

Risks and opportunities of smart education

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Abstract

Smart education integrates technology into teaching and learning, which can provide challenges for both students and teachers. The aim of the study is to show the impact of intelligent education on student learning, as well as the effect it has on the teacher's new way of teaching. The research objectives refer to identifying the risks of technology in education, as well as highlight the opportunities that pupils/students can achieve due to digitalization of education. The study is important because technology has clearly changed the approach to education in recent years. Smart education has evolved significantly in the last five years with the emergence of COVID-19, when schools and universities have had to continue their schooling using technology. The educational system, regardless of the state, has undergone changes in the institutional organization (digital equipment in classrooms) and in the organization of the teaching act (online tutoring, online courses). The study represents an in-depth analysis of a current topic, and the quantitative research is conducted with reference to fields such as sociology, political science, education, geography, psychology, and technology. In conclusion, intelligent education enters education with both risks and opportunities. It requires today's teacher to be multifunctional, both using technology, becoming creative and being a good psychologist. Nowadays, it is a big challenge for a teacher to maintain students' interest in the classroom, as they have had access to the internet from an early age and know more and more things. On the other hand, technology-enhanced learning often integrates interactive elements, which can increase student engagement and motivation. Smart education is not only about the technology used in classrooms, but also about modern teaching-learning methods and adapting teaching projects to the level of the students.

Keywords: digital education, smart pedagogy, sustainability, emergency remote teaching, COVID-19

1. Introduction

The evolution of technology has permeated all sectors of society; however, it has not progressed equally across all countries, leading to disparities, including within educational systems [1].

The term "smart" first appeared during the 1970s, when the topic of automating mass production in enterprises was very seriously discussed. The roots of the concept of smart education was based on the "Malaysian Smart School Implementation Plan" project in 1997 [2]. In the same year, the development of a smart city was discussed, whereby about 50,000 cities would benefit from technology in the next decade [3].

The research on intelligent education started as early as 2002, with only a few more studies been written on the subject in the following seven years. A progress in this area of interest was seen in the year 2010, as shown in Fig. 1, and then its peak was reached in 2016, with a total of 62 articles [4]. This was followed by a short period of stagnation in the publication of articles on the topic of intelligent education, with a drastically negative percentage in 2019. According to Fig. 2, a significant number of keywords in the sphere of "smart educational" were used, such as "smart learning", "smart learning environment", "higher education", "technology", "virtual reality", "technology acceptance model (TAM)", "web application", "mobile device", "space", "smart environment", "performance", "model".

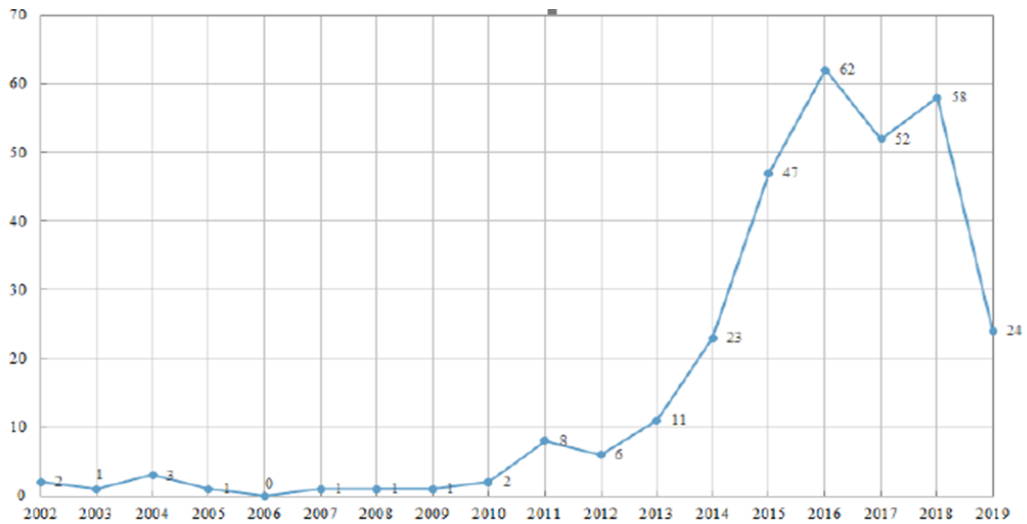


Fig. 1. Publication trend evolution
Source: [4]

