

SUSTAINABLE EDUCATION IN SMART CITIES

Bernadett Revák^{1,*}, Ágnes Csiszárík-Kocsír² and Serkan Savaş³

¹Óbuda University, Doctoral School on Safety and Security Sciences
Budapest, Hungary

²Óbuda University, Keleti Károly Faculty of Business and Management, Department of
Economics and Finance
Budapest, Hungary

³Institution Kirikkale University- Department of Computer Engineering
Kırıkkale, Türkiye

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ABSTRACT

Artificial intelligence offers new teaching and learning solutions that are widely used in education. New technologies have experienced a major transformation over the past decades. They also bring with them a wealth of opportunities. The emergence of new technologies brings the acquisition of knowledge closer to learners. Of course, in addition to innovation, it also brings challenges. The current generation of learners is characterised by a higher level of expectation to use digital tools. The question arises as to what level of technical, scientific, communication and information processing skills they need to achieve this, and what further steps are needed to develop them.

KEY WORDS

development, education, innovation, artificial intelligence, information

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*Corresponding author, *η*: revak.bernadett@kzsdabas.hu; -;
Nepszinhaz str. 8, 1081 Budapest, Hungary

INTRODUCTION

Appropriate examples are the so-called smart cities, where all aspects of life are built on digitalisation. In areas such as transport, energy management, public services, safety and security, environment and sustainability, as well as in education, technology plays a vital role, helping them to operate more sustainably and successfully. With the use of online learning platforms and digital tools in the education process, learning is made more efficient, convenient and flexible. Smart cities and education are closely and, in many ways, crucially interconnected. Technological innovation is a bridge between them. The use of digital infrastructures opens up a new, more colourful world for schools. They create learning environments adapted to the needs of students. By promoting life-long learning, they are interlinked to enable a higher quality of modern urban life. By improving the quality of life and increasing sustainability, our world would adapt to ever higher quality needs as economic growth is achieved. This is of timely importance as, in many parts of the world, globalisation, international and regional competition and the demands of social development, in addition to technological influences, are demanding changes in education.

Today, information plays a prominent role in education. The amount and variety of information available every day has brought a huge change. With the advent of new technologies, a completely different educational environment and methodology are needed. The changes brought about by the continuous technological development have an impact on society and the labour market. The information received inside and outside the classroom will have an impact on the society of the future, the next generation.

Digitalisation and the tools of innovation are changing the way people live, interact, and communicate. They also affect the way people learn and work. Considering the use and implementation of artificial intelligence, the focus of the present study, multiple challenges and opportunities can be expected in many areas of our lives [1-3]. We are experiencing job losses, job changes and the creation of new jobs [1]. In addition to the world of work, the educational environment is also undergoing a considerable transformation and evolution through technology. In the teaching-learning process, the expansion of information and communication technology is leading to significant changes, such as giving everyone an equal chance to acquire knowledge [4]. Consequently, the newest and most important focus of education is the development of information management competences. Improving the digital literacy of students and teachers involved in the educational process is a prerequisite for this. It is of paramount importance that these people are aware of the opportunities offered by digitalisation tools, such as the integration of the use of artificial intelligence (AI) in learning processes. They must also be aware of its dangers and safety-conscious use.

In the field of AI-related education, innovation and learning share a symbiotic relationship, each pushing the other forward in a continuous cycle of progress. Education serves as the bedrock on which AI innovation thrives by nurturing curious minds, encouraging critical thinking, and imparting essential skills in AI development and use. In turn, innovation in AI education is constantly reshaping and redefining the learning experience, adapting teaching methods, curricula, and technological tools to meet the evolving demands of the field. Whether through ground-breaking research in AI algorithms, the development of AI-enabled educational platforms, or creative teaching approaches that integrate AI applications, innovation enriches AI education by broadening access, increasing engagement, and unlocking new frontiers of knowledge. In turn, a well-educated public on AI becomes a catalyst for further innovation and fosters progress, prosperity, and societal transformation in the ever-evolving landscape of AI [5-7].

