Smart Pedagogy for Technology-Enhanced Learning

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Abstract The progress of technology has raised challenges to the educational environment, so it is necessary to search for answers to the questions: How can one teach better? How can one scaffold the student in the learning process? What kind of competencies should be developed? What competencies do teachers need? What kind of technology should be used or not be used? This chapter analyses the role of pedagogy for education and outlines the risks for cognitive development that may result from the introduction of technology without an understanding of pedagogical principles. These risks are defined as a *centrifugal effect* that can be mitigated by integrating technology into the educational process using the principles of Smart Pedagogy.

The idea of Smart Pedagogy for technology-enhanced learning is defined, and the author explains why the term 'Smart' has been chosen to define the pedagogical aspects of TEL. In addition, a conceptual model of the educational process in which Smart Pedagogy is the driving force of technology-enhanced learning is developed. There is outlined the necessity for *predictive analytical competence*, which is emerging for TEL.

Keywords Smart Pedagogy · Technology-enhanced learning · Conceptual model of technology-enhanced learning · Predictive analytical competence · Technology

1 Introduction

Pedagogy as a science is constantly evolving and looking for ways to better teach and to scaffold students in the process of knowledge building. An important milestone in the development of pedagogy can be seen from the year 1949, when a group of scientists in the fields of pedagogy and psychology worked out the development of an educational taxonomy, which was published in 1956, more widely known as

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Bloom's taxonomy (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). In the following years, various other taxonomies have emerged, which are based on the idea that the learning process should be structured. Marzano (2001) developed the idea that learning is hierarchically structured, where the acquisition of information, memorization, and then retrieval of this information from memory is the first step, followed by the understanding of information, analysis, and, finally, knowledge construction as the highest level. There are researchers who believe that this taxonomy is very valuable in scaffolding the learning and promoting a higher level of thinking skills (Eddy & Hogan, 2014; Toledo & Dubas, 2016), which is also an important result to be achieved in the TEL process. Marzano and Kendall (2007) offered an idea of how to separate the lower-level thinking skills from the highest level of thinking skills, where the lower-level thinking skills are characterized by knowledge acquisition and understanding, while higher-level thinking skills are characterized by the construction of new knowledge (Marzano, 2001), thus achieving a metacognitive thinking level. Anderson and his colleagues in 2001 presented Bloom's revised taxonomy, where learning is characterized by verbs: remembering, understanding, using, analysing, evaluating, and creating (new knowledge) (Anderson et al., 2001). SOLO (structure of the observed learning outcome) taxonomy (Biggs & Collis, 1982) is also often used in the learning process. In 2007, Churches adopted the idea of Bloom's digital taxonomy, which offers a hierarchical view of digital skills, from low-level thinking skills to the highest level of thinking. The lowest level is characterized by the search for information in the digital environment and its selection, operation in social networks, etc. The next level follows a targeted information search, its categorization, the addition of comments and annotations, as well as blogging. The third level is the maintenance and editing of a digital site. The fourth level involves the ability to understand how the specific digital tool works. The fifth level is the creation of reciprocal networks, collaboration with other digital tools, as well as testing them. The sixth level is characterized by programming, creating new products, testing, interacting with other products, etc. (Churches, 2007). These levels are not separate, and there are no specific indicators for when the next level has been reached, but these aspects can be taken into account when analysing the digital competencies and thinking about the pedagogical aspects of the learning environment in order to develop this digital competence to lead the student from the lower level of thinking, characterized by simple digital skills, to a higher level of thinking, which is characterized by the design of new knowledge and the creation of new products. In the context of Bloom's Digital Taxonomy (Churches, 2007), the digital competence required in technology-rich environments is emphasized but in TEL, not only digital competencies but the overall development of human competencies.

Technological progress brings about a transformation of the educational environment which happens faster than the literature can offer solutions for how to work in this environment. This puts in the focus the role of pedagogy in the context of the transformed educational environment; therefore, the present chapter will provide a vision of the role of pedagogy and its transformations in the discourse of 'Smart environment' and define the idea of 'Smart Pedagogy'. In the context of this chapter, the term *technology* is used to describe various types of information and communication technologies (ICT), digital technology solutions, educational robotics, smart devices, and so on. The term *teacher* is used to describe different kinds of educators.

2 The Role of Pedagogy in Education

In Webster's Dictionary, *pedagogy* is defined as the art, science, or profession of teaching (*Merriam-Webster.com*). Žogla (2017) has analysed the interdependence between pedagogy and the educational sciences, presenting the development of pedagogical science, which has changed direction from external influences on the learning process to the understanding of the complex nature of learning, which, from the perspective of the students, takes into account the individual needs of each student and looks for solutions with which to support the students by emphasizing and strengthening their abilities (Žogla, 2017). Different conceptions of the use of the terms *pedagogy* and *education* are to be found in the literature, but in the context of this chapter, *education* is taken as the broader process which supports the student, but pedagogy is the driving force to reach this result (see Fig. 1), where different