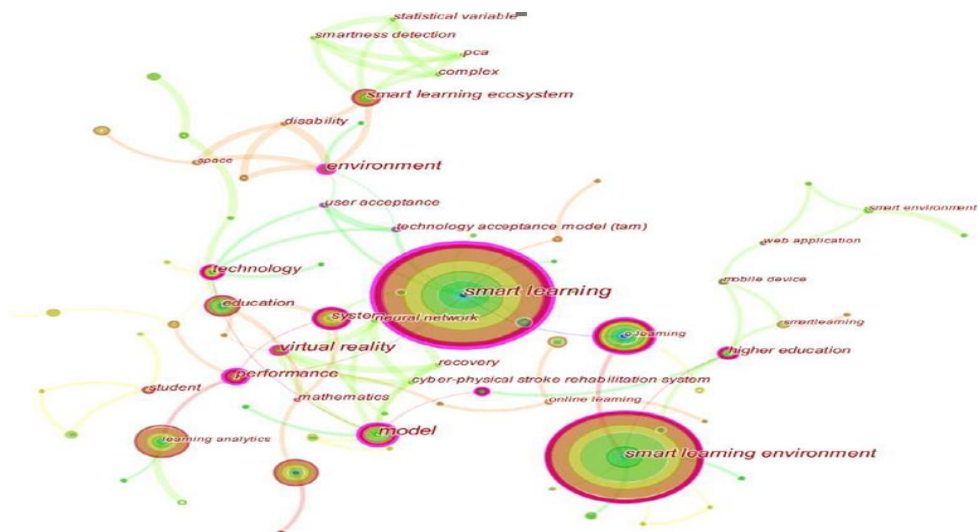


Fig. 2. Keywords for the concept of intelligent education
Source: [4]

In the sphere of intelligent education, as shown in Table 1, a top ten words have been made, and they are presented by the researchers in the following order: "smart learning", "smart learning environment", "e-learning", "learning analytics", "smart education", "system", "education", "model", "smart learning ecosystem" and "performance".

Table 1. Top 10 words used in intelligent education

Rank	Keywords	Frequency
1.	smart learning	53
2.	smart learning environment	47
3.	e-learning	18
4.	learning analytics	17
5.	smart education	14
6.	system	11
7.	education	11
8.	model	11
9.	smart learning ecosystem	9
10.	performace	7

Source: [4]

The digitization of education is a segment of human activity, both scientific and practical, which is related to the link between technology and the achievement of pedagogical goals [5]. In other words, through digitization of information the pupil/student gets to form new knowledge in the field of education, by approaching a modern learning-technique.

Another definition of smart education is also put forward by the authors Z. Zhu and B. He, from which it is clear that its main goal is to achieve "smart" environments with the help of technology, so as to create a personalized pedagogy based on the development of thinking and the formation of a stronger capacity [6].

According to R. Bajaj and V. Sharma, smart education refers to that form of education that can be accessed anytime and from any possible place [7]. These two authors argue that digitized learning goes beyond learning in the traditional manner. At the same time, intelligent education is an educational system, through which, students have the opportunity to study using various materials, according to their personal aptitudes as well as intellectual levels [8]. These intelligent study environments represent "a new era of educational systems", in which technology, pedagogy, and the fusion of the two are combined, leading to improved learning [9]. Smart education provides not only access to technology in education, but also new approaches to teaching and learning [10].

