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EDITORIAL

Smart Pedagogy as a Driving Wheel for Technology-Enhanced Learning

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Abstract

People have long talked about the use of technology in education and are looking for ways to incorporate different scientific advances into the learning environment, both to help students learn and make learning more interesting for them as well as to ensure that future generations can innovate based on previously accumulated knowledge. Today, when we talk about technology-enhanced learning, we mean the possibilities created by digital technology, which has become widely available to everyone thanks to both the creation of Intel's digital microprocessor in 1971 (Chan et al., in Research and Practice in Technology Enhanced Learning 1:3–29, 2006) and the creation of the world wide web in 1990 (Berners-Lee, T., & Cailliau, R. (1990, November 12). WorldWideWeb: Proposal for a HyperText Project. https://www.w3.org/Proposal.html). The current crisis caused by the Covid-19 pandemic has given a further boost to technological developments to ensure access to education, which is one of the most important areas of society. Everyone has come across education in its various forms, either by learning at any level or form of education or by being a parent who has become a provider of home-schooling during remote learning (Daniela et al., in Sustainability 13:3640, 2021), whether as an educator or a creator of learning materials and technologies. The Covid crisis has shown that the use of technology is sometimes the only way to provide access to education, but despite the potential of technology to organize synchronous and asynchronous learning, there are still many problems in using technology, both in terms of just sending students materials to learn by e-mail and also with the initial inflexibility of the learning process. For instance, synchronous online classes were organized for students according to the traditional agenda of classes without thinking about the students' ability to focus on on-screen activities for many hours and, after that, to do independent work.

Keywords Smart pedagogy · Technology enhanced learning (TEL) · Classiffication of TEL · Dimensions of TEL

Regardless of whether technology is used to build a blended, hybrid, flipped learning process or whether it is used to deliver remote learning, the essential point is how this

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pedagogical process is organized. Therefore, when thinking about pedagogical processes to provide technology-enhanced learning, the term “smart pedagogy” is used to refer to the fact that pedagogy is a branch of science on how to provide learning. However, there is still debate about exactly what "pedagogy" entails. In the *Merriam-Webster Dictionary*, it is defined as the art, science, or profession of teaching (Merriam-Webster, n.d.), but in the *Oxford Dictionary*, it is defined as the study of teaching methods (Oxford Learner’s Dictionary, n.d.). In addition, pedagogical knowledge is needed to guide the learning process (Shulman, 1986) and digital literacy to lead pedagogical processes (Biezā, 2020). The term “smart” refers to the use of digital technologies in the learning process (Borawska-Kalbarczyk et al., 2019; Daniela, 2019), and this smart pedagogy concept is put at the forefront of TELto analyze what kind of pedagogical activities need to be done so that the technology-enhanced learning process is not only rich in technology and technological solutions but also provides higher learning outcomes or better access to knowledge. Thus, smart pedagogical competence can be seen as a driving wheel that ensures that the use of technology in classroom activities has pedagogical value, thus providing techology-enhanced learning.

TEL can be divided into several types, one of which is a division based on the purpose of the use of technology:

(1) Learning takes place remotely and technology is used to provide remote or distance learning, so technology can make education accessible beyond time and space.
(2) Learning takes place face-to-face or remotely, using computer technology to help students acquire the use of computer (or other digital technology) and various software skills, where the main emphasis is on how to acquire specific technological skills.
(3) Learning takes place in person or remotely, and various technologies, technological solutions and online learning materials are used to help students acquire certain knowledge or provide access to knowledge. In such a situation, technology complements the learning process, and this use of technology may be in different proportions in relation to the traditional learning process.

Any of these types of TEL may exist in the learning process, but the pedagogical task is to ensure that a certain dimension of knowledge acquisition comes to the fore, considering whether such a learning process contributes to the development of knowledge, supports the quantitative growth of knowledge, provides access to knowledge, and helps to accumulate the acquired knowledge in new thinking schemas (Daniela, 2020).