The aim of the present research is to study the current knowledge, habits and vision of Hungarian and Turkish youth concerning artificial intelligence. For standard data collection a

quantitative questionnaire research method was carried out in Hungarian and Turkish. By analysing the samples received for the questionnaire, which consisted of 14 closed and open-ended questions, a clearer picture can be gained of the attitudes of the current generation of students towards AI.

LITERATURE REVIEW – THE CONCEPT AND ROLE OF SMART CITIES IN THE 21st CENTURY

In smart cities, education can in fact be defined as a dimension of society. One of the necessary conditions for this is a creative and inclusive society. The significant role of society in education and knowledge-centredness is particularly related to creativity [8]. In addition to delivering innovative educational ideas, information and communication technologies are also supporting people's collaboration by bridging the gap between online and offline life through social networks. The primary goal in these cities is to achieve a good quality of life, with work and education as important pillars. The latter concept is in fact a platform for workforce training and hence for economic development.

In these humane cities, education has a key role to play in teaching people to make good use of work and leisure time, Figure 1. They are characterised by a society that seeks to take advantage of opportunities such as lifelong learning. The literature on the definition and characterisation of smart cities presents them as learning cities where innovation is central. The importance of the intelligence factor is indisputable. There is no smart city without smart inhabitants. Creative tools to help shape attitudes, transfer knowledge and develop skills are a prerequisite for training smart citizens. This makes education a key segment of smart cities.

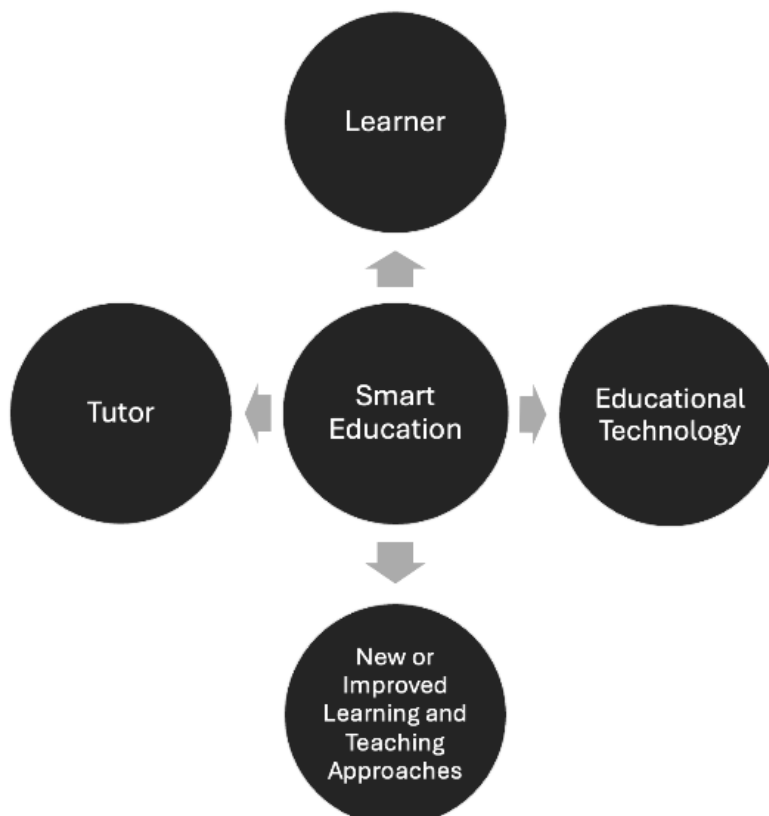


Figure 1. Essential elements of smart education [9].

The level and quality of education can be improved with greater convenience and lower costs thanks to digitalisation [10]. Obstacles such as long distances and time constraints can also be avoided. The integration of information and communication technologies (ICT) is an important element in the development of education in Europe and in other developed countries. Due to

the extent to which the needs and demands of communities have changed, many countries have not been able to adapt or are finding it difficult to adapt to fast technological change. Smart city solutions can in fact be a good point of reference, but they require that the society be aware of their principles. Therefore, education must support students in their ability to understand the world and develop their talents.