M. Yu and Y. Liao defined smart teaching as an activity that incorporates instructional tools and teaching objectives. It encompasses three aspects: smart technology, smart teaching, and smart talent cultivation [11]. This view is in agreement with K. Sarnok's research [12]. On the other hand, P. Twining believes that teachers' individual beliefs are also necessary in their technological professional preparation [13].

"Smart teaching" is defined by the authors M. Yu and Y Liao as a new method of teaching, aiming to develop "smart talents" (learners who are able to think and learn in a smart way) [11].

2. The impact of COVID-19 on digitization in education

Intelligent education also encompasses technology as an innovative factor in the teaching-learning process. Over the years, technology has evolved considerably in the field of

education, reaching its peak during the COVID-19 pandemic. Against this backdrop, all countries around the world have had to adapt new ways in which pupils/students to minimize the impact on their school/university journey. The only way in which teachers and students have been able to keep in touch with education has been through technology, i.e. through the use of gadgets (smart phones, computers, educational tablets, laptops, video projectors, power banks, e-book readers, interactive whiteboards) and communication software (zoom, microsoft teams, google meet, webex, skype, whatsapp). In the meantime, learning has become a hybrid sistem, especially in universities, where students and teachers have discovered that they can communicate effectively, combining both distance and face-to-face communication. For both teachers and students, the digitization of education has been a real challenge both economically, technically and psychologically.

Due to the sudden shift from traditional to modern online-based education, a panic and shock was created among educational establishments, caused by the fact that the usual structure of the educational process was annihilated by digitalization. Academic staff and students complied with the situation and integrated themselves into a process of experimentation with digital education [14].

An issue raised during the COVID-19 pandemic concerns teachers and their efforts to adapt to technology. Because of the sudden changes, teachers were faced with the need to become proficient users and not to stick to standard computer literacy. They suddenly had to master 'software' information in order to develop their teaching and learning methods. Following this experience, there have been scientific publications that have sharply criticized the effects that have harmed the educational system, with the emphasis on educational technology [15, 16, 17, 18].

3. Risks and opportunities of smart education

Some researchers argue that, regardless of the level of education, intelligent education (more specifically, intelligent systems made with the purpose of supporting education) is beneficial in the progress of a pupil/student. Some of the characteristics of intelligent education can be: complexity of education, realization of cognitive and research activities and flexibility.

3.1. The relationship between intelligent education and teachers

In the view of authors M. Ibrahim, H. Yang, M. Yu and Y. Liao, a teacher must be competent to be able to teach in smart classrooms [19, 20, 11]. P. Twining is of the opinion that teacher motivation makes a significant contribution in maintaining a quality intelligent learning environment [13]. Authors such as K. Sarnok and T. Manakul believe that teachers should be technologically literate [12, 21].

There is the concept of "smart teachers", also used in psychology, this term characterizing a competent person, able to teach digital natives [22]. There are not many studies showing smart teaching in terms of a teacher's abilities. Today, teachers and parents are not keeping up with the digital age of young children who are born surrounded by technology [23].

There are opinions that a teacher's teaching style may not be effective for some or most students, and because of this, it is recommended that a teacher should combine different teaching styles, such as a multifaceted approach [24, 25]. L. Liu believes that teachers, with the use of smart technology, can find solutions to the challenges that modern education brings to teaching [26].

In this regard, one can also discuss classroom analytics which are meant to help the teacher in the effective orchestration of classroom activities (time framing, suggestions on certain moments the teacher could do in the classroom, which student could be given more attention, feedbacks, etc.). This digital analysis contributes to the professional development of the teacher, as the person receives real-time or post-hoc advice about his/her teaching method [27].

Smart technologies enable teachers in the following aspects: effectiveness of instruction, reducing anxiety in students' life, accelerating the pace of teaching, supporting students' research activity, developing skills to solve an unpleasant situation, realizing an individual situation for each student. And for the students it allows the following prospects: expanded/developed skills, increased motivation, as well as improved school results [28].