There are researchers who emphasize the term “enhanced” to describe that the use of technology is not the main overarching goal of the learning process, as already pointed out by Kirkwood and Price (2014) in their publication analyzing whether technology is indeed considered to be a learning process enhancement. Steffens and colleagues also felt that there is no direct link between specific technology and learning achievements. They are convinced that although the use of different technologies can contribute to the achievement of learning achievements, it is affected by many other aspects (Steffens et al., 2015) that are related to the interactions between students and both the technology and learning contexts (Li, 2014). Similarly, the success of TEL also depends on students’ prior knowledge and motivation as well as on specific pedagogical activities that are the focus of this special issue so as to try to understand how the use of technology fits into educational models. Therefore, it is necessary to think about what exactly technology improves and whether any of the important dimensions of the teaching process can be brought to the fore (see Fig. 1); for example, we can talk about the dimensions of knowledge by analyzing them

Fig. 1 Dimensions of TEL

from different perspectives (Daniela, 2020), or we can bring the motivational dimension to the fore, anticipating that the fascination with technology or the opportunities created by technology can create additional motivation (Keller, 2010; Pedrotti & Nistor, 2016).

The use of technology in education can be analyzed from the perspective of educational sustainability, whether it helps to create a sustainable environment, or in terms of how the use of technology helps to achieve other sustainable development goals, such as helping to ensure access to education for all groups in society (Daniela et al., 2018; Visvizi & Daniela, 2019; Visvizi et al., 2020). Technology in education can also be a driving force for inclusive education and an inclusive society, both by providing support to students with specific learning needs and by providing opportunities for students to acquire knowledge that would not be possible without technological support (Rodriguez-Ascaso et al., 2011).

In addition, digital technologies can be analyzed from the perspective of rights and responsibilities with regard to the aim for all members of society to be provided with the opportunity to use technology and digital solutions without restrictions, guaranteeing them with the right to anonymity, the right to a secure environment and the right to access information. An important step in ensuring these rights for children was taken on March 25, 2021 with the approval of General Comment No. 25 on the Convention on the Rights of the Child, which asserts that all children must have this access and that states must both ensure that children have knowledge of the digital environment and develop laws and regulations that guarantee that children can express their views, act anonymously and be safe (Committee on the Rights of the Child, 2021).

Furthermore, TEL can be divided according to the learning purpose(s) of digital technologies:

1. Technologies that help to see knowledge differently, such as simulations, applications and videos, which help to expand the dimensions of perceived information, thus ensuring a more complete learning process, because the methods used help to broaden the understanding of certain concepts by offering their visualization (Dreimane & Daniela, 2020; Mayer, 2014).

2. Technologies that provide active learning and allow students to work on a hands-on basis where they actively create new knowledge by themselves, for example, by programming robotics, developing 3D printable objects or creating other technological solutions (Alimisis et al., 2019; Augello et al., 2020; Misseyanni et al., 2017).
3. Technological solutions that help to evaluate the acquired knowledge, ensuring the learning analytics process (Ifenthaler, 2017; Ifenthaler & Yau, 2020; Zhu & Shen, 2013).

In order to orchestrate all possible TEL solutions, a certain knowledge of the organizational principles of the pedagogical process for a technology-enhanced environment is required (Daniela, 2019), and both the way information is arranged to avoid cognitive overload and the way in which multimedia learning takes place must be taken into account (Mayer, 2014; Sweller et al., 1998).