The OECD (Organisation for Economic Co-operation and Development) Centre for Educational Research and Innovation launched the “School of the Future” programme in 1997. Its main mission and aim are to make the school of the future the best it can be. By highlighting some of the classifications they use, it is clear to see how much difference there can be among the schools today. Consider, for instance, the ‘back to the future’ type of schools, whose most important characteristic is their resistance to change and innovation, despite the dissatisfaction expressed towards them. Here education is entirely formalised, and other learning concepts are marginalised [11]. There are also schools that focus on renewal and become learning organisations, laying the foundations of a competitive society. They impart a new knowledge and understanding and give priority to continuous knowledge building and lifelong learning. The scenarios include extreme ideas that schools will disappear and be replaced by informal learning networks. This can be the result of the general dissatisfaction towards schools and the emergence of new mass communication learning techniques.

In summary, the aim of smart schools is to develop an education system that builds the knowledge and skills needed in the 21st century, considering the evolving demands and challenges of society. It also focuses on the preparation of students and teachers. In the future, education systems must adapt to the demands of the digital age and provide people with the knowledge, skills and competences that are essential for prosperity [12].

ARTIFICIAL INTELLIGENCE

Modern society must constantly face and meet challenges in the 21st century. These challenges depend largely on technical and virtual infrastructure. Due to the rapid development of computing and information systems, artificial intelligence is increasingly present in various aspects of social and economic domains. In terms of the way it communicates, AI can be defined as a kind of innovative communication agent.

There are many definitive approaches to the definition of AI. AI is the general term for the technology used to develop machines that are created using entirely artificial means and can exhibit similar behaviour and movements to humans. It is basically a set of techniques that allow computers to mimic human behaviour [13]. The term was first used in the 1950s and is now used in a wide range of fields. Many sectors are affected and reformed every day including education, or the military and security sectors.

AI is a field of technology that can change the way we interact in society. The emergence of different AI technologies is impacting teaching and learning methods. In recent years, its use has become more common. Several studies present examples of how AI technology can move education systems towards improving educational equity and quality. By supporting personalised learning, better learning outcomes can be expected. There are several articles on the extraordinary capabilities of AI [14]. Few deals with the challenges and threats it poses, such as security [15] or ethics [16]. Artificial Intelligence in Education AIEd opens new possibilities for educational practice. In its history, the learner can be an inclusive, collaborative partner or a leader. In three paradigms, AI techniques are used in different ways. They can stimulate and move the teaching and learning sciences in a positive direction [17]. It is important to emphasise that AIEd is a complex process, Figure 2, which is not only about the introduction and use of AI technology, but also an integration of pedagogical, social, cultural, and economic dimensions [18, 19].