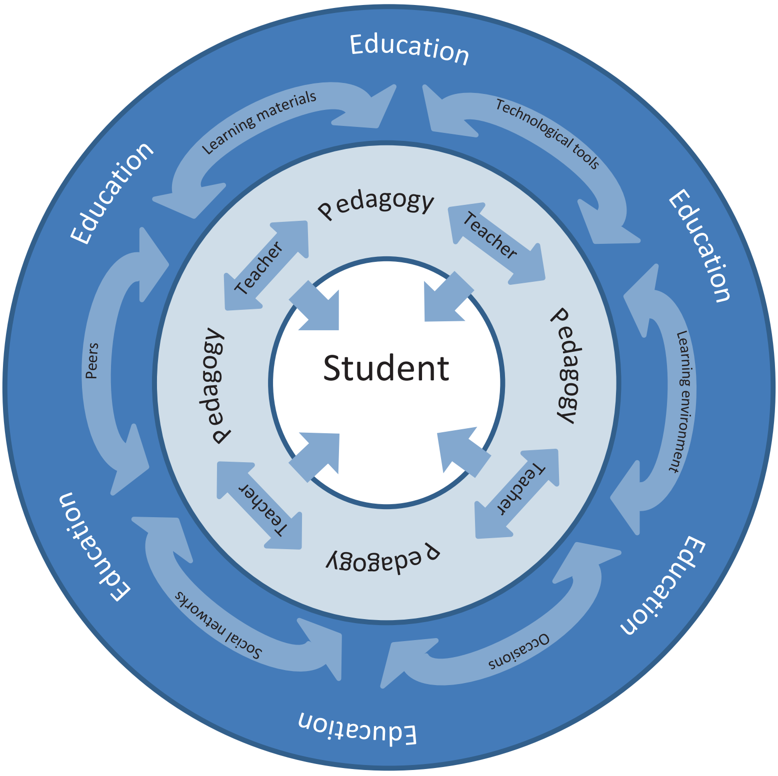

Fig. 1 Interrelations of *education* and *pedagogy*

actors in the educational process interact actively: *learning materials*, including digital teaching materials which, in the context of this chapter, are understood as materials that provide the content of the learning; *technological tools* that can include computers and smartphones, robots, smart boards, and so on; *the learning environment* which is the physical school and class environment and virtual environment; *occasions* which happen in everyday life; *social networks* which are peer-to-peer networks, family networks, as well as online social networks; and *peers*, which can be a learning resource and learning community for knowledge building. Teachers use their pedagogical knowledge to organize the learning process. In general, this is a traditional learning process in the discourse of the learning paradigm, where the student is at the centre of the learning process but the teachers are those who, using their pedagogical knowledge, plan and organize the educational processes to support all the students.

In general, education is considered to be a cyclic process (see Fig. 2), where the learning process provides the inclusion of new innovations, modifying the content of teaching, changing teaching strategies, developing new teaching materials, planning what competencies will be needed in the future, which occupations will be required in the labour market, and so on.

However, technological progress, which is becoming more rapid with the possibilities provided by digitization, poses a risk of *centrifugal effects* in the educational process (see Fig. 3), making it fragmented, where actors of educational processes operate independently, and the role of pedagogy is diminishing, which also affects the quality of education. This is due to several possible causes, and one of them that the possibilities which are provided by technology are interesting and exciting and can redirect students' attention away from the educational process, where these interesting and exciting technologies are not included. The reason why they are often excluded is because quite often technology is considered useless for promoting students' cognitive development, since there must be taken in account the regularities of student development and the need to support the development of the attention span. It is undoubtable that it is necessary to let students acquire the needed

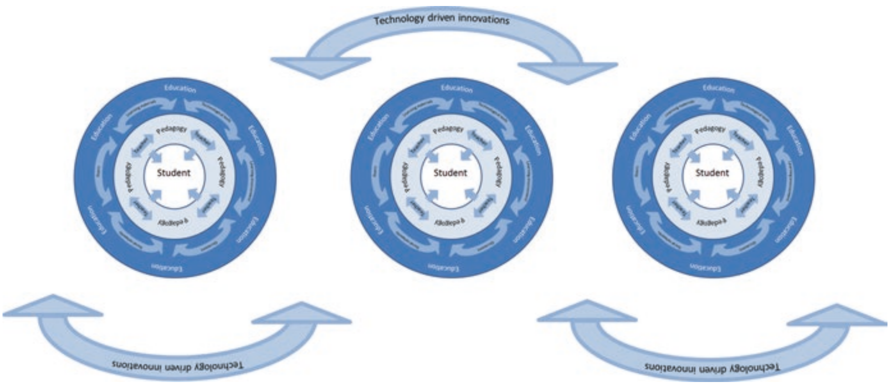

Fig. 2 Cycle of the educational process

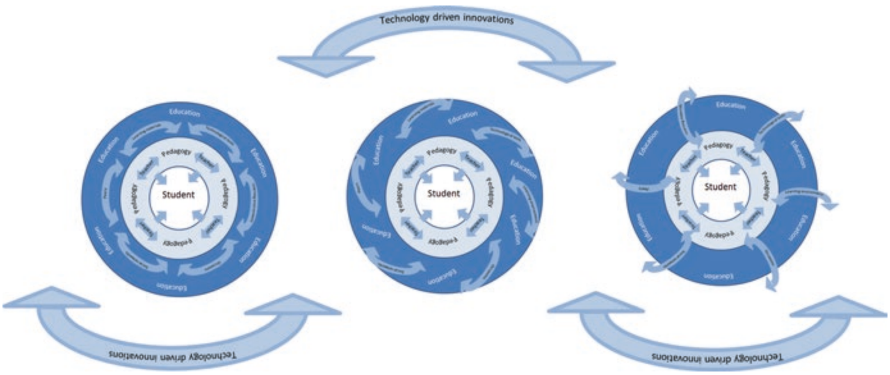

Fig. 3 *Centrifugal effect* on educational process caused by technology-driven innovations