3.2. The relationship between intelligent education and pupils/students

One problem that can be mentioned in this respect is that intelligent education does not define the concept of an 'intelligent pupil', given that the pupil is the main actor in the educational process. Representatives of the Organization for Economic Cooperation and Development (OECD) have set out ten key attributes that a 'smart learner' should have in the 21st century. The attributes have been grouped into four categories: way of working, way of thinking, way of living in the world and tools [29].

Intelligent education gives students with disabilities the opportunity to access curricular materials and to participate in different inclusive activities [27].

At the same time, there are a variety of technologies available to support hearing and visually impaired students to make learning easier. For students with Attention Deficit Hyperactivity Disorder (ADHD) there are technologies to help them self-regulate their bodies [27].

It reduces inequality among pupils by providing free access to technology on school premises. On the other hand, there could also be a negative effect, as socially and economically disadvantaged pupils may not be able to access technology at home or at school if they study in disadvantaged areas and have neither the digital materials nor an internet connection [27].

Studies claim that technology could be of more help to advanced students, as some of them have already learned the basics of the subjects they are studying, and with digitization, an advanced student has the chance to progress more easily in the learning process, compared to a less prepared student who acquires less knowledge [27].

It has been found that effective learning for a student is based on personalization. According to the "International Association of Smart Learning Environments", we speak of a smart learning environment when adaptive technologies are used, or when they are set to develop capabilities that enhance understanding [30].

There is a risk that students will be distracted from school tasks, fascinated and excited by educational technologies. Educational technologies provide opportunities for pupils who are not geographically advantaged. Several studies show that learning is different from case to case, depending on the learner [31]. There are learners who absorb information more quickly because of technology, but there are also learners who are distracted by the technology and its components.

It has been shown that a student understands a lesson better if it is supported by gadgets such as interactive whiteboards, maps, graphs, charts, diagrams, videos, than when the teacher gives an oral lesson, supported only by a traditional blackboard.

4. The contribution of intelligent education in different countries

The OECD program has shown that education can differ from state to state, with different learning outcomes. One promise that smart technology holds for education is to provide students with a higher quality teaching-learning process [27].

Over time, several countries have introduced the concept of smart education in education by implementing programs based on "smart education" as shown in Tables 2, 3. Moreover, according to Table 4, a number of technologies have been developed in the sphere of intelligent education that present themselves with a dual role in the life of the learner: risk and opportunity. For example, in South Korea, this concept includes self-directed, adaptive education, which relies strictly on technology and no other resources [32].

Japan is one of the countries that is heavily involved in the development and modernization of education through digitization, with resources being used for Information and Communication Technology (ICT) infrastructure. The strategy that has been used in the document "Use of ICT and Data in School Education" refers to the fact that a high-speed network is needed in the teaching-learning process. This strategy is based on the idea of providing every school unit with the opportunity to work with technology (computers and other digital tools). Japan supports the idea of data privacy, and thus emphasizes the need for cloud computing as well as virtual private networks (VPNs) in its strategy [33].

In terms of investment, three of the countries that are part of the European Union have divided the funds allocated to technology for education as follows: Germany (through "Digital Pakt" €5 billion were allocated to further improve the infrastructure in school units), Ireland (through the "Digital Strategy for Schools - 2025-2020" €210 million were allocated to improve the ICT infrastructure in the education system), Poland (allocated over €372 million through the "National Education Network", with the main objective of incorporating the necessary technology into school units to develop the education system) [34].

Australia has invested through "The National Broadband Network" (NBN), established in 2009, designing a powerful and affordable broadband internet network for all citizens, benefiting pupils/students and teachers. The UK is committed to building a world-class technology infrastructure to invest in the networks of the future, namely 5G and full fiber. The UK is expected to invest a sum of £400 million in the Digital Infrastructure Investment Fund. The United States is putting this area at the center of attention in the education sector, with challenges in accessibility as well as speed as the main barriers for schools. The US faces a lack of competitiveness for broadband services in rural areas. The United States is calling on world leaders to support learning with the necessary devices as well as good internet connectivity. As for the United States' strategy, it includes related elements such as: technical support, network management, device upgrades, equipment upgrades, technology correspondent licensing, firewall protection, and others [34].