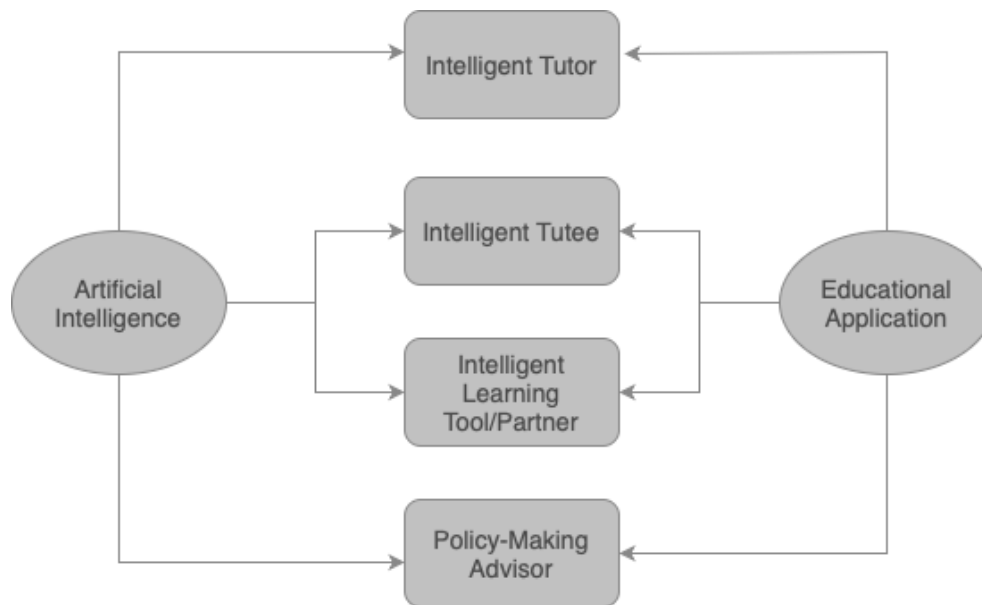


Figure 2. The Role of AIED [20].

THE RELATIONSHIP BETWEEN THE ARTIFICIAL INTELLIGENCE AND THE EDUCATION

The incorporation and application of innovations and improvements directly affect the level of education and development of different countries. Artificial intelligence can help to create personalised learning experiences, develop adaptive education systems, and even provide more effective support by analysing student performance.

In fact, education, and the new technology itself interact in two ways. When creating artificial intelligence algorithms, it is essential to collect sufficient data. The process of education itself supports this and allows the systematisation of the data coming from different individuals, students, teachers, parents, and school staff. This comprehensive information can be used both to create a policy based on generalisations in education policy and to develop AI-based software.

In the field of education, the use of AI brings countless innovations and developments. It allows the automation of basic educational activities, such as grading, which can become more objective and transparent. All this creates and supports human security. It shows where improvement and practice are needed and provides continuous feedback. Educational software can be adjusted to the needs of the learners. It teaches information interaction about how and where to find useful information, thus supporting and improving learning methods. The concept of safety awareness requires special attention at this point. Users need to be aware of the dangers behind the application and the solutions to avoid them.

Artificial intelligence can better visualise and model social processes. Partly, this is due to the multimedia interface through which it communicates with students. This channel is closer to the needs and attitudes of the current generation of learners. Technology is part of the everyday life of digital natives [21].

MATERIALS AND METHOD

The development and application of digital technology tools, such as artificial intelligence, in educational processes, as well as their potential and threats, were investigated through a comprehensive literature search, which included a review of books and journal articles published in print in the national and international literature. A questionnaire survey was conducted in secondary schools in Turkey and Hungary, asking students about their

knowledge, use and vision of AI. The research method chosen was a quantitative questionnaire research method as a standard data collection method. The questionnaire was prepared in Hungarian and Turkish, so that in addition to the Hungarian data, the opinions of the international scene could also be investigated. The questionnaire contained 14 questions in total, making it easy and quick to fill in. Through closed and open questions, we wanted to get a clearer picture of young people's attitudes and visions towards the concept and use of AI. This was also linked to our research aim to find out whether current young learners who are engaged in the education system are making great use of the potential of AI. Based on the samples collected on the respondents' digital competences and habits, we sought to answer the question whether digital knowledge is in line with digitalisation needs. The questionnaires were collected and distributed online in both Hungarian and Turkish. There was no possibility to identify the respondents, so the completion was completely anonymous. The Hungarian sample consisted of 456 responses and the Turkish sample of 326 responses, Figure 3. To draw conclusions, in addition to traditional basic statistical methods, analysis of variance and cross-tabulation were used. The results were evaluated according to the age of the respondents.