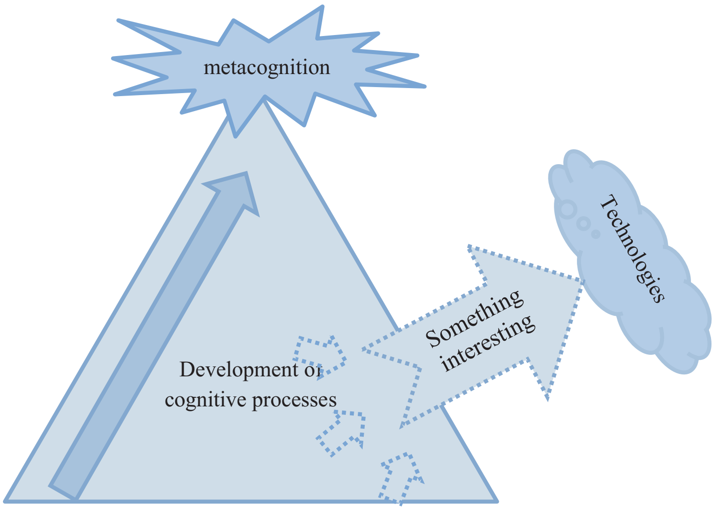

Fig. 4 Risks of interesting technologies

knowledge to analyse information, make informed decisions, and promote the development of higher-level cognitive processes in order to create new innovations. The fact that the learning process should be interesting and exciting is not new for educators. However, the fascination of technology makes it necessary to analyse the risks which can be caused by the concept 'interesting', as students are constantly shifting their attention to interesting technologies. This attention-shifting process can lead to the situation where long-term attention is not developed properly (see Fig. 4), which means that fragments of different pieces of information are stored in memory but do not allow being analysed as a whole picture of information, with the new information synthesized and new knowledge being constructed. This may endanger metacognitive development.

This does not mean that to support the development of metacognition what should be provided is a technology-free learning environment. On the contrary, it brings a focus on the pedagogy, which is where to find the answers for how to incorporate technology in the educational process to use the driving force of the concept of the 'interesting' in such a way as to direct the students' attention to reach higher levels of cognitive development (see Fig. 5).

It is necessary to diminish those risks which have been indicated in several investigations, where it has been concluded that the instant availability of information which is provided online can influence cognitive strategies (Mills, 2016). The possibility of such problems was indicated already by Bandura (2001), who wrote that the Internet is a tool for 'self-controlled learning', but when the information is reachable at the moment it is needed, it means that poor self-regulators can become overwhelmed and fall behind. Noncritical and unwise use of a variety of new and innovative technological and digital solutions can contribute to the development of a situation where lower levels of digital literacy are acquired without promoting a higher level of digital competence (Churches, 2007), which in the long run will affect the innovative and creative nature of digital solutions by next generations.

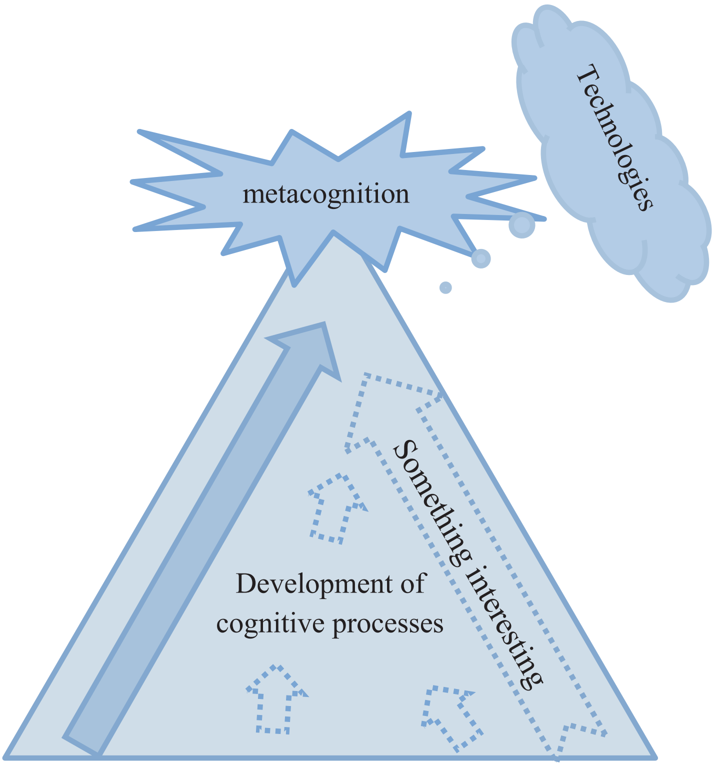

Fig. 5 Technologies for directing students' interest

This leads to the necessity to reconceptualize the regularities of the educational process, to define the teachers' competencies which are emerging for technology-enhanced learning (TEL), to ensure that fascination of technologies is used to support learning and not support the centrifugal effect on learning where teachers continue to compete for students' attention, providing interesting learning process, but students are searching for new interesting impulses on which they can focus their attention and technology provides this opportunity, thus ensuring the reduction of their attention span.