The Hungarian government considers that an optimal classroom is made up of interactive display devices suitable for 3D display, but also that each classroom should be equipped with one 3D printer for every 500 primary and secondary school pupils. On the other hand, the Hungarian Government considers that there should be one programmable robot in computer classrooms for every three pupils (Hungarian Government, 2016). In France, a strategy included in the 2015 Digital Education Plan provides for an evaluation of the effects produced by digitization on pupils (ELAINE), as well as the attitude of teachers towards digital learning [34].

Embracing technology in education was a top goal for the top 10 OECD countries in 2017, becoming more evident in 2022. Over the years, there have been several strategies for quality digital education, even reaching the point where the idea of every student bringing their own device to school has been proposed, through bring-your-own-device (BYOD) policies. In this way, students use their own devices, supported by the school's internet connection. There are no concrete pros or cons on this idea, but some researchers believe that BYOD is not a primary way for students to access digitized education, as not all students have smartphones or tablets. The US considers this a hindrance for teachers, as it would be difficult for a teacher to manage teaching activities across different devices and platforms. There are activities that may be incompatible with certain gadgets [34].

The International Organization for Standardization (ISO) has a group working to support the development of standards for "Information technology for learning, education and training". Technology-enhanced education is supported by several associations, including the "International Association of Smart Learning Environments", which argues that intelligent learning environments need to be developed. Both International Business Machines Corporation (IBM) and Samsung are working in this direction, as these two giants are also developing systems linked to smart education [34].

Table 2. Technological investments in the education system

EU and non-EU countries	Technology investment in education		
Germany	<i>DigitalPakt</i>	5 billion euro	Improving infrastructure in schools.
Ireland	<i>The Digital Strategy for Schools</i>	210 million euro	Improving ICT infrastructure in the education system.
Poland	<i>National Education Network</i>	372 million euro	Equipping schools with the necessary technology to develop the educational system.
Australia	<i>The National Broadband Network</i>	Data missing	Australia's National Broadband Network Project.
United Kingdom	<i>Investment Fund for Digital Infrastructure</i>	400 million pounds	Technology infrastructure on a global scale.
Hungary	Data missing	Data missing	The existence of robots in computer classrooms.
France	<i>2015 Digital Education Plan</i>	Data missing	Data missing

Source: Author own work

Table 3. Smart education initiatives and programs

Countries	Initiative program/name	Bibliographical references
Malaysia	Malaysian smart school implementation plan	Chan (2002)
Singapore	Intelligent nation (iN2025) master plan	Hua (2012)
South Korea	SMART education project	Kim et al. (2013)
Finland	Systemic learning solutions (SysTech)	Kankaanranta and Makela (2014)
Arab Countries	ALECSO & ITU smart learning framework	Jemni and Khribi (2017)
Australia	Smart student-centric education framework	Zhu et al. (2016b)
United Arab Emirates	Mohammed Bin Rashid smart learning program (MBRSLP)	Lavine and Croome (2018)

Source: [10]

Table 4. Smart education technologies

Information technology	Definition
Smart classrooms	Physical learning environments that are supported by technologies
Virtual classrooms	Virtual classrooms, where a new way of teaching and learning takes place
Web 2.0+	The technologies that emerged after Web 1.0, they offer interactive and intelligent services
Educational resources	Learning and teaching material (e-book)
E-books and interactive books	Digital books
Educational robots	Robots used for educational purposes
Ambient intelligence	It stands out with smart interfaces
Serious games	Online games used for instructional purposes
Mobile technology	Using portable mobile devices
Academic and corporate tubes	Online video-sharing platforms serving educational purposes