It is important to note that the use of technology depends to a large extent not only on the technology itself but also on the attitude(s) towards technology and its perceived ease of use and perceived usefulness (Davis, 1986; Venkatesh & Davis, 2000). This means that if we want teachers to use technology to enhance learning, they need to understand that technology can really improve knowledge, so we need to both carry out research that proves this and promote research results that strengthen this idea (Chai et al., 2015; Zogheib & Daniela, 2021). Researchers also need to think about appropriate research methodologies that can demonstrate that improvements have been made in certain areas; however, while the use of technological solutions is about providing access to knowledge rather than fostering knowledge growth, research data is instead being collected on knowledge growth, leading to incorrect conclusions that the use of technology has not led to a significant increase in knowledge. On the other hand, when it comes to the ease of use of technology, it is important to analyze it from an educational perspective because digital teaching/learning materials, for example, must be easy to use for both students and teachers, but often this is not the case. There are countless digital solutions where the information architecture is ill-prepared or the information is not arranged in accordance with the principles of media learning theory, and this entails the cognitive overload of both students and educators because the proposed solution is so complicated that the performed actions do not outweigh the benefits. This can be reduced in two ways: Firstly, by preparing teachers to use technology so that they become familiar with it and perceive it as easy to use, and secondly, after creating different digital solutions for use in the digital learning environment, by testing them to see how complex they are, how many clicks the materials require, if they are appropriate for all students, and how much effort the teacher should put into developing the materials. The development of teaching materials often requires specific knowledge,and teachers find that they are lacking in this specific knowledge.

To shed light on the smart pedagogical aspects of a technology-enhanced environment, this special edition has compiled the following articles. Firstly, "New Objectives for Smart Classrooms from Industry 4.0" provides theoretical reflections and recommendations for implementing smart learning spaces in schools. The authors believe that smart pedagogy needs to include a shared conceptual understanding of what knowledge is and what learning is, as well as a deeper theoretical consideration of how humans learn, how they think, and why they interact.

"Akasha: Custom Application to Support Elementary Geometry Learning First-Grade Children in Colombia" presents Akasha, a personalized software application to reinforce geometry teaching to elementary school children between 5 and 7 years old. Akasha provides ludic activities to identify and characterize polyhedra, polygons and shape attributes.

The paper “Educational Potential of Augmented Reality Mobile Applications for Learning the Anatomy of the Human Body” analyzes augmented reality (AR) solutions as enablers of interactive learning. It is concluded that AR solutions have the potential to increase students’ motivation, can be used to catch students’ attention and increase their interest, and offer the possibility for students to actively participate in the development of cognition; thus, being active participants in the learning process, they can promote discovery-based learning.

In the article “Learning Newtonian Physics through Programming Robot Experiments”, an instructional method to perform Newtonian physics experiments by programming a mobile robot is described. The authors prove that programming a mobile robot to perform physics experiments can improve knowledge about Newtonian physics, even without giving specific lectures on the subject and with a much shorter lecture plan with respect to traditional lessons.

The purpose of the research in “Potential Barriers to the Implementation of Digital Game-Based Learning in the Classroom: Pre-Service Teachers’ Views” is to examine pre-service teachers’ perceptions of the barriers to the implementation of Digital Game-Based Learning (DGBL). The authors conclude that the implementation of DGBL, as a smart and innovative pedagogical approach, is primarily a matter of political will for curriculum reform based on ongoing research into appropriate digital learning materials.

“Small Schools, Smart Schools: Distance Education in Remote Italian Areas” describes two teaching methods which provide education through technological settings and project-based learning to foster soft skills in students with the aim of learning disciplinary competences: (i) The Extended Learning Environment, where two or more classrooms work together on a common school subject project using different kinds of technological settings; and (ii) The Shared Lesson, based on everyday distance learning activities.

The paper “Digital Media as a Medium for Adolescent Identity Development” is devoted to examining the interrelationships between adolescents’ media activity, adaptive or maladaptive cognitions related to media use, and identity development processing styles.

The next paper is “Consistent and Appropriate Parental Restrictions Mitigating Against Children’s Compulsive Internet Use: A One-Year Longitudinal Study”. The aim of this study is to examine the internet use of primary school-aged children in association with the child-parent relationship, parenting practices in general and children’s internet use in particular as potential protective or risk factors for the development of children’s compulsive internet use.