Another cause for the centrifugal effect arises from the assumption that students are 'digital natives', or what are also sometimes called 'mobile natives' (Palfrey & Gasser, 2008; Prensky, 2001). Based on this, it is then argued that therefore the students already know how to exploit the possibilities of technology and hence the teachers need not pay much attention to this: they only need to provide the opportunity to use the technology (Mancillas & Brusoe, 2016). This is a concept posing quite a high level of risk, because if students are not provided with a pedagogical scaffolding in this process, it can lead to the development of avoidance (Bandura, 1997) or handicapped motivation (Migdley & Urdan, 2001): in case a cognitive effort is needed, students can wish to avoid that and choose the easiest way—which is easy in an online environment, where it is possible to switch from *window* to *window*, exploit the capabilities of smart devices, and find quick answers and solutions. This does not provide the brain with a cognitive load. It should also be noted that in some research, it has been found that students' perception of their digital competencies is higher than it is in reality (Černochová, Voňková, Štípek, & Černá, 2018; Katz & Macklin, 2007; Turney, Robinson, Lee, & Soutar, 2009), which again indicates the role of the teacher and the role of pedagogy.

A third factor which can lead to a centrifugal effect is the conservatism of the educational system itself, which is based on the idea that there cannot be brought in new, unresearched ideas. This is in contrast to the increasing pace of technological progress, which makes it challenging to plan and implement the necessary changes. It is traditionally assumed that before the introduction of certain changes, longitudinal studies should be carried out, the findings of which can be subsequently introduced in the educational process. But while these longitudinal studies about the learning outcomes of a particular technology or digital solution are being carried out, that particular technology will become outdated and be replaced with new ones. This can cause the learning process to fall behind the innovations, whereas it should rather guide and support the development of the innovations. Already in 1980, scientists encouraged paying more attention in the preparation of future teachers to preparing them for the extensive use of technology. They pointed out that the most influential factor which prevents innovations in education is the conservatism of the educational system itself (Perusse, Décamps, & Pécot, 1980). Nothing much has changed since that time: Because there are diverse multidimensional digital solutions developed for all aspects of life, it is already accepted that these solutions can significantly improve the quality of life, reach goals which couldn't be reached before, learn in a way where students are in the centre of learning and support them, providing the knowledge outside the borders of space and time. Unfortunately, digital learning solutions enter the educational system slowly, with great caution, and sometimes they are even ignored so as to not disturb traditional learning process (a line of reasoning based on the idea that before using a technology, there should be found evidence of positive outcomes from it).

After a review of the literature on TEL, where papers from 2010 to 2016 and in the next step papers from 2013 to 2018 were analysed (Daniela, Kalniņa, & Strods, 2017; Daniela, Strods, & Kalniņa, 2018), it can be concluded that the largest amount of research is on outcomes of one particular technology. Furthermore, these studies are short term, with small samples, mostly on the use of learning management systems (LMS), but there are just a few papers on pedagogical aspects in TEL. A literature review carried out by Ying-Tien et al. in 2013, where 322 papers were analysed, concluded that more attention should be paid to the role of interventions in technology-assisted instruction in future empirical research. Moreover, they also found that very few studies have simultaneously addressed achievement, learning process, and effective outcomes. This suggests that further research on technology-assisted instruction should be conducted with various samples, different subject domains, or multiple research foci (Ying-Tien et al., 2013). It illuminates a dialectical situation, where, on the one hand, there is a need for research to find answers to various topical issues arising from the use of technology, but on the other hand, there is a need to keep pace with technological progress, which is often faster than research logic of longitudinal surveys.

It is clear that technology cannot provide successful knowledge construction per se but can be a tool for widening the zone of proximal development (Vygotsky, 1978) if used according to learning objectives. In addition, pedagogy can redirect the focus from the use of technology merely in support of the learning process to creating new solutions (Kinshuk, Chen, Cheng, & Chew, 2016; Law, 2008). Together with the possibilities provided by the progress of these technologies, it is important to accept that they can be used to scaffold the learning in a digital learning environment. There are academics who affirm that pedagogical considerations are crucial in the use of technology in education (Leijen, Admiraal, Wildschut, & Simons, 2008), but, in reality, educators, although aware that technological solutions can be used, are often unprepared for their meaningful use (Burden & Kearney, 2017). A large number of studies point to the role of educators in making the learning process active in using different technologies, and most of these studies come to the conclusion that the attitude of educators towards technologies is the main influence on the decision to use or not to use specific technologies in the teaching process (Kreijns, Vermeulen, Van Acker, & van Buuren, 2014; Raghunath, Anker, & Nortcliffe, 2018). This confirms that the teacher is the one who has the pedagogical competence to organize and manage this process.