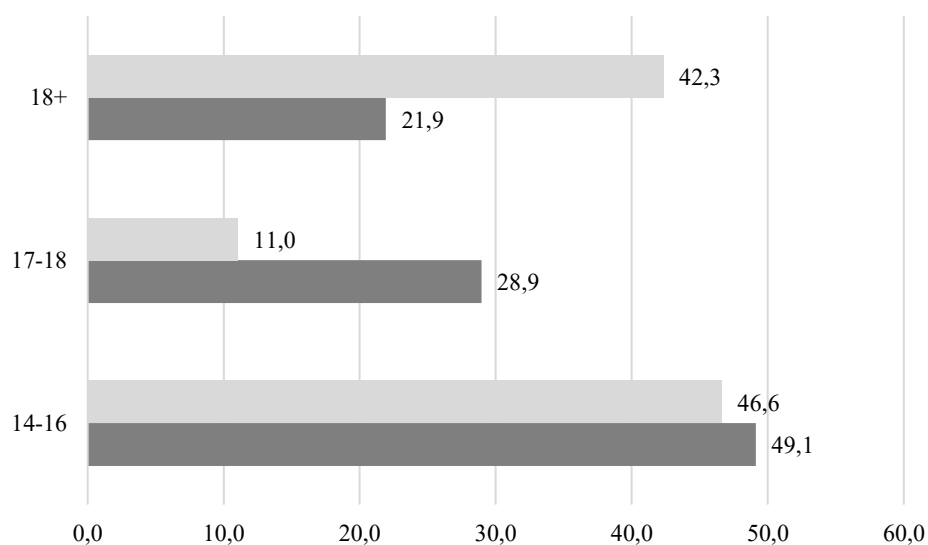


Figure 3. Composition of the sample 2023, with 453 Hungarian (light grey) and 326 Turkish (dark grey) respondents.

RESULTS AND DISCUSSION

As a first approach, we examined the overall perceptions of Hungarian and Turkish young people on artificial intelligence, Table 1. Regarding the applicability of AI in learning, both groups of respondents from both countries use AI occasionally in the learning process. However, it can also be observed that a much higher proportion of Turkish young people answered that they never use AI in the learning process than their Hungarian counterparts. The next question also shows the same tendency, i.e. Hungarian young people are more likely to use AI in the learning process or in the educational process than their Turkish counterparts. When asked whether teachers can be replaced by AI in education, almost half of Hungarian young people, i.e. 48,8%, answered yes. This proportion is less than one third for young Turkish people. The “maybe” answer option was the most popular with 41,1%. As regards the usefulness of AI in learning, more than half of Hungarian young people said they considered it less important and a slightly smaller proportion, 47,9%, of Turkish young people said they did not consider it useful at all. The above results clearly show that the usefulness of AI in education is rated much lower by Turkish youth than by Hungarian youth. This picture also gives an idea of the state of education as perceived by Hungarian young people and secondary school students.

Table 1. Overall distribution of the responses of 453 Hungarian and 326 Turkish young people to the questions asked (with weighting of responses), 2023.

		Hungarian	Turkish
Do you use artificial intelligence for learning?			
Regularly	3	18,4	10,4
Occasionally	2	68,4	56,4
Never	1	13,2	33,1
Do you think teachers can be replaced by AI in the education process?			
Yes	3	48,8	30,1
Maybe	2	36,3	41,1
No	1	14,9	28,8
How useful do you find the use of AI in learning?			
Completely	3	3,5	8,0
I find it less useful	2	50,4	44,2
I do not find it useful at all	1	46,1	47,9

Analysis of variance was then carried out to determine the extent to which the age of respondents influenced their answers to these three questions, Table 2. First, we looked at the mean values from the descriptive tables of the analysis of variance. Regarding the role of AI in learning, Hungarian youth aged 17 to 18 years were the ones who gave the highest proportion of this question on a scale of 3 (2,0). The highest proportion of Turkish youth, which is towards the upper end of the scale, was found for youth aged 18 years and older. The same ratio can be seen for the statement about the substitutability of teachers and the question about the usefulness of artificial intelligence. For the latter question, the high scores, above two integers for all age groups, indicate that there is a case for AI in the learning process. However, an interesting finding is that in Hungary, young people aged 17-18 already clearly rely on and consider AI to be important, whereas for Turkish young people this becomes more evident at a more mature age. The fact is that the former predestines these young people to be the ones who are more mature, more deliberate, and more focused in their use of AI.

