. *Computers & Education, 126*, 75–88. https://doi.org/10.1016/j.compedu.2018.07.003

Index

L. Daniela (ed.), *Inclusive Digital Education*, Educational Communications and Technology: Issues and Innovations, https://doi.org/10.1007/978-3-031-14775-3