According to Jones and Binhus (2011), it is necessary to change pedagogical methods to support the needs of each student and provide what the student expects from the educational process, since the way of learning is changing rapidly (Basso Aranguiz & Badilla Quintan, 2016; Eggen, 2011; Jones and Binhus, 2011; King, 1994; O'Loughlin, 1992; Schuh, 2003; Tin, 2000) and now the fact that the student is at the centre of learning is not enough. Neither is just changing the role of a teacher when they become technology users. Now educators must facilitate learning by providing a supporting framework for the students in their use of technology (Herro, 2015). Pedagogy must search for solutions to reduce the gap between the way students learn and the way educators teach. Students of the new generation process the information differently than their ancestors did, and these differences are wider and deeper than educators conceive at the moment (Dosaj, 2004).

To reduce the centrifugal effect mentioned previously (see Fig. 3), the full potential of technology should be used, providing at the same time a structured scaffolding for all the students where they are. It must be admitted that there is an urgent necessity for changing educators' competence, to be able to plan and organize educational processes suitable for all the students and be able to predict the unpredictable, incorporate all the possibilities provided by technological progress to prepare the next generation for the world which is instantly changing. Taking into account the fact of instantly changing discourse, Smart Pedagogy should be developed by following the principles of Grounded Theory (Glaser & Strauss, 1967) where the possibilities of technology are incorporated into a Smart educational process by bearing in mind the principles of Smart Pedagogy to avoid a situation where educators agree that the use of technology is necessary in the educational process, but they are not ready to act on the principles of the pendulum foundation when the result is not clearly known but only predictable.

3 Concept of Smart Pedagogy

It has already been stated that the role of pedagogy becomes more important for finding the ways to incorporate technology in education. Here there will be explained the concept of *Smart Pedagogy*, which was developed under the logic of Grounded Theory, where the direction is defined, but not the particular methods and tools, because the technological progress is ongoing process. The concept of Smart Pedagogy is triangular (see Fig. 7), where the important cornerstones are:

1. Human developmental regularities, which include the conditions for the development of cognitive processes, the conditions for sensory development, as well as the conditions for socio-emotional development.
2. The taxonomy of the educational process, which includes the goals to be achieved and the regularities of the learning process needed to achieve these goals.
3. Technological progress, which entails the need for changes in teachers' pedagogical competence, where one of the most important components of this competence is *predictive analytical competence*.

The term 'SMART', to characterize the pedagogical principles which are appropriate for a technology-enhanced environment, has been chosen for several reasons:

1. The first is the development of Smart Technology, of which the most prominent product is the Apple iPhone, which appeared on the market in 2007, and then in

2010 also the iPad (http://www.applemuseum.com/en/apple-history), which has provided the opportunity to use the telephone and the computer not only for their already known options but for added new possibilities where these options are mixed together and also provide access to information when connecting to the Web at any place and time. As Stephen and Edwards (2018) concluded, since that time, children's engagement with technology has grown rapidly in a very short time.
2. Another reason for choosing this term is also related to the field of technology, where SMART is short for Self-Monitoring Analysis and Reporting Technology, which is a diagnostic method originally developed by IBM and introduced with the ATA-3 specification that was at the time referred to as predictive failure analysis. This technology provides advanced warning of drive failures (see https://www.computerhope.com/jargon/s/smart.htm). This predictive principle, in other words, when the system is able to analyse opportunities and warn about problems, is what needs to be taken over into pedagogy.
3. The third reason is that even though there are an increasing number of studies analysing various aspects of the use of technology in the educational process where such terms as Smart Education or Smart Learning are used, it remains unclear which pedagogical principles are being used. This produces the need to develop a new theoretical direction for pedagogy.
4. The fourth reason is based on a pun: *SMART* refers to wisdom and cleverness and so on, and the goal of an educational process is the Smart Student.

In the research literature, the term *SMART* is used to describe contemporary society as a whole, the urban environment, business, etc. Smart technologies are those that are able to adapt automatically and change behaviour to suit the environment, sense things with technological sensors, provide data to analyse, and draw conclusions from the data obtained. They are able to learn how to use experience to improve their performance (Zoughbi & Al-Nasrawi, 2015). Spector defined technology as *smart* if it is effective, efficient, innovative, engaging, and flexible (Spector, 2014).

Smart Education is also described in various ways: there are studies that associate it with learning through a variety of smart devices (smartphones and tablets), there are studies where the term is used as referring to students' wisdom, and there are those who use SMART as an acronym for various terms:

1st Option SMART – Social, motivated, anywhere, anytime, resource enriched, and technology embedded (Chun, Kim, Kye, Jung, & Jung, 2013)

2nd Option SMART – Specific, measurable, achievable, relevant, and timed (Tofade, Khandoobhai, & Leadon, 2012)

In the educational sciences, various terms are used to describe learning in a technology-enhanced digital environment. During literature review, it was concluded that there are quite a few articles and studies that use the term *Smart Education* when analysing the TEL process. Jang (2014) states that this term has been used approximately since 2012. There are articles that confirm that this term had already entered the research literature a bit earlier, starting in 2007, when the TEL process was characterized by describing it as *Smart Education* (Klichowski et al., 2015; Rothman, 2007). There are also articles in which the term *Smart Education* is used to describe learning through smartphones (Igoe, Parisi, & Carter, 2013; Sykes, 2014).