Source: Author own work

5. Results

Education is a way for pupils/students to communicate in ways other than informal and non-formal, taking into account the rules of the educational institution they attend. In addition to the school rules, pupils/students have to fulfill a number of duties towards the school. It is the Internet that leads the pupil/student to new channels of communication, which in turn have come to transmit educational information that can be used during and beyond their studies. Therefore, these virtual environments can act as levers in the educational field, with a role in the development of the individual. A digital classroom can be represented as shown in Figure 3 [35]. Considering the specific components of such a classroom for its proper functioning, we consider the following: collaboration, flexible learning, accessibility, ease of teaching, learning actualization, innovative content and interaction.

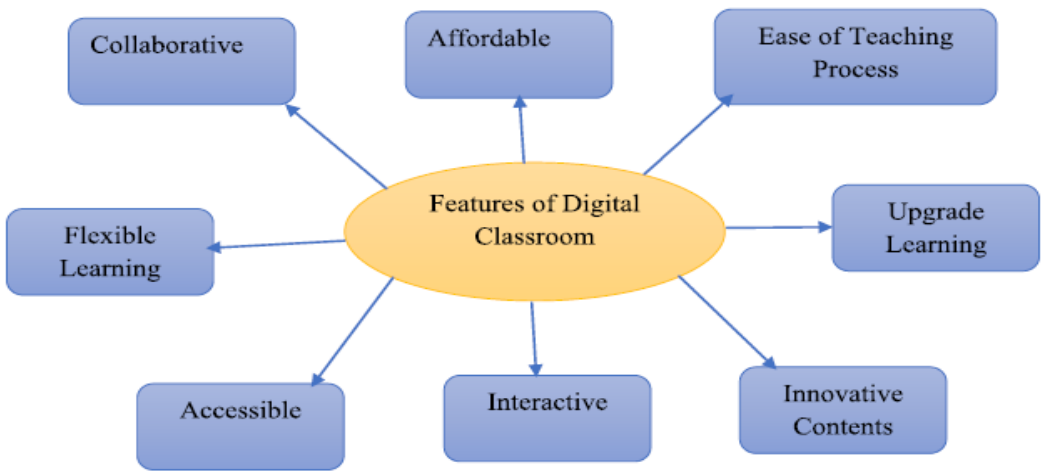


Fig. 3. Components of the digital classroom
Source: [35]

In order for pupils/students to adapt to the changing digital age workforce, two broad categories have been designed: technical skills (with an emphasis on developing analytical/research skills) and soft skills (with an emphasis on developing critical thinking, emotional intelligence, communication skills, teamwork and leadership). Studies show that the education system needs to focus on more human-centered skills such as communication and creativity and less on more rigid activities.

The 21st century has brought with it advanced changes of technology in education [36]. At the same time, in order for a teacher to have the developed basic skills for transmitting information required in the "Action Plan for Digital Literacy 2021-2027" [37], a number of skills are necessary for a teacher to have (collaboration, communication, technical, creativity, and coping with unpleasant situations) [38].

6. Conclusions

Smart education means that students have the chance to benefit from a more engaging and interactive learning experience, leading to a better understanding of information. Through

various studies conducted in the educational space, it has been found that digitization comes to the aid of pupils/students, irrespective of the discipline/faculty they are studying. Research shows that in mathematics, students understand the concepts of geometric shapes more easily as they have the opportunity to visualize mathematical figures in space.

The existence of digital textbooks, as well as books in electronic format, allow students to explore subjects in depth. Students can combine the convenient with the useful, allowing young people to develop at their own pace and in their own way. Thanks to smartphones, the teaching-learning process can take place from anywhere. Because digitization is still in the process of development, the possibilities and opportunities for smart education are endless.

Researchers argue both for and against digitization, but it cannot be overlooked that the majority of them believe that its introduction in the educational space is useful.

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