Table 2. Average value of 453 Hungarian and 326 Turkish young people's responses to each question in age groups, 2023.

		Hungarian		Turkish	
		Mean	Std. Deviation	Mean	Std. Deviation
Do you use artificial intelligence for learning?	14-16	1,938	0,540	2,026	0,539
	17-18	2,000	0,494	1,944	0,715
	18+	1,900	0,674	2,522	0,557
	Total	1,947	0,560	2,227	0,621
Do you think teachers can be replaced by AI in the education process?	14-16	1,686	0,698	1,882	0,745
	17-18	1,833	0,753	1,889	0,820
	18+	1,380	0,663	2,130	0,762
	Total	1,662	0,724	1,988	0,769
How useful do you find the use of AI in learning?	14-16	2,393	0,542	2,158	0,652
	17-18	2,561	0,528	2,389	0,688
	18+	2,320	0,618	2,667	0,473
	Total	2,425	0,562	2,399	0,633

The results of the analysis of variance are presented in Table 3 for the three questions examined. To this end, a one-way analysis of variance is performed, and the results of the ANOVA table are presented. The Hungarian results prove that the age of the respondents shows a correlation with the second and third questions based on the significance values. This means that they believe that teachers can be replaced by AI in the educational process, and AI has benefits in the educational process.

Table 3. Correlation of 453 Hungarian respondents' answers with their age, 2023.

		Sum of Squares	df	Mean Square	F	Sig.
Do you use artificial intelligence for learning?	Between Groups	0,612	2	0,306	0,975	0,378
	Within Groups	142,125	453	0,314		
	Total	142,737	455			
Do you think teachers can be replaced by AI in the education process?	Between Groups	11,957	2	5,978	11,961	0,000
	Within Groups	225,920	452	0,500		
	Total	237,877	454			
How useful do you find the use of AI in learning?	Between Groups	3,761	2	1,881	6,098	0,002

Based on the Turkish results, it can be stated that the age of the Turkish respondents influenced their answers to all the questions asked, which again can be supported by the significance values.

Table 4. Correlation of 326 Turkish respondents' answers with their age, 2023.

		Sum of Squares	df	Mean Square	F	Sig.
Do you use artificial intelligence for learning?	Between Groups	20,984	2	10,492	32,518	0,000
	Within Groups	104,218	323	0,323		
	Total	125,202	325			
Do you think teachers can be replaced by AI in the education process?	Between Groups	4,875	2	2,437	4,208	0,016
	Within Groups	187,076	323	0,579		
	Total	191,951	325			
How useful do you find the use of AI in learning?	Between Groups	18,727	2	9,363	27,141	0,000
	Within Groups	111,433	323	0,345		
	Total	130,160	325			

CONCLUSION

In conclusion, artificial intelligence is playing a very important role in all aspects of life today. AI has the potential to fill a part of our lives, in education, research or even science, for which human capacity may not always be available. AI is both a blessing and a curse. If used properly and regulated, it can greatly facilitate people's lives, both in learning and in the world of work, but to leave it unregulated and let it run wild could pose many dangers to humanity. Relying entirely on AI can make people vulnerable, which in many cases can have a negative impact. It is enough to consider the most popular AI application, chatGPT, to see that it can also give

incorrect answers to many simple questions. Therefore, it is very important to always look at the answers given by AI through a filter, which in turn requires a conscious approach. Digital awareness includes these questions and enables us to revise the information provided by AI and check its veracity. The survey results show that Turkish young people are more cautious about AI, with a higher percentage of AI use in adulthood, above the age of 18. It is important to note that there is also a wide variation between different parts of the country when looking at a single country. These patterns, for example, depend on and are related to the social background of different areas. In Hungary, however, it is the 17-18 age group that tends to be more likely to use AI. However, age-related characteristics clearly show that awareness is not always present at this age, as has been demonstrated by numerous studies. It is therefore essential to include digital awareness training in the education process as early as possible, including training and preparation for the use of AI.

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