Smart Learning is also a term used in the research literature. There are articles that explore how to use personalized smart devices to learn (Graham & Zengin, 2011; Junghwan, Hangjung, & Hwansoo, 2014; Raghunath et al., 2018; Tofade et al., 2012) or analyse student learning through Learning Platforms (Caldirola, Fuente, Aquilina, Gutiérrez, & Ferreira, 2014). Spector (2014) defined *Smart Learning* as being where all philosophical and psychological aspects are taken into consideration in the learning environment and technological possibilities are added.

Digital Pedagogy also appears as a term, and there are articles that reflect on the role of digitization now and in the future (Lewin & Lundie, 2016; Turner, 2017), but at the same time, pedagogical principles have not been analysed. There are articles that analyse how to acquire specific knowledge through digital technology, for example, in music (Ajero, 2014), or mastering Victorian culture (Alker & Donaldson, 2016).

There are also articles that analyse the principles of *Mobile Pedagogy*, which highlights that despite pedagogy's becoming mobile, it is essential to remember that learning is key (Kearney, Schuck, Burden, & Aubusson, 2012; Schuck, Kearney, & Burden, 2017).

As a result of the analysis of the literature, it can be concluded that in the field of education, there is relatively high uncertainty about which pedagogical principles should be taken into account when providing learning in a technology-enhanced and digital environment, the organization of the learning process, and the competencies that need to be developed in order that students become 'smart'. So far, the pedagogical principles necessary for a transformed education have not been thoroughly analysed and defined in order to be aware of the technological possibilities, human developmental regularities, and also the principles of educational taxonomy to support the learning process. All of this points to the need to start developing a new direction of research: *Smart Pedagogy*, which is now based on the principles of Grounded Theory, and is the most appropriate in the current situation where there is no and cannot be long-term research, because the technological progress is faster than the logic of longitudinal studies.

At the centre of the educational process, there is still the student, who is becoming a *Smart Student* in the technology-enhanced environment. To reach this goal, a *Smart Education* is needed where *Smart Pedagogy* is the driving force behind a learning process which is structured and supportive. The technology-enhanced learning (TEL) for technology transferred educational environment can be seen (see Fig. 6) as a continuously changing process where different technologies are used in the learning process to support students to become smart, motivated learners who know how to construct their knowledge and are supported by competent educators, who continuously evaluate the process and carry out predictive analyses. In general, this process is driven by, and the centrifugal effects of technology are mitigated by, *Smart Pedagogy*, which takes into account the opportunities offered by technology that affect all actors in this pedagogical process. This model differs from Goodyear's (2005) conceptual framework for networked learning environments, where the use of technology was accepted as consisting of two elements: the teacher's pedagogical approach and the educational environment in which learning takes place. *Smart Pedagogy* plays an important role in the model offered in the present chapter, which is a driving force for ensuring that all the actors interact in a balanced way in the

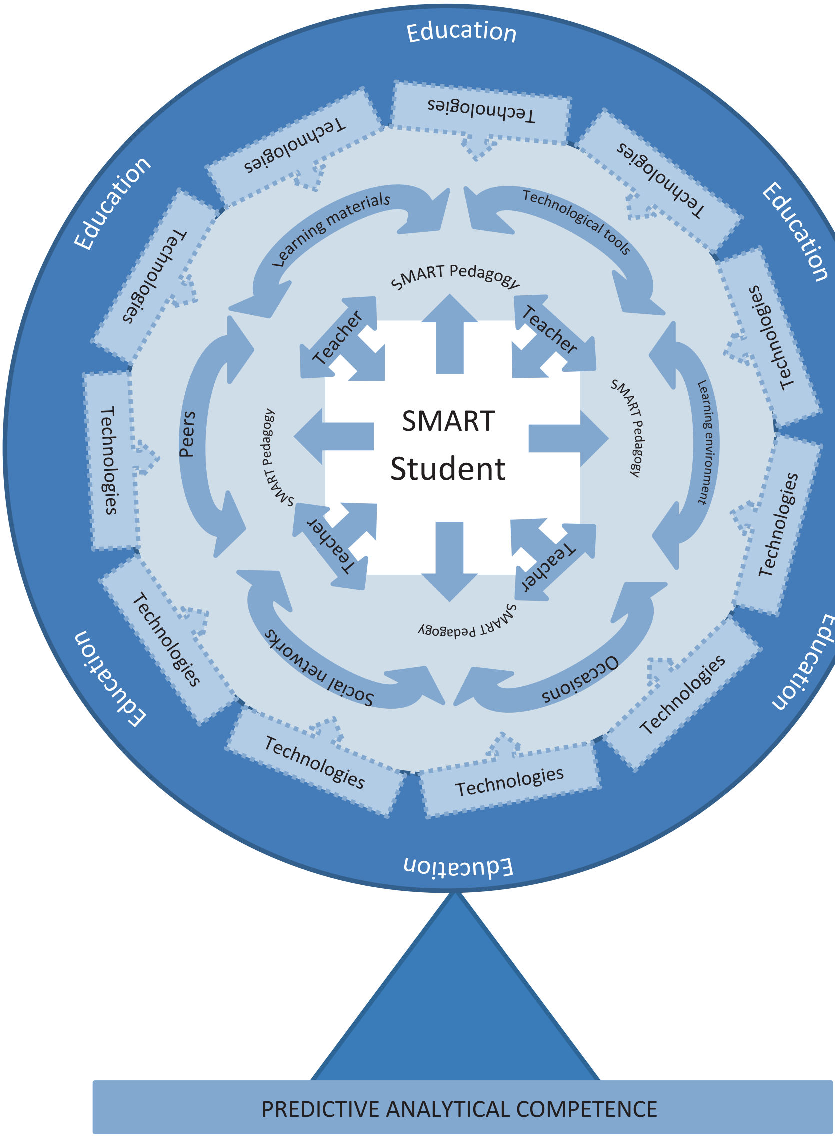

Fig. 6 The technology-enhanced learning process with Smart Pedagogy as the driving force

educational process, the technology is used to support and structure the learning, and the students are active learners who collaborate with the educational environment.