The article “Smart Education as Empowerment: Outlining Veteran Teachers’ Training to Promote Digital Migration” explores how central veteran teachers are for the progression to a smarter education scenario through debating training aimed at promoting their digital migration.

In the article “The Role of Principals in Learning Schools to Support Teachers’ Use of Digital Technologies”, the role of school principals in supporting teachers’ skilful use of information and communication technologies in education is analyzed. Two groups of principals are identified: One concerned with care for infrastructure and ensuring teachers’ easy access to modern equipment, and a second concerned with the promotion of a culture of cooperation which facilitates the development of ICT skills.

In the paper “The Digital/Technological Connection with COVID-19: An Unprecedented Challenge in University Teaching”, the authors analyze how the challenges of the pandemic were solved at the Polytechnic University of Madrid, where classroom education was compulsory until the pandemic.

"The Development of the Core Competencies of Construction Managers: The Effect of Training and Education" identifies training methods and approaches that support the development of the knowledge, skills and attitudes that construction managers require. The study reveals 20 elements of the knowledge, skills and attitudes that are most significant to construction managers in the form of competencies and the training methods and approaches that can deliver those competencies.

The paper "Technology-Enhanced Learning for Promoting Technical and Social Competences in Hydrological Science" explains and analyzes a virtual gamification experience developed by a teaching group from the University of Catania (Italy) and the University of Cordoba (Spain). A competition based on professional tasks concerning hydrological planning was implemented in two subjects on Hydrological Sciences of the degrees of Civil and Forest Engineering and this learning experience improved the undergraduate engineering students' perceptions on their own competences, as well as interest on water planning.

"The Effectiveness of VR Head-Mounted Displays in Professional Training: A Systematic Review" provides insight by way of a review which aimed to investigate the extent to which VR applications are useful in training, specifically for professional skill and safety training contexts. It also maps out the current known strengths and weaknesses of VR HMDs.

The paper "Virtual Reality-Based Training in Electrical Engineering Education" introduces, explains and illustrates the real-life application of a virtual training tool for electrical engineering education. Early studies and feedback from educators and students prove this tool to be of great assistance to the process of education, facilitating knowledge acquisition and providing an innovative way to put theory into practice.

In "Video-Based Learning (VBL)—Past, Present and Futu an overview of research works published from 2008 to 2019" on video-based learning to assist teachers and other educational professionals in widening their understanding of the educational benefits of video-based learning is presented and analyzed.

The article "Classification of Instructional Videos" presents a scheme designed for the definition and classification of instructional videos based on the names and qualifications used in the literature before examining the usability of this scheme, which allows for video types to be classified based on eight main features. The classification model will provide guidance for smart pedagogy studies in terms of data definition and orientation.

"Webinars as a Future Educational Tool in Higher Education in India: A Survey-Based Study" summarizes students' opinions on some aspects of the inclusion of the webinar in higher education. The results illustrate that though students are well versed in the use of technology, there is a lack of awareness regarding webinars.

The paper "The Discovery of Interactive Spaces: Learning by Design in High School Music Technology Classes" describes an educational experience realized in the form of extracurricular workshops involving music technology students. The discovery of interactive spaces is framed within the broader themes of computational thinking and creativity, learning by design, and technology awareness. These themes represent the pillars of technological citizenship, which is considered crucial for the 21st-century student.

"Enacting Smart Pedagogy in Higher Education Contexts: Sensemaking through Collaborative Biography" is focused on ICT that provides flexibility of time and place and softens boundaries between students' learning lives by analyzing a specific Australian case study in which ICT reforms have been deliberately implemented to adhere to smart pedagogies.

Finally, in "Promoting Students' Collective Cognitive Responsibility through Concurrent, Embedded and Transformative Assessment in Blended Higher Education

Courses", collective cognitive responsibility is analyzed in terms of participation, interdependence between participants, level of metacognitive reflection, and the relationship between participation and metacognitive reflections on strategies.

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