The technology that makes the circle between education and Smart Pedagogy for this model is intentionally not precisely defined, as it is constantly evolving and its progress must be taken into account in the educational process. This TEL model is put on a pendulum foundation, envisaging that the teacher not only fulfills the traditional role in supporting students in the learning process but also develops a *predictive analytical competence*, which includes the traditional competencies that educators already have (hopefully): the planning of the learning process, its organization and monitoring, support for the knowledge construction process, assessment of learning outcomes, selection of appropriate study materials, organization of peer learning process, and so on. In the transformed learning space, there should be added the ability to predict the unpredictable, to analyse the outcomes of types of technology which no one has used and assessed yet, the ability to make immediate decisions, and the readiness to use types of technology which are unfamiliar to the teachers themselves and therefore can make them feel uncomfortable in using them. This means that there are two main features of this emerging competence: the ability to predict and the ability to accept that uncomfortable feeling which, for teachers, means that they are looking for new solutions and challenging themselves and their students to reach new levels of development.

In the inner part of the circle, there are the important actors in the educational process. In the context of *Smart Pedagogy*, the following are not considered as separate elements of the educational process but as mutually interactive: the learning materials, the technological tools, the learning environment, occasions, social networks, and peers, where the ongoing process of the continuous evaluation and adaptation of the pedagogical process takes place. It also requires an elasticity of the educational environment, where these changes are possible in the actual moment needed. Although in this model the actors are referred to as separate elements of the educational process, it must be borne in mind that their boundaries are less strictly separated on a daily basis, because the technological tools can even be a supportive tool in the educational process and a tool that also contains a certain content; therefore, at the same time, it can also be considered as a learning material. Peers can be a learning source, make peer networks, and so on. *Predictive analytical* competence is one which keeps the process balanced, evaluates how and when to use technology for its general purposes and technology for specific instructional purposes, as well as understands how to evaluate the possible outcomes, support the students, evaluate the technological tools, and combine different pieces of tools, materials and content, and so on, in a pedagogically structured and supportive environment. The centre of this model is the student, who becomes the SMART student, who is an active actor of learning, co-collaborates with the learning environment, takes part in knowledge construction, and is not a mere passive observer who takes the role of an external evaluator.

4 Conclusion

All the above analysis allows making the assertion that the most important educational goal is a competent person, but in order to prevent a centrifugal effect in a TEL environment that can contribute to the fragmentation of the educational process, it is necessary to develop the principles of *Smart Pedagogy*, which becomes the driving force for the TEL. At the forefront, there is the need to supplement teacher competence with *predictive analytical competence*. In the context of technology-led pedagogical transformations, SMART can be read as follows:

S – smart (in the sense of intellectual smartness), social
M – meta-cognitively developed and motivated
A – anywhere, anytime (in the sense of a learning process that is flowing across the temporal and spatial borders)
R – rapidly changing
T – technology enhanced, which takes into account the peculiarities of human development, the taxonomy of the educational process where the next generations are using the benefits of technology, and *Smart Pedagogy* bringing the students of the next generations in front of progress to serve as developers for new levels of innovation

At the same time, ‘smart’ can be used as a synonym for such adjectives as clever, brilliant, wise, knowing, and so on, but with regard to the term *Smart Pedagogy*, one should not lose sight of the meaning of smart technology, which is the reason for the necessary changes.

From the student perspective, being a part of *Smart Pedagogy* means an active participation in the learning process, being someone who constructs their own knowledge in a self-directed learning process. But at the same time, the teachers must not forget that the ability to construct knowledge should be developed step by step.

Smart Pedagogy from internal perspective is the driving force of TEL, but from external perspective, it ensures that for every activity there are three cornerstones which should be taken into account (see Fig. 7), and these are:

1. Human developmental regularities, which include the conditions for the development of cognitive processes, the conditions for sensory development, as well as the conditions for socio-emotional development
2. The taxonomy of the educational process, which includes the goals to be achieved and the regularities of the learning process needed to achieve these goals
3. Technological progress, which entails the need for changes in teachers’ pedagogical competence, where one of the most important components of this competence is *predictive analytical competence*

The most important principles of Smart Pedagogy are:

I. Technology should be incorporated in the learning process to use the students’ natural interest in technology, as a tool for the sake of providing a scaffolding, but there should be made predictive analyses of these technologies to be evaluated in accordance with the:

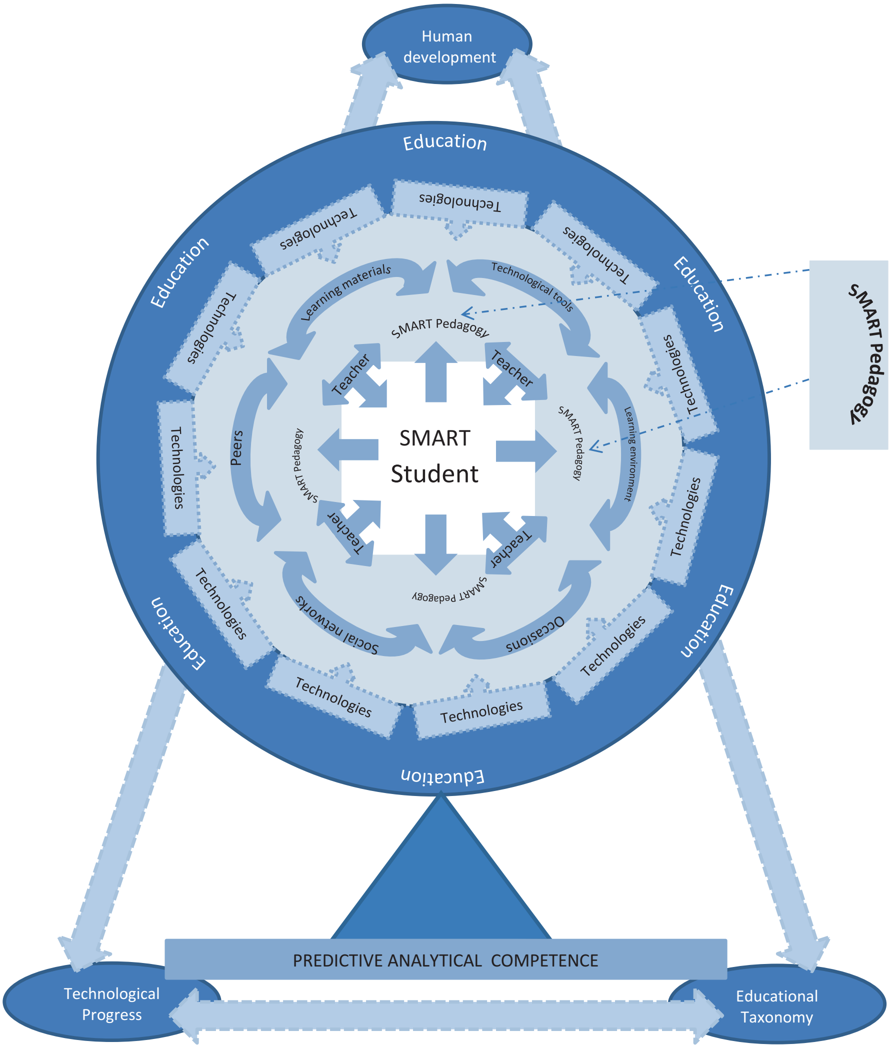

Fig. 7 Conceptual model of SMART Pedagogy

1. *Didactical criteria*:
   - Is coherent with learning content
   - Is coherent with other learning materials and learning forms
   - Helps to reach learning goals
   - Ensures self-directed learning
   - Can be used in assistive learning process as an agent
   - Is integrated/can be integrated into particular curriculum
   - Helps to develop learning motivation
   - The target group has adequate competence in their use

2. *The criteria of cognitive development:*

   – Is coherent with target group's zone of proximal development
   – Is coherent with target group's existing knowledge
   – Helps to construct new knowledge on the basis of existing knowledge
   – Prevents cognitive overload
   – Helps to focus attention, develop imagination, and processes of memory

3. *The criteria of socio-emotional development:*

   – Is coherent with the socio-emotional development of the target group
   – Ensures socio-emotional development
   – Prevents emotional overload/stress
   – Is coherent with learners' expectations
   – Is coherent with inclusive and heterogeneous learning process (special needs, different ethnical, religious groups, etc.)
   – Ensures mutual cooperation among individuals

4. *Physical development criteria:*

   – Fosters the sensory development of individuals
   – Causes no physical overload or sensory impairment

5. *Technical criteria:*

   – Visual/auditory/tactical solutions are qualitative and help to capture the learning content to be learned
   – Interactive to allow students take active part in use of them in knowledge construction
   – Easy to perceive and easy to manage
   – Teachers have guidance on their use
   – User manual easy to perceive
   – It is possible to apply to different age groups, peculiarities of pupil perceptions, and the diversification of the pedagogical process
   – It is possible to combine forms of collaboration using individual–individual collaboration, individual–device collaboration, and device–device collaboration, where the individual is the content creator, using the particular technology
   – Provide personal data protection

II. Teachers need to develop *predictive analytical competence* to evaluate possible outcomes of technologies which are not used yet.
III. Teachers are active participants in the use of the technology together with the students and accept that a discomfort in their use is part of the teachers' identity.

Smart Pedagogy is not a wonder wheel, which is offered to solve various problems that can arise in the TEL process, but more of a continuing process that respects the knowledge that has been accumulated over the ages and forms a new multidimensional knowledge based on Grounded Theory (Glaser & Strauss, 1967) principles. The proposed Smart Pedagogy vision has to be developed by identifying practices and standards that describe all the actors of the SMART pedagogical process, preparing concepts, putting concepts together to develop categories, and, for the next step, developing the theory of *Smart Pedagogy*.

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